

UNIVERSITY OF NAPLES "FEDERICO II"
FACULTY OF MEDICINE
DEPARTMENT OF GYNAECOLOGY AND OBSTETRICS, AND PATHOPHYSIOLOGY
OF HUMAN REPRODUCTION

"RIPRODUZIONE, SVILUPPO E ACCRESCIMENTO DELL'UOMO"

PHD THESIS

XXI CICLO



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**"SEE & TREAT HYSTEROSCOPY IN DAILY
PRACTICE"**

Candidate

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Academic course 2005- 2008

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CHAPTER 1

HISTORICAL BACKGROUND

Where there is no
vision the people perish

Proverbs 29:18

We cannot understand where we are going, if we do not remember where we come from. Never has there been a statement so aptly suited to hysteroscopy and, more widely, to endoscopy. The word endoscopy has Greek origins and is literally defined as *observing within* or *looking inside*.

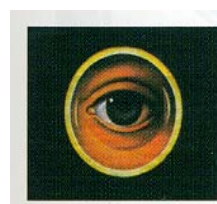
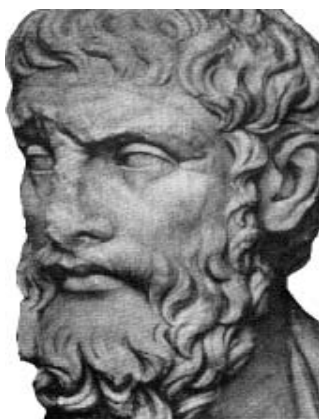


Fig. 1

Its history has been slowly traced over centuries and lies in the issue of categorization. What essentially is endoscopy? Is it an instrument or technique, a revolution or an evolution? Many have come to understand the meaning of endoscopy as merely that of a technology or instrumentation. A more accurate definition, however, places endoscopy firmly in the realm of a new philosophy, one rooted in what is now referred to as *minimally invasive surgery*. Interestingly, the idea of minimal intervention is



Hippocrates

Fig. 2

not necessarily a modern phenomenon. Much of the Hippocratic Corpus may be interpreted as predominantly advocating this minimalist approach, as can be inferred by the modern version of the Hippocratic ancient edict “First, do no harm.” Hippocrates (**fig.2**) specifically instructed physicians to avoid as much as possible invasive methods, allowing instead allow for the body’s own miraculous powers of healing to take effect. Of course, this approach was certainly influenced by the fact that invasive

surgeries were almost unthinkable, as the mortality risk from infections was simply too great.

The first instrument developed to look into deeper cavities was probably the rectal speculum; the earliest mention is found in Hippocrates’ treaty on fistula. Galen’s *Levicom* refers to the catopter (now in the Naples Museum), an anal speculum. The ability to reflect light in deeply located organs was a central problem in designing open tubes to explore or

retract tissues and allow the examiner to observe these structures. To address the problem, the light guide system was developed.



Philip Bozzini (1773-1809)

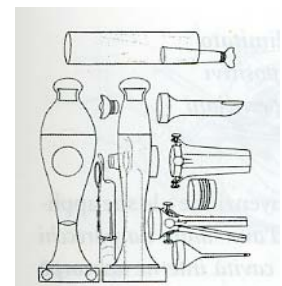
Fig. 3

Philippe Bozzini (**fig. 3**), one of the critical workers in this field and nowadays known as the “father of endoscopy”, was born in 1773 in Mainz, Germany, to an aristocratic Italian family. His father had been forced to flee his native country after coincidentally killing another aristocrat during a duel. Bozzini joined the Austrian army and became a medical officer following the French occupation of this part of Germany. He then moved to Frankfurt to avoid service under the French government. He became interested in mathematics, philosophy, and chemistry as well. He was also a gifted artist, creating an admirable self-portrait, and even designed an early type of airplane.

Throughout the history of endoscopy, many have denounced Bozzini’s device as rather simplistic in form, not the stuff turning points are made of. However, engineers at Mercedes Benz, who were recently commissioned to reconstruct the *Lichtleiter* using only Bozzini’s drawings, were in fact “very impressed” by the technical skill required to make the instrument.

Bozzini’s light conductor, the *Lichtleiter*, as he named it (**fig. 4-fig.5**), consisted of a housing in which a candle was placed. On one side, he attached open aluminium tubes in various sizes and configurations that could be introduced into externally accessible body cavities such as the mouth, nose, ears, vagina, cervix and uterus, urethra and urinary bladder, and rectum .

He even devised one with a mirror to examine the vocal cords.



Lichtleiter

Fig.4.The Lichtleiter was a housing in which a candle was placed



Lichtleiter Photo

Fig. 5

On the opposite side of the housing was an eyepiece. Bozzini was one of the first inventors to insert reflecting, strategically angled mirrors (flat, concave and convex) between the visual tract and the candlelight, so that the light would be reflected only toward the organ and not into the examiner’s eye. Some aspects of Bozzini’s invention cannot be considered innovations at all. For instance, reflecting light using mirrors was not at all a new concept, since Al-Qasim experimented with similar

concepts nine hundred years earlier. Moreover, the technology required to make a functional endoscope had been available since at least 1710. This includes the lens system that Bozzini utilized, which had been derived from 17th century telescopes.

Nevertheless, Bozzini's creative genius went beyond the work of earlier innovators, for he was the first ever to efficiently solve endoscopy's main flaw: reflecting images back to the eye.

Although Bozzini published a brief description of his instrument in 1804 in a Frankfurt newspaper, it was not until 1805 that he announced, again in a newspaper, that he had created a device that made it possible to inspect the inner cavities of the human body. Bozzini's colleagues were extremely hostile toward his endoscopic ventures and scorned his lectures and publications. In 1807, when he recommended that the first prospective study of this device be performed in military hospitals, he received his first positive response. Gynecologists and ear, nose, and throat specialists expressed particular interest. However, he came under harsh criticism from the influential Dr. Stifft, who held a prominent position at the medical academy in Vienna. The medical faculty dismissed his endoscope as a "new toy," and opinion was sharply divided between the academy and the military hospitals about the usefulness of this so-called toy. The resistance from his colleagues was so strong that Bozzini was asked to take a state examination on the grounds that he came from another city. When he took it in 1803, he failed the first round. But thanks to his outstanding performance as an army doctor and after political pressure from the Austrian government, he passed a repeat examination and obtained permission to practice. During an epidemic of typhus, he, as a conscientious doctor, made house calls. He became infected and died from the disease at age 35 after an extremely hard life. He left his widow such poor financial conditions that she was unable to support their three children, who were later adopted. Bozzini's ideas were, however, his vindication. Indeed, despite the limitations of his invention, he is remembered as the first to illuminate and examine deeply located organs.

His epitaph, inscribed in Latin on a marble slab attached to an outside wall of the Frankfurt cathedral, reads: *In memory of the devout, deceased soul of Philip Bozzini, medical doctor. He, German born, was the first who tried to look into the hollow cavities of the human body by ingeniously conducted light. During the rage of a malignant fever which he bravely kept away from others and from which he cured many by his art and devotion, death took his life in his 36th year on the night of April 4th to 5th, 1809. Himself a victor, he became defeated. His faithful friends*

It is of great importance to mention that Bozzini did in fact understand the significance of the endoscope's operative potential and such designs truly establish the

Lichtleiter as one of the most significant precursors to operative endoscopy. He described his hopes in the following passage:

“Surgery will gain not only from the new operations that could not easily be performed until now, but also all other uncertain operations, which depended on mere luck and chance, will now be relieved of uncertainty by the influence of sight...But extirpation of carcinoma of the uterus, many of the unfortunate women who otherwise could not escape certain death will be returned to the enjoyment of life and health. Deformations of the uterine orifice, the vagina, polyps and ulcers of the same, and of the rectum and the bladder stone can be operated by sight”

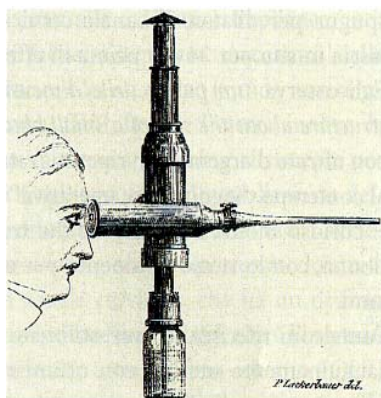
– Bozzini, 1805

Although Bozzini personally did not use his *Lichtleiter* for hysteroscopy, it is clear that most of the experiments conducted with the light conductor aimed at visualizing the rectum and the uterus. In the obstetric and gynecologic field, Bozzini became especially frustrated that only blind palpation was available as a means of examination. In fact, a common



Fig. 6

saying during his time was that “the eye of the obstetrician should be located in his fingertips.” (**fig.6**) Yet, this was a view Bozzini did not share in the least. Bozzini is quoted as stating that such inspections relied “merely on good luck and chance.” He firmly believed that such games of chance could finally be ended by using his device.

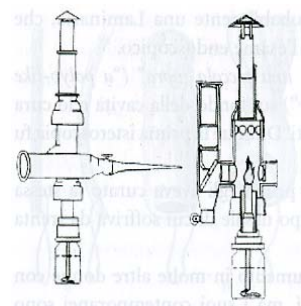


Desormeaux's
Cystoscope

Fig. 7

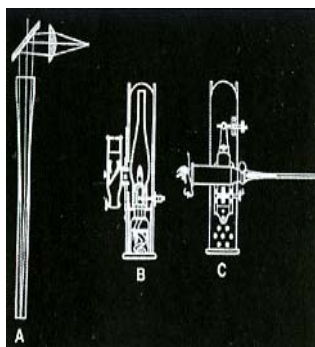
In 1853, Antoine Jean Desormeaux of France developed an instrument to examine the urinary tract and the bladder. He named it “endoscope.” (**Fig.7-Fig. 8**) This was the first time this term was used. Twelve years after the Desormeaux invention, Cruise, from Dublin, made some improvements to this endoscope, replacing the alcohol and turpentine by petroleum and a little dissolved camphor and adding a small glass chimney to contain the vapors.

Bozzini's intuitions became true 60 years after his death. Indeed, in 1869 Commander DC Pantaleoni of Ireland, who learned from Cruise (**fig.9**) how to use the endoscope, performed the first hysteroscopy with the aid of Desormeaux's endoscope (a modified cystoscope lit with reflected candle light) in a



Desormeaux's
Cystoscope

Fig. 8



Cruise's
endoscope

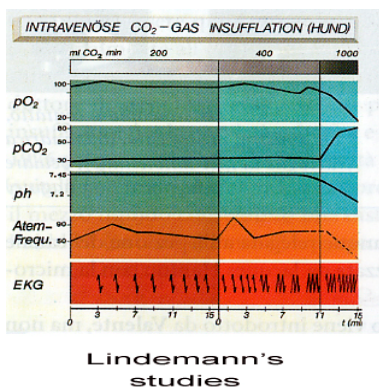
Fig. 9

60-year-old woman with abnormal uterine bleeding. He not only diagnosed an endometrial polyp, but also cauterized it with silver nitrate under hysteroscopic view. Three years earlier, he had tried to use the same endoscope to observe the nasal passages and treat some polyps in a similar way. Arguably, he was the first to combine the two main functions of the modern hysteroscopes: diagnosis and treatment. To other physicians who claimed that the same evaluations could be done with a finger palpation of the uterus, Pantaleoni cleverly responded that while this was true in an

overdilated cervix after delivery, it was extremely difficult, if not impossible, in an undilated cervix. Moreover, when dilatation of the cervix was required for finger palpation, it had to be at least twice that required for his instrument. He added that, even granting that the finger could diagnose abnormal lesions, it certainly could not offer direct treatment.

Other physicians followed suit after Pantaleoni's first known hysteroscopic diagnosis and treatment; still, inadequate light transmission, bleeding inside the uterus, and the inability to distend the organ properly slowed the development and applications of hysteroscopy. Indeed, in subsequent years, hysteroscopy remained a curiosity rather than a truly useful clinical technique. It took over 100 years for the clinical importance of hysteroscopy to become apparent, thanks to developments in optic systems and distension media, which made it possible to obtain satisfactory visualization of the uterine cavity.

Indeed, many ingenious modifications of the early endoscopes were introduced to overcome cumbersome uterine bleeding and maintain adequate uterine distension for panoramic viewing. In- and out-flow channels for uterine irrigation were independently

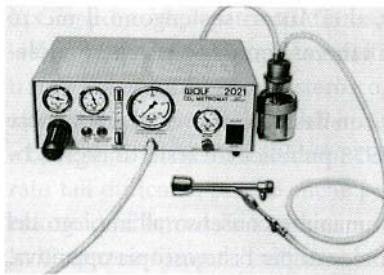


Lindemann's
studies

Fig. 10

introduced by Heineberg in 1914 and Seymour in 1926. The endoscope used by Heineberg had an internal channel for illumination and contained a system of irrigation with low-viscosity fluids to wash any blood and permit uterine distension. This method was the beginning of continuous-flow hysteroscopy and the basis for all such methods introduced late on. In 1925, Rubin reported on his experience and excellent results using CO2 to distend the uterine cavity for hysteroscopy. However, the use of this gas remained rare as most physicians preferred working with low viscosity fluids, especially German

physicians. Nevertheless, in the late 70s, Lindemann (**Fig. 10- Fig. 11**) proposed this method of distending the uterus as the best of hysteroscopy.



Lindemann's device

Fig. 11

In the same years, Menken published his pioneering experience with high- viscosity fluids for uterine distension. Compared with low viscosity fluids, a lesser quantity of a high-density fluid (a mixture of linear polymers of different lengths and molecular weights) was needed for uterine distension, which meant a lesser chance of peritoneal spillage during hysteroscopy. However, because this medium is not biodegradable and has a yellowish tinge in solution, it was not

widely adopted for hysteroscopy. In those times of transition, while investigators were struggling to decide whether to use high-viscosity fluids or carbon dioxide gas for uterine distension, others were opting for a return to low-viscosity fluids. In their 1972 publications of the results of their investigations regarding tubal sterilization by electrocoagulation of the cornual regions of the fallopian tubes, Quinones-Guerrero and collaborators reported delivering to the uterus a 5% water solution of dextrose and modernizing with special tourniquets and pumps Norment's method of increasing intrauterine pressures. That same year, Sugimoto reported opting for low-viscosity fluids, particularly a normal saline solution, and combining gravity pressures with positive pressures provided by a 3-way connection and an attaches syringe to increase intrauterine distension selectively. Still, the problem remained of obtaining a continuous irrigation system that permitted a clear view while avoiding excessive vascular intravasation of the fluid used.



Fig. 12

Between the late 70s and early 80s Jacques Hamou revolutionized the field of hysteroscopy with a new and fine instrument (**fig.12-13**). During his youth, Hamou was been first interested in math and physic before deciding to dedicate himself to medicine. He became

very interested in emerging hysteroscopic technique so he went to USA to learn it. When he came back to Paris, his native city, he was able to built a new device of a total diameter of no greater than 5 mm.



Fig. 13

His new instrument consisted of an improved visual optics using a 4-mm rod lens system scope inserted into a diagnostic sheath to guide the distension media into the uterine cavity.



Microhysteroscope
Image
Fig.14

The “Hamou I microcolpohysteroscope”, (**fig.12-13**) as it was called, offered a new combination of hysteroscopy and microscopy. His device allowed for multiple magnifications (X1, X20, X60, and X150) for cellular exploration and it presented new diagnostic opportunities by combining the data offered by hysteroscopy, colposcopy, and cytology (**fig. 14**).



Fig. 15 Instrumentation for traditional
hysteroscopy

Throughout the 1980s, no significant technological improvements were reported in the field of hysteroscopy, which was invariably performed using the so called “traditional technique”. Speculum and tenaculum (**Fig. 15**) were used to visualize and grasp the cervix, CO₂ was the most commonly used distension medium, and, due to the wide diameter of the hysteroscopes, very often cervical dilatation and local or general anaesthesia with hospitalization were required.

However, in the early 1990s, several developments in the technical and instrumental areas made hysteroscopy less invasive and painful and increased its widespread use reducing the number of hysteroscopies performed in operating room and increasing those performed in outpatient setting (**Fig. 16**).



Fig. 16

Such developments included:

- the introduction of an atraumatic technique for the insertion of the scope inside the uterus without the aid of speculum or tenaculum (the so called: vaginoscopic approach or no touch technique)
- the miniaturization of the optics which allowed for the reduction of the total diameter of the hysteroscopes and
- the widespread use of saline as a distension medium

PATIENT SATISFACTION WITH OUTPATIENT HYSTEROSCOPY VERSUS DAY CASE HYSTEROSCOPY: RANDOMIZED CONTROLLED TRIAL				
VARIABLE	Outpatient group (n=49)	Day case group (n=48)	P value	
N. (%) OF PATIENTS SATISFIED	41 (84)	37 (77)	0.42	
N. (%) OF PATIENTS WHO NEEDED ANALGESIA	6 (12)	7 (14)	0.74	
PAIN SCORE AT 30 MIN (SCALE 0-10)	0.4 (0-1.2)	0.3 (0-2.2)	0.34	
MINUTES TO RECOVERY OF FULL MOBILITY	0 (0-5)	105 (80-120)	<0.001	
N. (%) OF PATIENTS NEEDING PAIN RELIEF	15 (30)	16 (33)	0.27	
MEDIAN N (RANGE) OF DAYS OF ANALGESIA	0 (0-2)	0 (0-4)	0.27	
FULL RECOVERY ON DAY	2 (1-2.7)	3 (2-4)	<0.05	
DAYS AWAY FROM WORK	1 (0-1.6)	3 (2-4)	<0.0001	
MINUTES AWAY FROM HOME	120 (110-170)	480 (450-525)	<0.0001	

Fig. 17

with inpatient hysteroscopy; presenting distinct advantages such as reduced anaesthesiologic risks, enhanced time-cost effectiveness and patient's preference. Currently outpatient hysteroscopy represents the gold-standard for the evaluation of the uterine cavity.

The first randomized controlled study (**Fig. 17**) comparing inpatient and outpatient hysteroscopy demonstrated that despite similar patient satisfaction, patients undergoing outpatient hysteroscopy recovered significantly more quickly than those undergoing inpatient hysteroscopy.

Moreover, throughout the years, several studies have demonstrated that outpatient hysteroscopy shows good correlation of findings compared

Throughout the 90s, a new philosophy started: the so called “see & treat” hysteroscopy, or



Fig. 18

office operative hysteroscopy, which reduced the distinction (Fig 18) between a diagnostic and an operative procedure, introducing the concept of a single procedure in which the operative part is perfectly integrated in the diagnostic work-up

(Fig. 19).



Fig. 19

The single most important technical innovation contributing to the development and widespread diffusion of such philosophy was the development of small-diameter hysteroscopes with continuous flow features and operative sheaths, through which mechanical instruments could be introduced.



Fig. 20

The possibility of visual examination of the uterine cavity and contextual operative facilities has provided endoscopists with the perfect “diagnostic” tool: they

can examine the cavity and take biopsy or treat benign intrauterine pathologies in a relatively short

time without any premedication or anaesthesia. Finally, a revolution occurred in 1997 with the introduction by Gynecare, Ethicon of a versatile electrosurgical bipolar system dedicated to hysteroscopy called Versapoint (Fig. 20) which represents a key point in the history of office operative hysteroscopy. As a matter of fact, thanks to the use of 5 Fr bipolar electrodes the number of pathologies treated by office operative hysteroscopy has increased tremendously, reserving the use of resectoscope and operating room to a very limited number of cases.

The future looks to further simplification of instrumentation and a safer and easier delivery of energy sources. The number of operative procedures performed in an office setting will increase as technological simplification increases safety and accuracy and expedites performance. In turn, this trend will increase the use of diagnostic and operative hysteroscopy. What is now the present was a distant future at the beginning of

hysteroscopy, and the future soon will be the present as we go on building on the foundations and pillars our predecessors have laid or erected.

CHAPTER 2

EQUIPMENT AND OFFICE SET-UP

The term “hysteroscopy” is derived from the fusion of two ancient greek words “*histeros*” (uterus) and “*scopeo*” (to see) and refers to the “*direct visual examination of uterine cavity*”. Indeed hysteroscopy is a procedure in which an illuminated scope called “*hysteroscope*” is inserted through the cervix into the uterine cavity that has been distended by a fluid or gas distension medium, in order to diagnose or eventually treat uterine abnormalities. Good visualisation is the key to a correct diagnosis and a precise treatment. The five essential elements for an optimal visualization include: Monitor, Endocamera, Light source, Light cable and Optic.

ENDOCAMERA

In modern hysteroscopy the human eye has been replaced by the endocamera (**Fig. 1**). Several types of endocamera are available, each differing from the other in three main characteristics:

- Sensibility
- Resolution
- Definition



Fig. 1

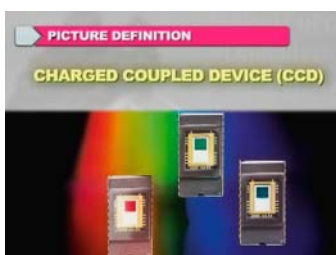


Fig. 2 CCD Transforms the real image into an electronic signal

Sensibility, measured in lux, represents the minimal quantity of light necessary to make captable an image; resolution represents the number of vertical lines which constitute the image, which can be detected on the screen;

picture definition is proportional to the number of picture elements, called pixels, produced by the chip. The chip is a microprocessor also called Charged Coupled Device (CCD) (**Fig. 2**) because it transforms the real image into an electronic signal. The image captured by the endocamera is split into the three main colours: red, green and blue, which are send either to one or to three

different chips, one for each colour. Obviously, the higher the number of chips, the better is the chromatic accuracy of the image.

LIGHT SOURCE



Fig. 3 Karl Storz
1911-1996

In 1960 Karl Storz (**fig 3**) discovered that it was possible to transmit light from a light source outside the body via a light cable through an endoscope to the examination site. This discovery marked the birth of “cold light endoscopy” (**fig. 4**) . During the last 40 years several types of light sources each one more powerful than the other have been developed in order to provide a clear vision inside the uterine cavity which is characterized by a high absorption of light, because of the predominance of red color.

At present xenon light sources are preferred to the halogen ones for several reasons:

- Produce twice the light output as a modern halogen lamp
- Provide white light, which is ideal for endoscopy
- The light intensity is uniform while lamp lasts
- Have a longer duration (nearly 500 hours)
- And a realer colour temperature (6000 K) which results in better colour chromatic performance

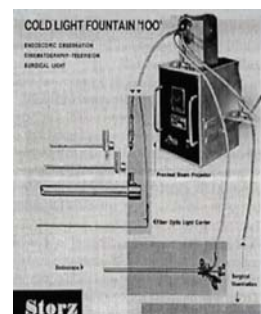


Fig. 4 The “cold light endoscope transmits light from a light source outside the body via a light cable.

A 175 watt xenon light source gives good depth of field, enough to perform an adequate office operative hysteroscopy. A light source of 300W is recommended for video recording.

LIGHT CABLE

Two types of cables can transmit the cold light from the light source to the endoscope. The transmission of light through a glass fiber cable depends on the phenomenon of total internal reflection. If a fiber is straight or curved, light entering one end travels in a zig-zag path, repeatedly reflecting off the internal surface of the fiber until it emerges from the other end, with the same angle of incidence of the entrance (fig. 5).

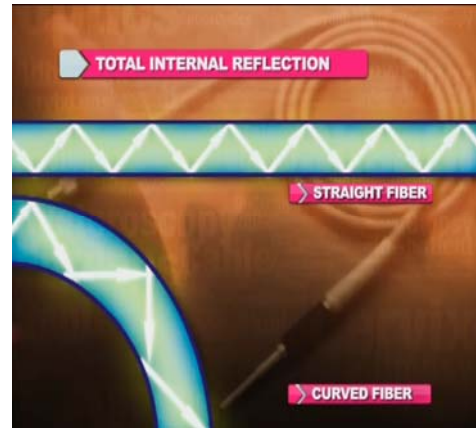


Fig. 5 Light travels through the fiber in a zig- zag path



Fig. 6

These glass fibers are rather vulnerable: damage or rupture of these fibers caused by forced bending will immediately reduce the light intensity. The liquid crystal cables are made of a fluid medium, typically colesteric saline. These cables transmit a higher light intensity (fig. 6) for a similar power of light emission,

in comparison with optical fiber cables. Despite their higher rigidity, which may often hamper the endoscopic procedures, it has the distinctive advantage of duration.

HYSTEROSCOPES

Fundamentally, the hysteroscope only consists of an optical system (even called telescope) to carry light to the object being viewed and to convey the image back to the camera. In its simplest form, the telescope fits into a sheath through which a distension medium can be infused to provide necessary distension for panoramic viewing.

Two different types of hysteroscopes are used world-wide in office setting: rigid and flexible ones (Fig.7) The rigid telescopes are based on glass

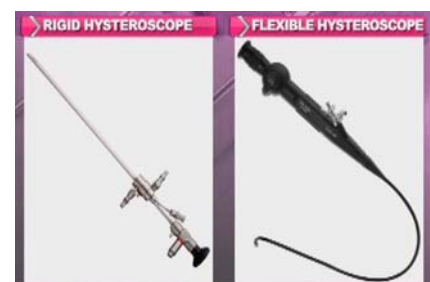


Fig. 7

lens alternated with air bubbles. These constitute the transmission lens system. Surrounding the optical components are glass fiberoptic bundles that transmit cold light by way of a glass fiber cable from a xenon light source.

Prof. John Hopkins from Baltimore, USA, introduced a great innovation by modifying the shape and length of the lens inside the instruments: from small lens with spherical shape (**Fig 8a**) to longer and cylindrical ones (**Fig. 8b**) This resulted in an inverted ratio between



Fig. 8 a Old lens based optic

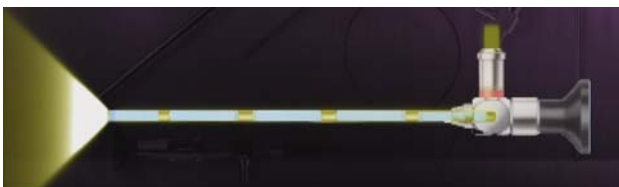


Fig. 8 b Modern lens based optic (Hopkins system)

air and lens in favor of lens which provided lower optical aberrations, greater brightness and higher definition. All the modern rigid hysteroscopes are based on Hopkins rod-

lens system From the first generation rigid optics of the 1970s, characterized by a poor quality of vision and a diameter of 5.5-6mm, we have moved through the second generation optics ranging from 4mm to

2.9mm, to the current revolutionary 2mm rigid optics with excellent quality of view.

Rigid telescopes are available either with 0, 12, 30 or 70 degree viewing angles (**fig 9**). Selection of these angles is mostly a matter of personal preference. For the beginners, the 0-degree (**fig. 10**) telescope is much easier to use because orientation is similar to that of normal vision. The view through the fore-oblique view scopes (typical of all the modern Hopkins lens-scope based hysteroscopes), once the tip of the scope is

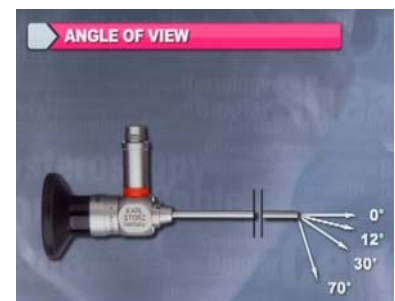


Fig. 9

placed 1-1.5cm from the fundus, permits a rapid and easy evaluation of all the uterine walls, the cornual recesses and tubal ostia by simply rotating the telescope slightly on its



Fig. 10

axis to the right or left. On the contrary, the same view with a 0-degree scope is possible only by angulating the whole instrument to the left or right by lateral movements thus determining a major stretching of cervical myometrial fibers which is mostly responsible for patient's discomfort. In the early 90s, together with the

development of rigid hysteroscopes, improvements in fiberoptic technology allowed manufacturers to create 0-degree flexible hysteroscopes characterized by a smaller diameter thus less invasiveness in comparison with the rigid ones.

At the beginning, the widespread acceptance of these scopes was hampered by the poor quality of the images (the so-called “fly view”), the high costs and a number of issues regarding their design, use and maintenance. Although recent technological advances have made it possible to achieve a image quality almost comparable to that of the rigid hysteroscope, these scopes are rarely used in office operative procedures. Optic miniaturization both for rigid and flexible hysteroscopes has been important for two reasons. Firstly, it has significantly improved patients’ compliance to the procedure; indeed a 1- to 2-mm reduction in the optical diameter and consequently of total hysteroscope size has reduced the instrument section area by about 50-75%. This makes the introduction of the instrument in the cervical canal and uterine cavity easier and less painful compared to the conventional larger-diameter hysteroscopes. This trend towards smaller instruments has largely contributed to the performance of hysteroscopy as an outpatient procedure. Secondly, the miniaturization of the optics has made it possible to produce not only very thin diagnostic sheaths, but also operative sheaths with a diameter equal to or less than 5 mm, as was the case in the old generation of purely diagnostic scopes, including the working channel and continuous flow features. The possibility of making a visual examination of the uterine cavity and at the same time exploiting the contextual operative facilities represents the so called “see & treat” philosophy , even called “Office Operative Hysteroscopy”.

A) OFFICE CONTINUOUS FLOW OPERATIVE HYSTEROSCOPE “SIZE 5” AND “SIZE 4”



Fig. 11

One of the most commonly used rigid hysteroscopes is the Office Continuous Flow Operative Hysteroscope (**Fig 11**) “size 5” developed by Storz, based on a 2.9 mm rod lens system with 30-degree foreoblique view, and an outer diameter corresponding to 5.0

mm. Recently, a thinner version has been developed based on a revolutionary 2.0 mm rod lens system scope that reduces the final diameter of the hysteroscope to 4.0 mm.

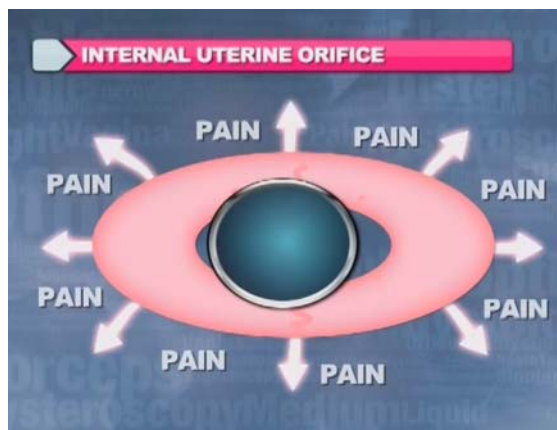


Fig. 12

Both instruments feature two sheaths (one for irrigation and one for suction, thus creating a continuous flow system for the washing of the uterine cavity), an operative 5-Fr canal (of approximately 1.6 mm) and are oval in shape, ideal for atraumatic insertion of the scope into the cervix. Indeed, the internal uterine orifice is normally oval, with a transverse main axis and a diameter of approximately 4-5mm; therefore, if

we want to insert a round hysteroscope measuring 5mm in diameter through it we need to modify the spatial disposition of the muscle fibres, stretching some of them, stimulating the sensitive fibres and as a result, causing pain to the patient (**fig. 12**). Instead, these two hysteroscopes conform more strictly to the anatomy of the cervical canal; thus a simple rotation of the scope on the endo-camera by 90-degree (**Fig. 13**) is adequate to align the longitudinal main axis of the scope with the transverse axis of the internal uterine orifice.



Fig. 13

B) VERSASCOPE

Recently the improvement in fiberoptic technology has allowed the realization of a revolutionary semi-rigid 3.2mm minihysteroscope called Versascope (**Fig. 14**), developed by Gynecare, Ethicon. It consists of a 1.8 mm fiberoptic scope with 0-degree angle of vision (which becomes 10-degree in sheath) and a single, disposable, outer sheath with both inflow/outflow channels. This sheath



Fig. 14

has an additional expanding plastic collapsible channel: when the “outflow cannula” is inserted through it, the continuous flow of distension media is established and maintained.

Furthermore 7Fr semirigid mechanical instruments or 5Fr bipolar electrodes can be inserted through it, allowing immediate conversion from diagnostic to operative procedure. This instrument has the main advantage to be a-traumatic and easy to use, which allows the use of more robust 7 Fr mechanical instruments. Despite the great improvements in fiber-optic technology, Versascope still cannot match image quality of a rod-lens-based telescope system. However, because outflow (and not inflow!) is the working channel, it allows to maintain the same quality of image throughout the whole procedure, even when inserting instruments.

DISTENSION MEDIA

The endometrial mucosal lining has a tendency to bleed on contact; therefore distension of the uterine cavity is necessary to view within the uterus. Whether the best distension media in office setting is CO₂ or normal saline is still very debated in literature. The available evidence seems to suggest that, even if CO₂ is generally well tolerated and does not distort the



Fig. 15



Fig. 16

intrauterine view in any way, uterine distension with normal saline should be preferred in office setting, particularly if operative procedures are to be performed. Indeed, apart from better patient tolerance and being cost effective, the main advantages of liquid distension include clearing of blood, blood clots and debris during the procedure, as well as the possibility to use bipolar instruments.



Fig. 19

The saline solution may be insufflated at atmospheric pressure (by means of two 3 or 5-l bags connected by a urologic 'Y' outflow and located 1.5 m above the patient (**Fig. 15**)) or at a pressure generated by a pressure bag (**Fig. 16**). However, to maintain a clear field of view and a constant distension of uterine

cavity, an electronically controlled irrigation and suction device has to be recommended. The Hamou Endomat (**Fig. 17**) is particularly suitable for office operative hysteroscopy. The different parameters on the pump (flow, pressure, aspiration) are set to obtain an average constant distension of 30-40 mmHg. (**Fig. 18**) These values, lower than the 70 mmHg present within the tubes for the abdominal counter pressure, prevent the distention media from passing into the peritoneal cavity thus eliminating both patient's pain and risk of vagal reaction. However, even with an electronic pump, it is still practically impossible to obtain clear intrauterine view using liquid distension without a continuous flow hysteroscope.

The problem with non continuous flow system occurs when the cervical canal and the internal uterine ostium are the same size or smaller than the hysteroscope. The liquid drains into the uterine cavity, because it cannot flow out or pass through the tubes into the abdomen. The view will be unclear due to the presence of hanging mucosa particles. In these cases many endoscopists will try to solve the



Fig. 18

problem, by raising the flow and so the intrauterine pressure. However, as the compressed liquid cannot flow out of the cervical canal, it will be forced to move into the abdomen through the tubes, causing pain and risk to the patient.

MECHANICAL INSTRUMENTS



Fig. 19

Mechanical operative instruments have long been the only way to apply the “*see and treat*” philosophy in an outpatient setting.

These instruments, available in two different size of 5 or 7 Fr (**Fig.19**), enables one to perform a target-eye biopsies, to remove small uterine polyps or lost intrauterine device and to cut adhesions or septa.

As stated before, the 7 Fr instruments carry the notable advantages of a wider opening and an increased volume of the collected tissue.

BIPOLAR ELECTRODES

A) VERSAPOINT SYSTEM

The advantages of bipolar over monopolar technology are well accepted in the medical field. The most important benefit in hysteroscopy is the use of saline solution as well as the reduction of energy spread to the tissue during its activation. A versatile electrosurgical system dedicated to hysteroscopy called Versapoint Bipolar Electrosurgical System developed by Gynecare, Ethicon was introduced in 1997. It consists of a high-frequency bipolar electrosurgical generator and co-axial bipolar 5Fr (nearly 1.6mm) electrodes. The generator provides three different modes of operation: the vapour cut waveform, resembling a cut mode, the blend waveform and the desiccation waveform, resembling a coagulation mode. Versapoint electrodes utilise a revolutionary design where the active and return electrodes are placed “in-line”, with a ceramic insulator in between. During vapour-cut mode, when the electrode is activated in a conducting solution such as saline, an extremely high impedance vapour pocket is generated that surrounds and insulates the active electrode, preventing completion of the circuit until tissue contact is achieved. After tissue contact, the circuit is completed and the tissue between the active and return

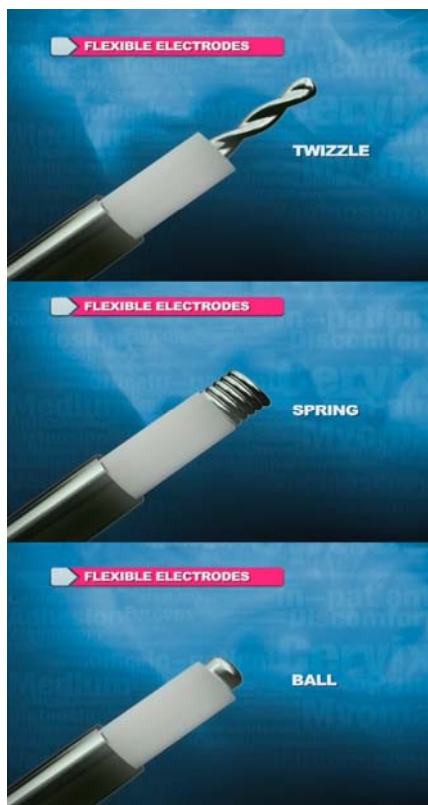


Fig. 20

electrodes is vaporized accordingly. Desiccation dehydrates the cells and leads to hemostasis. During desiccation mode, a vapour pocket does not form and tissue forms part of the return circuit. Thus Versapoint appears and performs like a monopolar device but retains all the inherent safety advantages of bipolar electrosurgery in saline.

Three types of flexible electrodes are available (**Fig. 20**): the Twizzle, specifically used for precise and controlled vaporization, the Spring, used for diffuse tissue vaporization and the Ball, used to coagulate tissues.

The Twizzle electrode is what we definitely prefer to the others in our clinical practice because it is a more precise, needle-like “cutting” instrument and it can work closer to the myometrium with lower power setting and

consequently with less discomfort to the patient. Once the 5 Fr Twizzle electrode is connected, the generator automatically adjusts to the default setting on VC1 and 100 W. However, according to the available international literature and to our clinical experience we believe that the mildest vapour cutting mode (VC3) and the halving of the power setting to 50 W together with the pulsed activation of the bipolar circuit, carry the advantage to produce minimal dissection of the tissue (resembling a precise cut) with minimal generation of bubbles and with high patient tolerance. A further advantage of Versapoint system is that the same electrosurgical generator can be also connected to disposable loops and vaporizing bars in order to be able to perform resectoscopic surgery in the operative room.

B) OTHER MINIATURIZED BIPOLAR ELECTRODES

More recently a new generation of electrical generators, allowing the use of bipolar energy on miniaturized electrodes, has been presented (Autocon 400 II, Karl Storz Endoscopy, Germany). Due to the increased efficiency and to the different “quality” of the energy produced, has been possible to develop a second generation of 5 Fr bipolar electrodes (Karl Storz Endoscopy, Germany). The main advantage of these instruments is to be reusable and therefore to reduce the costs of Office Operative procedures. The application of this electrode and the technique used to perform the procedures is the same of those described for the Versapoint system.

OFFICE SET-UP



Fig. 21

An appropriate office set-up is one of the keystones for the performance of a successful hysteroscopy. The procedure should preferably take place in an adequate outpatient unit in a hospital, clinic or private office where any unforeseen complications can be appropriately managed(**Fig. 21**). Hysteroscopy should be scheduled in the early proliferative phase of the cycle, as it is easy to pick up

pathology. The nurse should set up the room where the procedure takes place in order to ensure that all the necessary equipment and instruments are in proper working conditions and readily available. A comfortable electrohydraulically adjustable chair is always recommended as this will add to the comfort of both the patient and the physician. The items needed for office hysteroscopy can be singularly arranged on a trolley or incorporated in a single compact device. Although rare, there is always the possibility of complications due to vasovagal response and adverse reactions. Thus the nursing staff and physicians should always follow the procedure being prepared for emergency situation and a complete emergency set must be available in the procedure room. Patient preparation is a key factor in ensuring a positive patient outcome. Ideally, patient preparation begins immediately after the patient and the physician have decided to proceed with an office hysteroscopy. It includes a clear explanation of the procedure, a thorough assessment of the patient's understanding of information given and a period of time for question



Fig. 22



Fig. 23

and answers during which the doctor may discuss and address any patient's concerns about the procedure. It has been speculated that women who are anxious while undergoing a hysteroscopy usually experience more discomfort during the procedure.

Therefore, if the doctor or a nurse is able to develop a plan of care that will help to minimize the patient's anxiety, a more positive outcome and an increased

patient satisfaction can be expected. In our clinic neither analgesic nor mild sedative are administered before the procedure. The gynaecologist should also ensure that the informed surgical consent is signed and that the medical record contains information about any pathological conditions or allergy the patient may have. A nurse or a resident should instruct the patient to empty her bladder and then accompany her to the procedure room, instruct her to undress from the waist down and position her on the examination table in a lithotomy position, ensuring that she is adequately draped to maintain her privacy. During the procedure, the nurse or a resident should provide emotional support to the patient and assistance to the physician as needed. Moreover, in order to further reduce the patient's anxiety the physician may also get the patient more involved into the procedure by inviting her to look at the monitor and explaining the view or any abnormalities found. An additional monitor dedicated to the patient's view may be useful to address such issue (**Fig. 22**). After the procedure, the patient generally does not need any recovery time and should be able to go home immediately. Therefore, the physician should review discharge instruction with the patient, including what to expect immediately after the hysteroscopy and during the first few days following the procedure such as mild cramping and vaginal spotting (**Fig. 23**). A non steroidal anti-inflammatory drug or a spasmolytic agent may be prescribed to control discomfort and the patient is instructed to notify the physician immediately if she notices any abnormal bleeding or pain. Normal activities restriction is usually not required after an outpatient hysteroscopy, even in case operative procedures are performed.

CHAPTER 3

FEASIBILITY AND ADOPTION

Although it is well established that outpatient hysteroscopy with a success rate close to 100% represents the gold standard for the evaluation of the uterine cavity, the number of gynecologists performing such procedure continues to be low.

These figures drop further when considering the number of gynecologists who prefer to remove benign lesions in an outpatient setting rather than in the operating theatre.

Several reasons given for this include:

1. A perceived limited number of patients who would benefit from the procedure

There are no scientific reasons as to why there should be any scarcity in the number of patients who would benefit from outpatient hysteroscopy specially when it has been proved beyond a shadow of doubt that patients who do not wish to or cannot undergo general or local anaesthesia as well as virgin patients who wish to preserve the integrity of their hymen

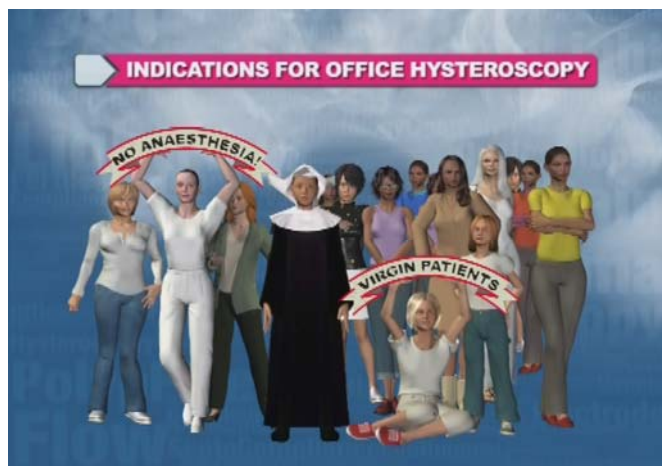


Fig. 1

can all be treated by hysteroscopy in an office setting (**Fig.1**). In this regard, Attilio Di Spiezio Sardo and coll, published a “Letter to the editor” (**A. Di Spiezio Sardo, M. Guida, M. Pellicano, C. Nappi, S. Bettocchi. JMIG 2006; 13(5): 489-90**) concerning the paper of *Xu et al*, entitled “*Hysteroscopy for the diagnosis and treatment of pathologic changes in the uterine cavity in women with an intact*

hymen” (JMIG 2006; 13:222-4). The author’s purpose was just to underline that office hysteroscopy with minihysteroscopes and vaginoscopic approach should always represent the first-line approach to a virgin patient who requires endoscopic investigation of the uterine cavity.

At present, office hysteroscopy may be preferable in most situations where either a major or minor intrauterine anomaly is suspected, including asymptomatic patients.

2. A duplication of procedures for patients who need surgery in the operating room

The most common concern for any gynaecologist is that a patient who need surgery will undergo two procedures if there is a lesion to be removed. However modern hysteroscopic technology has made it possible to diagnose and treat most intrauterine pathologies in a single outpatient setting.

3. High initial investment with poor payback



Fig. 2

“see and treat” hysteroscopy within the office setting rather than to take a patient to the operating room (Fig. 2- Fig. 3).

It is undeniable that mandatory equipment for office hysteroscopy is expensive and payback depends primarily on location and customer affluence. However, from an overall perspective of both time and money, it can be argued that it is much more productive to perform a rapid



Fig. 3

4. The supposed high level of expertise needed to perform any operative procedure in an office setting



Fig. 4

Experience has shown that office operative hysteroscopy is not a difficult technique and that the learning curve may be further reduced by supervised training (**Fig.4**), proper knowledge of techniques and instruments as well as the use of minihysteroscopes with adequate optical features. A new generation of hysteroscopists, familiar with the modern hysteroscopes and able to simultaneously use the scope and the 5-Fr or 7-Fr instruments is on the increase

particularly in Europe rather than in the USA.

Currently, the main limiting factor to a widespread use of office hysteroscopy is pain and discomfort experienced by the patients during the procedure. Unfortunately, hysteroscopy continues to be perceived as an invasive and painful technique by most patients with many of them still preferring the inpatient approach, believing that it will be pain-free.

Furthermore, many gynaecologists are themselves responsible for the poor diffusion of outpatient procedures because of their fear of inflicting pain on their patients. Coupled with this is the fact that most gynaecologists are apprehensive at not being able to perform the examination with the patient being awake witnessing and judging the performance.

Pain during hysteroscopy is primarily due to:

1. The introduction of hysteroscope through cervical canal, especially when it is pushed through the internal ostium (**Fig.5**) ;



Fig. 5

2. The contractile activity of the myometrium caused by the distension of the cavity by means of distension medium (**Fig.6**);

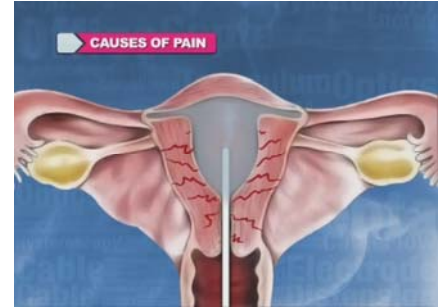


Fig. 6

3. The direct stimulation of the uterine walls coming into contact with the instrument (**Fig.7**).



Fig. 7

• VAGINOSCOPIC APPROACH

In the last decade, all efforts have focused on maximizing the chance of success of the procedure by minimizing patients' discomfort. Above all, the following have greatly increased the feasibility and acceptability of office hysteroscopy, making it nearly painless, quick and complication-free.

- the use of saline as distension medium;
- the availability of high resolution rigid and flexible mini-endoscopes;
- and the introduction of a refined technique for the insertion of the hysteroscope in the external uterine orifice which is less traumatic to the patient

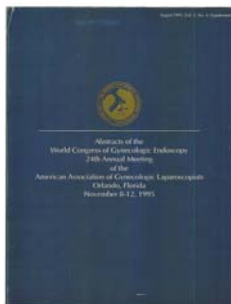


Fig. 8

This vaginoscopic approach has been developed by Prof. Bettocchi in 1995 (**Fig. 8**) and it avoids the need for a vaginal speculum and a cervical tenaculum. The vagina, being a cavity, can be distended by introducing the liquid distension medium through the hysteroscope placed into the lower vagina at the same pressure (30-40 mmHg) used for the subsequent

distension of uterine cavity. Then the scope is guided towards the external uterine ostium and through the cervical canal.

Several retrospective and randomized studies have shown that vaginoscopic approach is effective and faster than conventional approach and also reduces patient discomfort. Particularly, Sharma, Attilio Di Spiezio and coll, conducted the first prospective randomized controlled study (**M. Sharma, A. Taylor, A. Di Spiezio Sardo, L. Buck, G. Mastrogamvrakis, I. Kosmas, P. Tsirkas, A. Magos. Outpatient hysteroscopy: traditional versus the 'no-touch' technique. BJOG. 2005; 112: 963–967**) in order to assess whether outpatient hysteroscopy using the 'no-touch' technique confers any advantages in terms of patient discomfort over the traditional technique. All women referred for outpatient hysteroscopy in a 12-month period were randomised to undergo either traditional saline hysteroscopy requiring the use of a speculum and tenaculum, or a 'no-touch' vaginoscopic hysteroscopy which does not require a speculum or tenaculum. Each group was further subdivided to have hysteroscopy with either a 2.9-mm or 4-mm hysteroscope. Patients were asked to complete pre- and postprocedure questionnaires ranking pain scores. The main outcome measures were: the relative success of each of these techniques, requirement for local anaesthetic and pain scores at different times during the hysteroscopy were recorded at the end of the procedure. The time taken to carry out each procedure was also measured. One hundred and twenty women were recruited in this study: 60 were randomised to traditional hysteroscopy and 60 to 'no-touch' hysteroscopy. The overall success rate for hysteroscopy was 99%. There was no significant difference in the requirement for local anaesthetic between the two groups, but those who underwent 'no touch' hysteroscopy with a 2.9-mm hysteroscope had the lowest requirement of local anaesthetic (10% compared with 27% in the no-touch hysteroscopy with a 4-mm hysteroscope group). The time taken to perform hysteroscopy and biopsy was significantly shorter with 'no-touch' hysteroscopy (5.9 vs 7.8 min; difference 1.9, 95% CI 0.7–3.1). There were no differences in pain scores between the groups at different times during hysteroscopy. Therefore, the authors found that 'No-touch' or vaginoscopic hysteroscopy is significantly faster to perform than the traditional technique. Although there was no difference in pain scores between the two techniques, local anaesthetic requirements were least in those who underwent 'no-touch' hysteroscopy with a narrow bore hysteroscope. The echo of

this paper spread far and wide, so that it has been amply commented in “**Obstetric and Gynecologic Survey**”

Pain reduction, during vaginoscopic hysteroscopy, is mainly due to the first phase of the procedure being vaginal distension by means of liquid, which is not painful, whereas the introduction of even the smallest speculum is usually poorly tolerated. This could be particularly relevant considering that patients undergoing hysteroscopy are often very anxious; so lowering the pain sensation in the first phase of this procedure could contribute to a better global performance.



Fig. 9

Vaginoscopic approach requires a good knowledge of the physics and instrumentation as well as the operator's ability to correlate the image on the screen with the actual position of the fore-oblique scope. Indeed the required image with a fore-oblique view scope

should not appear in the middle of the screen, but in its lower half to enable the scope to be aligned with the mid-longitudinal axis of the cervical canal (**Fig. 9- Fig. 10**).

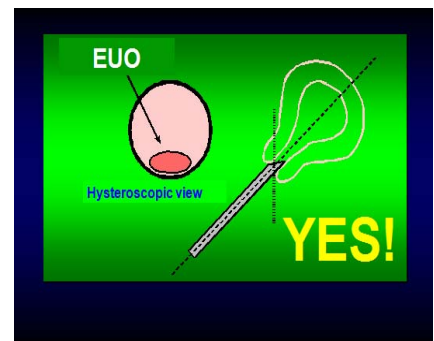


Fig. 10

Until now in all published studies, the vaginoscopic approach has been performed with different-sized standard rigid hysteroscopes. In the recent years, a semi-rigid 3.5-mm fibre-optic minihysteroscope (Versascope, Gynecare, Ethicon) has been developed. In this regard, M.Guida, Attilio Di Spiezio and coll, conducted the first prospective randomized controlled study in order to compare surgeons and hysteroscopic methods (vaginoscopic and traditional approach), using this new semi-rigid hysteroscope, to assess whether vaginoscopic approach is associated with a lower pain score without any increase in procedure time. (**M.Guida, A.Di Spiezio Sardo, G.Acunzo, S.Sparice, S.Bramante, R.Piccoli, G.Bifulco, D.Cirillo, M.Pellicano and C.Nappi. Vaginoscopic versus traditional office hysteroscopy: a randomized controlled study Human Reproduction . 2006.21; 12: 3253–3257**). In this trial three hundred patients were randomized in two groups: Group A, diagnostic hysteroscopy with vaginoscopic approach (150 patients) and Group B, diagnostic hysteroscopy with traditional approach (150 patients). All procedures were performed using a

semi-rigid 3.5 mm minihysteroscope with a 0° grade optic. Patients of each group were divided into three subgroups according to their reproductive status: fertile nulliparous (FN), fertile multiparous (FM) and post-menopausal (MEN) women. Women were asked to rate their degree of pain during four phases of the procedure: introduction of hysteroscope (Group A) or speculum (Group B) into the vagina (Phase I) and progression through cervical canal up to internal uterine orifice (IUO) (Phase II), inspection of uterine cavity (Phase III) and performing of endometrial biopsy (Phase IV). A total pain score was calculated for each group. For each patient, the duration of hysteroscopy was recorded from the introduction to the extraction of the scope (Group A) or of the speculum (Group B). Although the median total pain scores were 2 in each group, the 95% confidence interval for vaginoscopic hysteroscopy (1.86–2.01) was significantly ($P < 0.05$) lower than that for traditional hysteroscopy (2.10–2.26). Comparison between the corresponding phases of the procedure showed the only significant difference during Phase I of the procedure [Group A: 1 (95% CI 1.0–1.18) versus Group B: 2 (95% CI 2.3–2.8); $P < 0.05$]. No significant differences in terms of duration of the procedure were observed between the two approaches. Therefore, the authors concluded that, when surgeons using vaginoscopic hysteroscopy with a semi-rigid minihysteroscope were compared with those using traditional approach and the same instrumentation, the operating times and the patients' pain scores were similar.

Obviously, high patient compliance during the procedure represents the key prerequisite not only to reach a correct diagnosis but also to possibly treat those pathological conditions found in the uterine cavity.

However, without the advent of modern hysteroscopes and the availability of bipolar electrodes respecting the sensitive anatomy of the uterus, the philosophy of office operative hysteroscopy would have neither broadened its indications nor increased its acceptability.

As a matter of fact, today office operative hysteroscopy is considered to be absolutely safe and feasible, provided we have:

- 1) the appropriate equipment
- 2) proper training and knowledge of the correct techniques

Under these assumptions, nowadays it is possible to offer the patient an effective and painless treatment which also:

- 1) avoids local and general anaesthesia and associated risks and morbidity
- 2) allows quicker recovery time and return to mobility and full fitness
- 3) reduces costs related to dedicated personnel and operating room usage
- 4) reduces waiting lists for major surgery by avoiding the need for the operating room in case of minor procedures

For all these reasons office operative hysteroscopy is a tool which should belong to every modern gynaecologist.

Nezhat et al¹—more recently. The harmonic scalpel was used in most of the steps of radical hysterectomy with the advantage of not leaving staples in the pelvis unnecessarily. After our experience in 48 cases, we are currently using a new vessel-sealing technology (Ligasure Five LS 1500, Autosuture, Valleylab, Boulder, CO) that produces a consistent, reliable, permanent seal of veins, arteries, and tissue bundles by fusing the collagen in vessel walls.

The use of standardized, strict, and correct terminology for the description of total radical hysterectomy completed exclusively by the laparoscopic route is essential for research purposes, as well as for the comparison of surgical results regarding morbidity and outcome of the procedure reported by different groups.

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doi:10.1016/j.jmig.2006.05.008

the vaginal cuff incision and vaginal cuff closure can be performed either laparoscopically or vaginally. The vaginal approach offers better visualization of the vaginal resection margin with less manipulation of the cervix during specimen removal. Our technique does not increase operation time, and may lead to fewer vaginal cuff eviscerations which may be attributable to laparoscopic vaginal cuff excision and closure.²

In 2000, Olive and colleagues³ published the American Association of Gynecologic Laparoscopists (AAGL) classification system for laparoscopic hysterectomy, which described a system of nomenclature based on the portion of the procedure completed under laparoscopic direction. This publication, however, did not address classification of laparoscopic radical hysterectomy. A new guideline has been developed by The Practice Guidelines Committee of the AAGL describing the classification of laparoscopic radical hysterectomy and is presently under review.

Farr Nezhat, M.D.
Nimesh P. Nagarsheth, M.D.
New York, NY

doi:10.1016/j.jmig.2006.06.009

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Response:

In a recent publication, we described the technique of total laparoscopic radical hysterectomy using the harmonic shears as the sole instrument for dissection, division, and maintenance of hemostasis of all major surgical pedicles.¹ In this report, we provided a detailed description of our procedure with the entire surgery being performed laparoscopically with the exception that the vagina was cut and closed under direct visualization using a vaginal approach to assure adequate surgical margins. In a letter to the editor, Díaz-Feijoo and colleagues have brought up the important issue of using standardized terminology for the description of total laparoscopic radical hysterectomy and argue that the use of the vaginal route to assure adequate margins during our procedure should negate the ability to classify our procedure as a total laparoscopic radical hysterectomy.

We believe that the important steps of the radical hysterectomy include the development of the avascular pelvic spaces, ligation and division of the vascular pedicles, unroofing and mobilization of the ureters with dissection down to their insertion into the bladder, and division of the uterosacral/cardinal ligaments with resection of the parametria. In our series, all these steps were performed laparoscopically. In our opinion,

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To the Editor,

We wrote this letter on the wave of the heterogeneous emotions that the paper of Xu and his colleagues¹ stirred up. Reading its title, we got excited, imagining a proposal of a new technique to perform hysteroscopy in “women with an intact hymen.”

Unfortunately, reading the article thoroughly, we felt very disappointed when we became aware that the technique proposed by the authors was no less than the vaginoscopic approach (no-touch technique), a well-recognized and widely used technique since the beginning of the 1990s.²

Several studies have already demonstrated that the vaginoscopic approach is effective, reduces patient discomfort, and increases the possible applications of hysteroscopy, being ideal in patients who otherwise might require general anesthesia, such as older women with somewhat stenotic vaginas and virgin patients.^{2–4}

The vaginoscopic approach together with technical and instrumental improvements has significantly increased the feasibility and acceptability of hysteroscopy, allowing the performance in outpatient settings of some minor and major

procedures (e.g., see-and-treat hysteroscopy) that otherwise would require general anesthesia, cervical dilatation, and the use of the wider resectoscope.⁵

We would expect that Xu et al would treat intrauterine pathologies in such virgin patients using the new minihysteroscopes with mechanical or bipolar 5F or 7F instruments and without general anesthesia,⁵ maybe with some specific tricks related to the presence of an intact hymen.

Nothing of that was described in the paper, with all the 14 reported hysteroscopies performed under general anesthesia using a classic vaginoscopic approach and a 4.5-mm hysteroscope, replaced by a wider 6.5- or 8-mm operative hysteroscope when intrauterine lesions had to be removed.

Apart from the "maneuvers for a successful procedure," which may facilitate the access to the external uterine ostium and cervical canal in a virgin patient, nothing of the described "surgical procedure" seemed to represent an innovation worthy to be followed when a virgin patient has to undergo an operative hysteroscopy.

In particular, we were really surprised about the possibility of introducing an 8-mm resectoscope into the cervical canal without mechanically dilating it. Whereas Xu and his colleagues propose the preoperative use of rectal misoprostol to soften the cervix, anyone who performs operative hysteroscopies knows the extreme difficulty in entering the internal cervical os with an 8-mm instrument in a cervical canal of a nulliparous patient, which has a diameter varying from 4 to 5 mm; the moreso when an intact hymen prevents the possibility of performing wider movements!

In conclusion, we are firmly convinced that office hysteroscopy with minihysteroscopes and vaginoscopic approach should always represent the first-line approach to a virgin patient who requires endoscopic investigation of the uterine cavity. The 5F or 7F mechanical and bipolar instruments might offer the possibility to perform biopsies and to treat most of the intrauterine pathologies simultaneously.

According to our experience, the use of the resectoscope should be reserved only for such intrauterine pathologies that cannot be treated with 5F or 7F instruments (i.e., myoma > 2 cm).⁵

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doi:10.1016/j.jmig.2006.06.031

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Response:

Thank you very much for taking the time to review and comment on our article. We welcome all comments and criticism, although in this technique we are in nearly complete agreement with your opinion. Small differences are likely the result of varying surgical experiences and skills in accomplishing the same goal.

In fact, the technique proposed by us was similar to the vaginoscopic approach (no touch technique).¹ However, our procedure is not the same as that previously reported:^{1–3}

1. All of our patients were women with an intact hymen.
2. We carried out not only the diagnostic, but also the operative hysteroscopy.
3. We employed hysteroscopes with a diameter ranging from 4.5 mm to 8 mm.
4. The main goal of our procedure was to preserve the intact hymen under the special cultural background in China.
5. We did some preoperative preparation, such as using misoprostol to soften the cervix.
6. We used the loop-electrode to curette the thickened endometrium mechanically to control uterine hemorrhage in women with dysfunctional uterine bleeding.

According to our experience, general anesthesia is required, because virgin patients are too nervous to cooperate with doctors without general anesthesia during the procedure, which may cause possible injury of the intact hymen.

In our study, because of the preoperative use of misoprostol and the persistent uterine bleeding, it is less difficult to introduce a 6.5-mm or 8-mm hysteroscope into the cervical canal without mechanically dilating it.

We hope these explanations will further assist with adopting this technique.

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doi:10.1016/j.jmig.2006.07.005

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Outpatient hysteroscopy: traditional *versus* the ‘no-touch’ technique

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Objective To assess whether outpatient hysteroscopy using the ‘no-touch’ technique confers any advantages in terms of patient discomfort over the traditional technique.

Design Prospective randomised controlled study.

Setting Outpatient hysteroscopy clinic in a large university undergraduate teaching hospital.

Population All women referred for outpatient hysteroscopy in a 12-month period.

Interventions Women were randomised to undergo either traditional saline hysteroscopy requiring the use of a speculum and tenaculum, or a ‘no-touch’ vaginoscopic hysteroscopy which does not require a speculum or tenaculum. Each group was further subdivided to have hysteroscopy with either a 2.9-mm or 4-mm hysteroscope. Patients were asked to complete pre- and postprocedure questionnaires ranking pain scores.

Main outcome measures The relative success of each of these techniques, requirement for local anaesthetic and pain scores at different times during the hysteroscopy were recorded at the end of the procedure. The time taken to carry out each procedure was also measured.

Results One hundred and twenty women were recruited in this study: 60 were randomised to traditional hysteroscopy and 60 to ‘no-touch’ hysteroscopy. The overall success rate for hysteroscopy was 99%. There was no significant difference in the requirement for local anaesthetic between the two groups, but those who underwent ‘no-touch’ hysteroscopy with a 2.9-mm hysteroscope had the lowest requirement of local anaesthetic (10% compared with 27% in the no-touch hysteroscopy with a 4-mm hysteroscope group). The time taken to perform hysteroscopy and biopsy was significantly shorter with ‘no-touch’ hysteroscopy (5.9 *vs* 7.8 min; difference 1.9, 95% CI 0.7–3.1). There were no differences in pain scores between the groups at different times during hysteroscopy.

Conclusions ‘No-touch’ or vaginoscopic hysteroscopy is significantly faster to perform than the traditional technique. Although there was no difference in pain scores between the two techniques, local anaesthetic requirements were least in those who underwent ‘no-touch’ hysteroscopy with a narrow bore hysteroscope.

INTRODUCTION

Hysteroscopy is widely accepted to be the gold standard for direct visualisation of the endometrial cavity. The most common indications are abnormal uterine bleeding and subfertility. It has been shown to be well tolerated as an outpatient procedure with a high success rate.¹ However, one of the most common reasons for failure is pain, especially during introduction of the hysteroscope, and this can occur even if local anaesthesia is used. Pain may arise as the cervix is dilated with the hysteroscope, or when the uterine walls are distended with the distension medium.

Anaesthetic requirements tend to be greater in nulligravid and postmenopausal women. The rate of local anaesthetic use is around 30% with the use of traditional hysteroscopic techniques.^{1,2}

A variety of refinements have been tried to improve tolerability of the procedure. Local anaesthetic has been used in the form of either intracervical or paracervical instillation, or topically with a gel or spray, often with conflicting results. Intracervical local anaesthetic was found to be no more effective than placebo in a study involving 100 women.³ Two randomised studies of paracervical anaesthesia reached opposite conclusions about the efficacy of the preparation to reduce pain in postmenopausal women.^{4,5} Lignocaine spray to the cervix has been compared with placebo and failed to show any significant difference in pain scores for hysteroscopy, the only benefit being reduction in pain as the cervix was grasped.⁶ Local anaesthetic cream, local anaesthetic gel and placebo, all applied to the cervix, resulted in significantly less pain than treatment with placebo,⁷ but local anaesthetic gel alone was not found to confer any benefit to outpatient hysteroscopy.⁸

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Large diameter hysteroscopes have been compared with narrower scopes in terms of tolerability and accuracy in evaluating the endometrium. Narrow hysteroscopes reduce pain while giving equally satisfactory views of the endometrial cavity with lower failure rates and fewer incidences of vasovagal side effects compared with standard 4 mm hysteroscopes.^{9–11}

A vaginoscopic or 'no-touch' approach to hysteroscopy has been described, avoiding the need to introduce a vaginal speculum and tenaculum to expose and grasp the cervix.^{11–14} We have conducted a randomised controlled trial to ascertain whether there was a true difference in the discomfort of outpatient hysteroscopy using this approach compared with the traditional technique, and whether this led to a difference in the need for local anaesthesia.

METHODS

Ethical approval for this study was obtained from the Royal Free Hospital Local Research Ethics Committee (No. 6056). Women who attended for outpatient hysteroscopy were invited to take part. Following a detailed history,

the women were asked to complete a preprocedure questionnaire scoring their level of anxiety, concurrent abdominal pain and backache utilising a 10-cm visual analogue scale (0 = no symptoms, 10 = worst possible symptoms).

Following informed consent, the women were randomised to one of two groups:

Group 1: Traditional technique with speculum and tenaculum

Group 2: 'No-touch' technique

Both groups were further randomised to different size of hysteroscopes:

A: 4 mm 30° single-flow rigid hysteroscope (5 mm sheath)

B: 2.9 mm 30° single-flow rigid hysteroscope (3.7 mm sheath)

Randomisation was based on a computer-generated randomisation table, and was performed using opaque envelopes immediately prior to the hysteroscopy. The hysteroscopy was performed by one of seven operators attending the clinic each of whom had performed at least

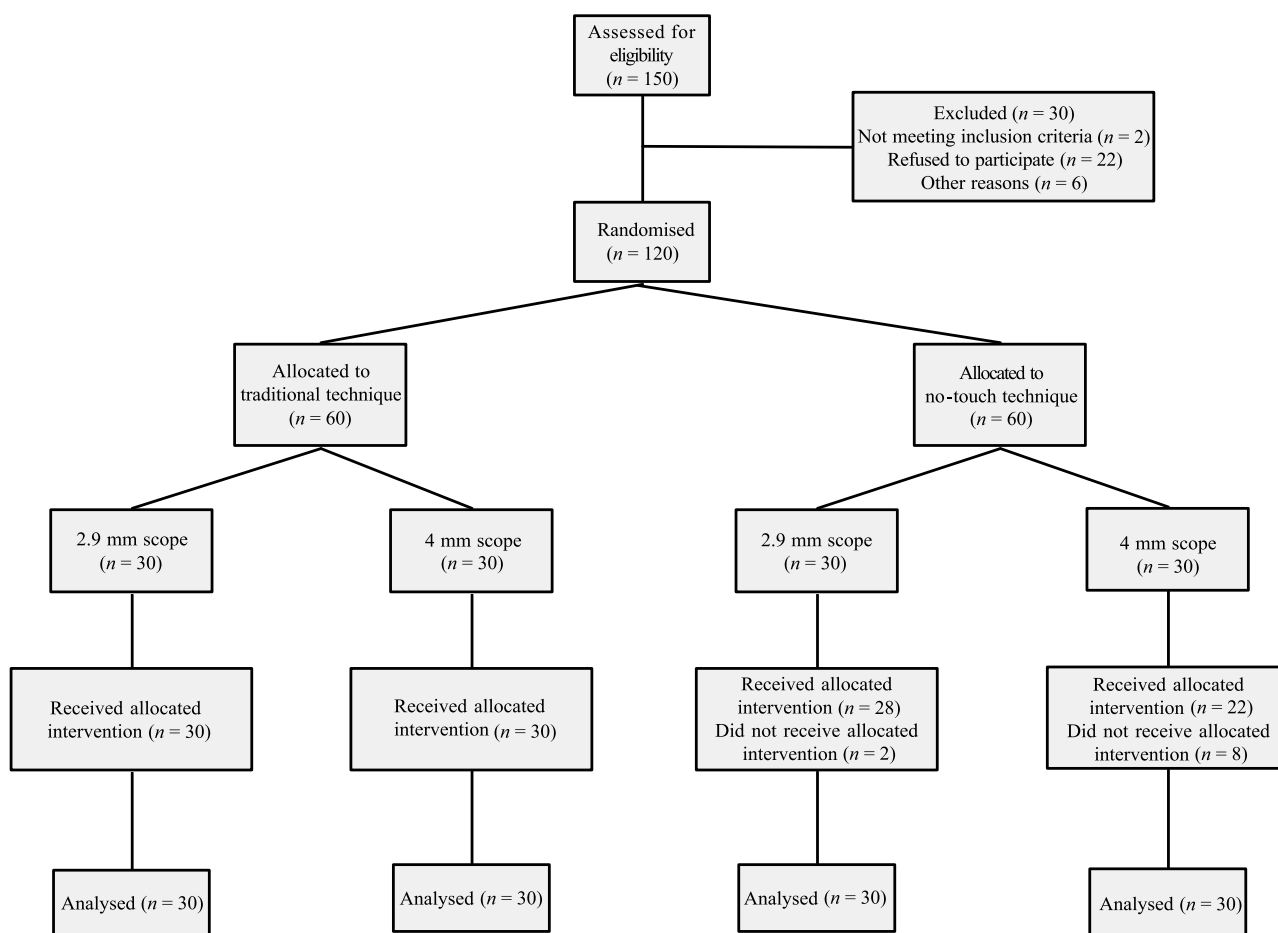


Fig. 1. Consort diagram.

Table 1. Patient characteristics. Data are mean [SD]; median (range) or number (%).

	Traditional technique (n = 60)	'No-touch' technique (n = 60)
Age (years)	45 [7.5]	43 [8.0]
Parity	2 (0–5)	2 (0–10)
Nulliparous/multiparous	18 (30)	20 (33)
Postmenopausal	9 (15)	6 (10)
Indications*		
Menorrhagia	35 (58)	36 (60)
Prolonged periods	10 (17)	5 (8)
Postmenopausal bleeding	9 (15)	5 (8)
Intermenstrual bleeding/ Postcoital bleeding	10 (17)	10 (17)
Subfertility	4 (7)	6 (10)
Miscellaneous indications	2 (3)	1 (2)

* Some patients had more than one indication for hysteroscopy.

20 traditional and 'no-touch' diagnostic hysteroscopies previously.

For the traditional technique, following a bimanual examination, a Collins bivalve speculum was inserted into the vagina to expose the cervix. The anterior cervical lip was grasped with Littlewood's forceps. The cervical canal was only dilated if it was judged to be too narrow to admit the hysteroscope. Intracervical local anaesthesia (2.2 mL of 3% prilocaine with felypressin 0.03 U/mL) was not given routinely but was available if requested by the patient. Hysteroscopy was performed using normal saline as the distension medium at a pressure of 150 mmHg, and was guided through the cervix making adjustments to allow for the angle of the optic.¹⁵ The uterine cavity and the endocervical canal were inspected in a systematic fashion. If an endometrial biopsy was required, a Pipelle de Cornier sampler was used.

For the 'no-touch' technique, following a bimanual examination, the hysteroscope was placed into the lower vagina and the normal saline was turned on at 150 mmHg pressure. The instrument was directed towards the cervix, and on identifying the external os, was introduced into the cervical canal and guided into the uterine cavity. The uterus was inspected as previously described before being

withdrawn. If an endometrial biopsy was indicated, a speculum was inserted to expose the cervix and the cervix was held with Littlewood's forceps. Cervical dilatation or intracervical local anaesthesia was only used if needed, in which case the hysteroscopy was converted to the traditional technique.

Success of the investigation (defined as adequate inspection of the canal and endometrial cavity) by the intended technique, and need for local anaesthesia were recorded. Other parameters assessed included the need for cervical dilatation and the duration of the procedure (defined as the interval between the vagina being instrumented to the time the last instrument was removed from the vagina). Patients were asked to complete a postprocedure questionnaire immediately following the investigation scoring their discomfort at various phases of the hysteroscopy [e.g. insertion of speculum (if used), local anaesthetic injection (if required), insertion of the hysteroscope, inspection of the uterine cavity, endometrial biopsy (if done), and immediately after and 30 min after hysteroscopy]. In addition, they were asked if they would recommend the procedure to a friend, if they would prefer general anaesthetic in future and how acceptable they found the procedure.

We used the need for local anaesthesia as our primary outcome measure. We hypothesised that with a no-touch technique only 10% of patients would require analgesia compared with the figure of 30% for the group who had traditional hysteroscopy.^{1,2} For the probability of a type 1 statistical error to be less than 0.05 and the probability of a type 2 statistical error to be less than 0.2, we calculated that we would need 60 patients in the traditional and 'no-touch' groups, respectively. Our secondary outcome measures included procedure time and the effect of hysteroscope size, but we made no attempt to power the study for these particular variables.

Analysis was by intention to treat. Data were analysed using Student's *t* test for continuous variables which were normally distributed, and the Mann–Whitney *U* test if they were not. Confidence intervals for difference in means were calculated for continuous variables if the distribution was normal. Relative risk and confidence intervals were calculated for nominal variables. All tests were two-sided and a result of $P < 0.05$ was considered statistically significant.

Table 2. Outcomes between traditional and 'no-touch' hysteroscopy. Data are number (%) except where indicated.

	Traditional technique	'No-touch' technique	Difference between means or relative risk	95% CI
Procedure time (min), mean (SEM)	7.8 (0.5)	5.9 (0.4)	1.9	0.7–3.1
Cervical dilatation	15 (25)	10 (17) [†]	0.8	0.4–1.3
Local anaesthetic	13 (22)	11 (18)*	0.9	0.6–1.5
2.9 mm optic	7	3		
4 mm optic	6	8		
Biopsy taken	42 (70)	40 (67)	1.1	0.8–1.3

* Eleven patients required local anaesthetic (one for biopsy only).

† These 10 patients were converted to traditional technique.

Table 3. Pain scores during hysteroscopy. Data are median (range). Comparisons are by Mann–Whitney *U* test.

	Traditional technique	'No-touch' technique	<i>P</i>
Insertion of hysteroscope	5 (0–10)	3 (0–9)	0.62
Hysteroscopic inspection	5 (0–10)	5 (0–10)	0.12
Speculum	3 (0–8)	3 (0–9)	0.84
Local anaesthetic	4 (0–6)	6 (2–9)	0.15
Biopsy	5 (0–9)	5 (0–10)	0.04
End of procedure	3 (0–10)	3 (0–10)	0.52
30 minutes after procedure	1 (0–8)	1 (0–9)	0.49

RESULTS

The flow of patients through the trial is shown in Fig. 1. Patient characteristics and indications for hysteroscopy are shown in Table 1. There were no significant differences in any demographic variables, preprocedural anxiety, stomach pains and backache scores. The outcomes for the two groups are shown in Table 2. Overall, 119/120 hysteroscopies (99%) were carried out successfully; only one hysteroscopy was judged to be non-diagnostic because of bleeding which obscured the hysteroscopic view. No-touch hysteroscopy was significantly quicker to perform. A fifth of patients required local anaesthesia during hysteroscopy with no statistical significance between treatment groups. The influence of optic size was not statistically significant, but women undergoing 'no-touch' hysteroscopy using a 2.9-mm hysteroscope had the lowest requirement for local anaesthesia (3 of 30, 10%) (Table 2).

Pain scores at various stages of the hysteroscopy are also shown in Table 3. The only statistically significant difference in pain scores between the two main groups at any phase of the hysteroscopy was in relation to endometrial sampling, which was more painful in the 'no-touch' group. Overall, the highest pain scores were for pain from local anaesthetic injections in women allocated to the no-touch group who had to be converted to the traditional technique (median score 6).

Ninety-three percent of our patients said that they would recommend this procedure to a friend who needed this investigation. Twenty-one percent of participants said that if they required hysteroscopy again they would prefer a general anaesthetic (15% with a 2.9-mm hysteroscope and 27% with a 4-mm hysteroscope, $P = 0.18$). Ninety-two percent of women found outpatient hysteroscopy very or fairly acceptable with no difference between the two groups.

DISCUSSION

This is the first randomised controlled trial to compare traditional hysteroscopy with the vaginoscopic or 'no-touch' approach. Our findings confirm that outpatient hysteroscopy is a successful procedure which is generally well

tolerated by patients. Although we have failed to demonstrate significant differences in pain for the 'no-touch' technique, we have shown that it is significantly quicker to perform. The advantage that the 'no-touch' technique was found to be about 25% quicker to perform is important for those patients who are anxious about undergoing what they consider to be an embarrassing procedure.

Our results are at considerable variance with the scant published data. In our study, only one patient scored zero for pain during the hysteroscopy, and one in six requested local anaesthesia. In contrast, in an observational study, Bettocchi and Selvaggi¹² reported that 96% of women undergoing vaginoscopic hysteroscopy reported no discomfort or pain, and none were given local anaesthesia. In that study, CO₂ was used as the distension medium, which typically causes more discomfort than fluid distension because of diaphragmatic irritation. It is difficult to explain the discrepancy between our results and that of the Italian study and we wonder if there are cultural reasons for these differences.

Nonetheless, the lack of advantage of 'no-touch' hysteroscopy in terms of the need for local anaesthesia was unexpected, both from the published literature and our prior clinical experience. We can think of three reasons for this. Firstly, based on our earlier studies,^{1,2} we expected 30% of women undergoing traditional hysteroscopy to require local anaesthesia, but in fact only 20% did so. As a result, our study was underpowered and we would have had to investigate 200 patients in each group to confirm that 'no-touch' hysteroscopy reduced this rate to 10%. Secondly, the finding that 'no-touch' hysteroscopy with the larger optic proved to be the most painful of all the techniques further compromised our study. Over 25% of patients required local anaesthesia, a rate quite different from the 10% with the narrow optic. It may be relevant that fewer women required cervical dilatation with the smaller hysteroscope. Our overall results were, therefore, distorted by including two sizes of hysteroscopes in this study. Although such a large effect of optic size was not expected, it is noteworthy that the surface area of the larger hysteroscope is almost twice as large as that of the narrower optic (19.64 mm² vs 10.756 mm²). Thirdly, we analysed our data by intention to treat, which means that the results for the no-touch group includes those who required conversion, whereas there was no similar conversion option for the traditional group. This aspect of our study was likely to dilute any real difference between the two techniques.

Similarly, there were no major differences in pain scores recorded by our patients. However, this finding is more difficult to interpret because of the use of local anaesthesia in some. What our data does confirm is that cervical injection remains the most painful part of outpatient hysteroscopy.

In summary, our study confirms that no-touch hysteroscopy is feasible in the majority of patients attending for outpatient hysteroscopy. We have found that 'no-touch' hysteroscopy was no less painful than when a traditional

technique is used but was significantly quicker by an average of 2 min. We did, however, find some evidence that the 'no-touch' approach is less uncomfortable when a narrow optic is used, and this deserves further study. Since completing this study, we have developed a device for obtaining an endometrial biopsy without the need for a vaginal speculum which is applied through the diagnostic sheath of the hysteroscope once the optic has been removed.¹⁶ It is anticipated that this will not only reduce the time taken for hysteroscopy and biopsy even further, but hopefully will also reduce the discomfort of the biopsy process.

Acknowledgements

The authors would like to thank Sisters Rosanne Spry and Bola Sota for their hard work and support throughout this study.

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Accepted 29 June 2004

Vaginoscopic versus traditional office hysteroscopy: a randomized controlled study

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BACKGROUND: A randomized, controlled study was performed to compare vaginoscopic versus traditional (speculum with or without tenaculum) hysteroscopy in terms of pain score and procedure time. **METHODS:** Three hundred patients were randomized in two groups: Group A, diagnostic hysteroscopy with vaginoscopic approach (150 patients) and Group B, diagnostic hysteroscopy with traditional approach (150 patients). All procedures were performed using a semi-rigid 3.5-mm minihysteroscope with a 0° grade optic. Patients of each group were divided into three subgroups according to their reproductive status: fertile nulliparous (FN), fertile multiparous (FM) and post-menopausal (MEN) women. Women were asked to rate their degree of pain during four phases of the procedure: introduction of hysteroscope (Group A) or speculum (Group B) into the vagina (Phase I) and progression through cervical canal up to internal uterine orifice (IUO) (Phase II), inspection of uterine cavity (Phase III) and performing of endometrial biopsy (Phase IV). A total pain score was calculated for each group. For each patient, the duration of hysteroscopy was recorded from the introduction to the extraction of the scope (Group A) or of the speculum (Group B). **RESULTS:** Although the median total pain scores were 2 in each group, the 95% confidence interval for vaginoscopic hysteroscopy (1.86–2.01) was significantly ($P < 0.05$) lower than that for traditional hysteroscopy (2.10–2.26). Comparison between the corresponding phases of the procedure showed the only significant difference during Phase I of the procedure [Group A: 1 (95% CI 1.0–1.18) versus Group B: 2 (95% CI 2.3–2.8); $P < 0.05$]. No significant differences in terms of duration of the procedure were observed between the two approaches. **CONCLUSIONS:** When surgeons using vaginoscopic hysteroscopy with a semi-rigid minihysteroscope were compared with those using traditional approach and the same instrumentation, the operating times and the patients' pain scores were similar.

Key words: pain score/procedure time/traditional hysteroscopy/vaginoscopic hysteroscopy introduction

Introduction

Hysteroscopy can be regarded as the *gold standard* for the evaluation of the uterine cavity and subsequent detection of intrauterine pathology.

It is a safe and simple procedure and, if it can be carried out successfully in an outpatient setting without anaesthesia, it would be an attractive practice.

Notwithstanding, the international literature suggests that outpatient hysteroscopy without any form of analgesia or anaesthesia is a well-tolerated procedure with a high success rate (Finikiotis, 1990; Nagele *et al.*, 1996; Lau *et al.*, 1999; De Iaco *et al.*, 2000; Kremer *et al.*, 2000; Cameron *et al.*, 2001; Yang and Vollenhoven, 2002)—in general, it continues to be considered an invasive and painful technique by most gynaecologists and patients.

Indeed, pain experienced during the procedure continues to represent the most common reason for failure, and this can

occur even if local anaesthesia is used (Marana *et al.*, 2001; Yang and Vollenhoven, 2002; De Angelis *et al.*, 2003; Sharma *et al.*, 2005).

Thus, pain continues to represent the main limiting factor to a large-scale use of office hysteroscopy (Campo *et al.*, 2005).

To minimize patient's discomfort and maximize the chance of success of the procedure and its widespread use, a new technique based on the employment of small-diameter rigid and flexible hysteroscopes and an atraumatic insertion technique (vagoscopic approach) has been developed. This technique has permitted complete elimination of any kind of premedication, analgesia or anaesthesia, making the procedure faster and complication-free (Bettocchi and Selvaggi, 1997; Campo *et al.*, 1999; Cicinelli *et al.*, 2003; Cicinelli, 2005).

Until now in all published studies, the vaginoscopic approach has been performed with different-sized standard rigid hysteroscopes (Bettocchi and Selvaggi, 1997; Paschopoulos *et al.*,

1997; Campo *et al.*, 1999; Cicinelli *et al.*, 2003; Pellicano *et al.*, 2003; Sharma *et al.*, 2005).

In the recent years, a semi-rigid 3.5-mm fibre-optic minihysteroscope (Versascope, Gynecare, Ethicon) has been developed. No studies comparing this semi-rigid hysteroscope with a standard rigid one of same size of pain score have been reported. However, our clinical experience and the technical features of semi-rigid hysteroscopes suggest that hysteroscopic procedures performed with this instrument might offer a better compliance.

However, the flat tip of the scope and the standard 0° angle of vision may interfere with cervical penetration and cavity exploration (Cicinelli, 2005).

The aim of this prospective, randomized, controlled study was to compare surgeons and hysteroscopic methods (vaginoscopic and traditional approach), using this new semi-rigid hysteroscope, to assess whether vaginoscopic approach is associated with a lower pain score without any increase in procedure time.

Materials and methods

The protocol of the study was approved by our Institutional Review Board, and the study was conducted according to the guidelines of the Declaration of Helsinki (1975). Patients' flow chart is shown in Figure 1.

From February 2003 to November 2004, all patients who were referred to the Unit of Hysteroscopy of the Department of Obstetrics were asked to participate in a study on two different approaches of diagnostic hysteroscopy. Three hundred and eighty-five patients were

considered eligible for the study. Three hundred and twenty-two patients accepted to participate, with 22 of these refusing the randomization process, thus leaving a population of 300 patients who were included in this randomized trial (Figure 1).

Before entering the study, the purpose of the study was clearly explained to women attending our Unit of Hysteroscopy, and a printed explanatory consent form was signed and obtained by all subjects enrolled.

Indications for hysteroscopy included abnormal uterine bleeding, increased endometrial thickness at ultrasound, suspect of endometrial polyp, myoma or carcinoma, endocervical polyp and repeated spontaneous abortion or unexplained infertility. The contraindications were the presence of active infection of the genital tract, cervical cancer, heavy bleeding, severe cardiovascular disease and suspected pregnancy.

The primary outcome measure was the median pain score. On the basis of the existing literature (Sharma *et al.*, 2005) and our preliminary results, a sample of 100 patients in each group would provide 90% power to detect a difference of 25% in the median pain score during all phases of the procedure with significance level of 5%, assuming a baseline value of 2 and given that the expected SD in the pain scores would be 0.67 pain score units.

All patients were prospectively randomized and divided into two groups consisting of 150 patients each. Randomization was achieved with sealed envelopes containing computer-generated random numbers in blocks of 6.

Randomization and recruitment to the study were carried out independently of the clinician who later performed the hysteroscopy.

Patients in Group A were subjected to vaginoscopic hysteroscopy, whereas patients in Group B underwent traditional hysteroscopy for scope introduction into the external uterine orifice (EUO).

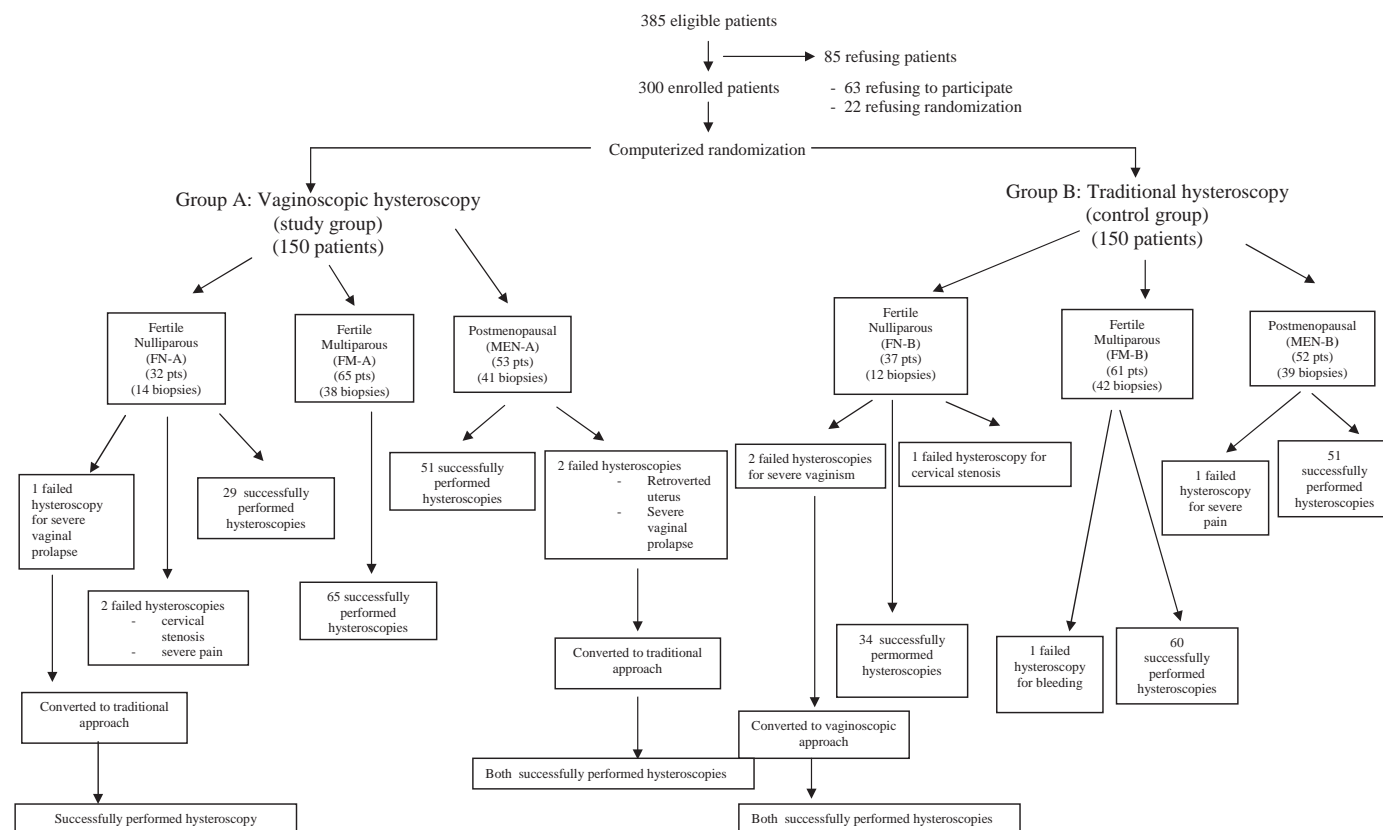


Figure 1. Patients' enrolment and randomized assignment.

Vaginoscopic technique

The technique avoids the need to introduce a speculum and a tenaculum; the vagina, being a cavity, can be distended by introducing the distension medium through the hysteroscope placed into the lower vagina; the anatomy can then be followed by gentle movements of the instrument towards the cervix and cervical canal.

Traditional technique

A speculum is inserted in the vagina to visualize the cervix, and a tenaculum (if required) is applied to the anterior lip of uterine cervix to create counter-traction and to facilitate the insertion of the optic.

Patients of each group were divided into three subgroups based on their reproductive status: fertile nulliparous (FN), fertile multiparous (FM) or post-menopausal (MEN). Patients from Group B were considered as control group.

Women were considered 'fertile' if they were in the period of their life lasting from the menarche to the menopause.

Hysteroscopy was performed using a 3.5-mm minihysteroscope (Versascope, Gynecare, Ethicon, Sommerville, NJ, USA) with a 0° grade optic. Illumination was provided by a 250-W Xenon light source. The images were viewed on a high-resolution colour monitor using one-chip camera, and unusual lesions were recorded by video. Normal saline was used for uterine distension and was instilled from a flexible 500-ml bag wrapped in a pressure cuff connected to a manometer and pumped up to 80–120 mmHg.

No pharmacological preparations or local anaesthetics were administered before the examination. Women in whom vaginoscopic approach failed underwent traditional hysteroscopy; women in whom traditional approach failed underwent vaginoscopic approach; and women in whom both approaches failed were planned for hysteroscopy under general anaesthesia.

The endometrial surface was inspected systematically, and the tubal ostia were identified. The hysteroscope was then pulled back towards the internal uterine orifice (IUO) to obtain a panoramic view of the whole cavity.

If indicated, endometrial biopsy tissue was taken with the biopsy forceps under direct visualization. When indicated, two or three biopsies for each patient were performed. The endocervical canal was inspected during withdrawal of the hysteroscope.

All vaginoscopic hysteroscopies were performed by the most experienced operators (A.D.S.S., M.P. and S.B.) for vaginoscopic technique. Similarly, traditional hysteroscopies were performed by operators with most experience on using this technique (G.A., M.G. and R.P.).

Operative time was recorded from the introduction to the extraction of the scope (Group A) or of the speculum (Group B).

Women were asked to rate their degree of pain during four phases of the procedure: introduction of hysteroscope (Group A) or speculum (Group B) in vagina (Phase I), progression through cervical canal up to IUO (Phase II), inspection of uterine cavity (Phase III) and performing of endometrial biopsy (Phase IV). A second operator (G.B.), next to the patient, quizzed the patient during the procedure.

During the different phases of hysteroscopy, patients were asked to record their degree of pain with a visual analogue scale (VAS). Specifically, pain sensation was scored on a scale of 1 to 5, indicating 1 = no pain, 2 = slight pain, 3 = tolerable pain, 4 = severe pain and 5 = intolerable pain (Guida *et al.*, 2003).

A total pain score was calculated considering all the individual pain score values in all phases of the procedure for each group.

Statistical analysis was performed using the SPSS 9.0 (SPSS, Chicago, IL, USA).

The Shapiro–Wilk's test was performed to evaluate data distribution of all variables. Age, weight, parity, uterine size and procedure

time showed a normal distribution, and differences between groups were evaluated by two-tailed Student's *t*-test for independent data. Differences in pain score between the groups were calculated by Mann–Whitney *U*-test. Statistical significance was set at $P < 0.05$.

Results

No significant differences in age, weight, uterine size and parity between patients of Groups A and B (Table I) were observed. Patients' allocation and randomization are shown in Figure 1.

No major adverse events were recorded during hysteroscopies performed.

Hysteroscopy failed in five patients, and an additional five patients had to undergo an alternate hysteroscopy to the one they were assigned. These 10 patients were excluded from the statistical analysis. For further details, please refer to Figure 1.

Directed biopsies were performed in 14 FN-A patients, 38 FM-A patients, 41 MEN-A patients, 12 FN-B, 42 FM-B and 39 MEN-B patients.

Data on pain score in Groups A and B are shown in Figure 2.

Primary analysis showed that although the median total pain scores were two in both Groups A and B, the 95% confidence interval for vaginoscopic hysteroscopy (1.86–2.01) was significantly ($P < 0.05$) lower than that for traditional hysteroscopy (2.10–2.26).

The secondary analysis of corresponding phases showed a significantly higher pain score during Phase I in Group B in comparison with Group A [2 (2.3–2.8 95% CI) versus 1 (95% CI 1.0–1.18), $P < 0.05$], whereas no significant differences were detected during the Phases II, III and IV (median pain score 2 in all phases of both groups) (Figure 2).

In subgroup analysis, we observed a trend to have lower pain score values during Phase I in FN [1 (0.9–1.2 95% CI) versus 2 (1.7–2.9 95% CI)] and MEN women [1 (1.1–1.4 95% CI) versus 3 (2.1–2.6 95% CI)] undergoing vaginoscopic hysteroscopy.

The time required for the procedures is summarized in Table II. Regardless of the hysteroscopic approach, the duration of the procedure was significantly longer ($P < 0.001$) in patients who underwent endometrial biopsy. However, no statistically significant differences in procedure time were detected between Groups A and B, irrespective of whether endometrial biopsies were performed or not.

In subgroup analysis, we observed a trend of reduction in time procedure in FN and MEN women undergoing vaginoscopic approach, and in FM women undergoing traditional approach.

Table I. Patient's characteristics

Characteristic	Group A (vaginocopy)	Group B (traditional)	Significance
Age (years)	43 ± 14.6	40 ± 15.6	Not significant
Weight (kg)	69.7 ± 14.8	72.2 ± 13.7	Not significant
Uterine size (hysterometry) (cm)	7.6 ± 2.1	7.9 ± 3.4	Not significant
Parity	1.5 ± 0.7	1.3 ± 0.8	Not significant

All values are mean ± SD.

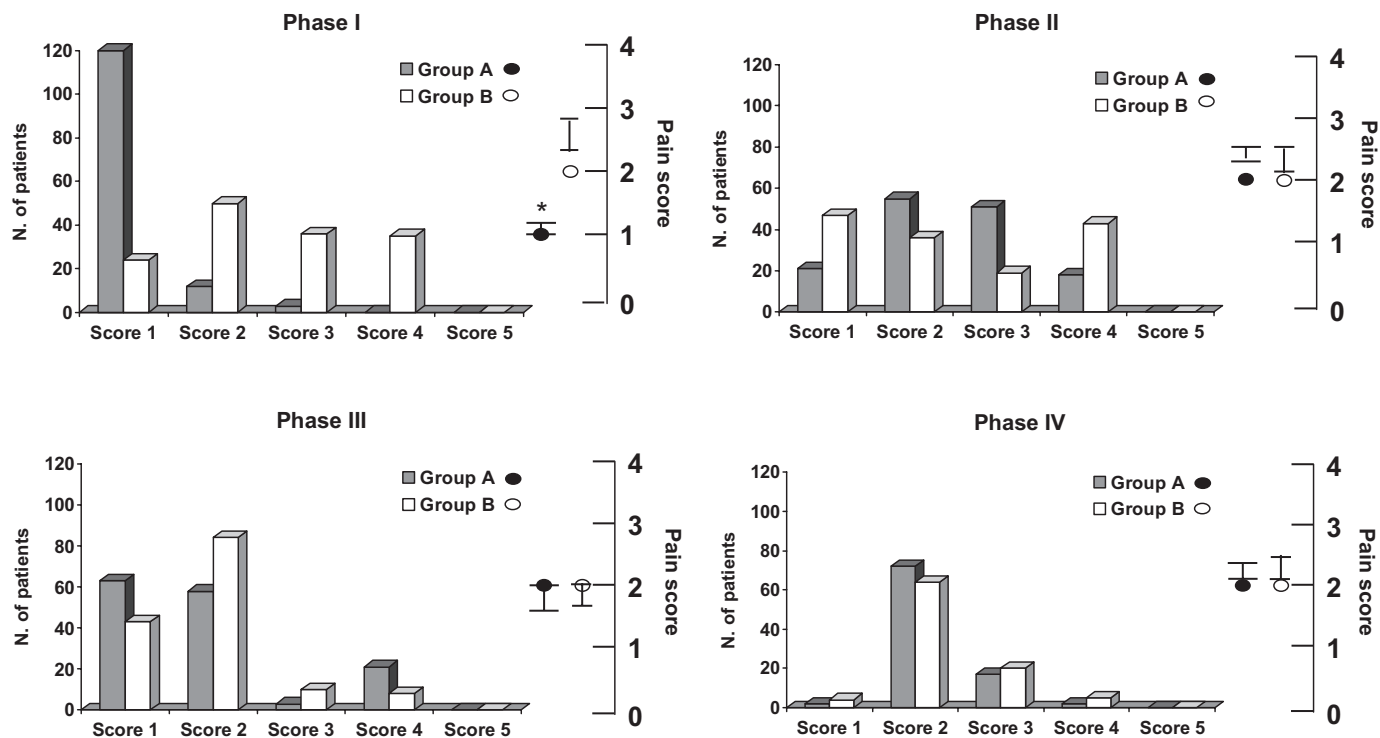


Figure 2. Pain score distribution in Groups A and B. The number of patients for each phase (left side) and median pain score with 95% confidence interval (right side) are shown in each graphic. Group A, vaginoscopic group and Group B, traditional group. Phase I: introduction of hysteroscope (Group A) or speculum (Group B) in vagina; Phase II, progression through cervical canal up to internal uterine orifice; Phase III, inspection of uterine cavity and Phase IV, performing of endometrial biopsy. Pain sensation was scored on a rank scale ranging from 1 to 5, indicating 1 = no pain, 2 = slight pain, 3 = tolerable pain, 4 = severe pain and 5 = intolerable pain. * $P < 0.05$ versus Group B.

Table II. Duration of procedure

Groups	Number of patients	Procedure time \pm SD (s)
A	145	273.29 \pm 68.87
B	145	269.11 \pm 62.48
A without biopsy	54	215.08 \pm 57.82
B without biopsy	55	214.56 \pm 46.14
A with biopsy	91	308.97 \pm 49.86
B with biopsy	90	302.55 \pm 45.31
A + B with biopsy	181	305.75 \pm 47.62*
A + B without biopsy	109	214.83 \pm 52.08
FN-A with biopsy	13	291.70 \pm 33.20
FM-A with biopsy	38	322.10 \pm 54.11
MEN-A with biopsy	40	302.40 \pm 48.02
FN-B with biopsy	11	317.68 \pm 45.80
FM-B with biopsy	41	281.08 \pm 38.80
MEN-B with biopsy	38	322.21 \pm 41.28
FN-A without biopsy	16	199.20 \pm 42.0
FM-A without biopsy	27	233.25 \pm 58.02
MEN-A without biopsy	11	199.85 \pm 69.20
FN-B without biopsy	23	221.68 \pm 45.20
FM-B without biopsy	19	193.04 \pm 46.21
MEN-B without biopsy	13	231.25 \pm 38.24

Group A, vaginoscopic approach; Group B, traditional approach; FN, fertile nulliparous women; FM, fertile multiparous women; MEN, post-menopausal women.

* $P < 0.001$ versus A + B without biopsy.

Discussion

Nowadays office hysteroscopy represents the gold standard technique for intrauterine diagnostic evaluation. The main limitation to

its widespread use is higher pain and lower patients' compliance in comparison with other less invasive diagnostic tools (i.e. ultrasonography).

In recent years, the reduction of hysteroscope calibre, the rare need for anaesthetics or analgesia and the introduction of vaginoscopic technique have significantly improved patients' compliance to hysteroscopy. Furthermore, according to several authors (Campo *et al.*, 1999; Cicinelli *et al.*, 2003; Pellicano *et al.*, 2003), vaginoscopic approach for hysteroscopy avoids the need for any premedication and renders the procedure faster with a very low rate of complications.

The aim of this study was to compare surgeons and hysteroscopic methods (vaginoscopic and traditional approach) using a semi-rigid mini-hysteroscope to verify whether vaginoscopic approach is associated with better compliance without expansion of the procedure time.

A serious limitation to this study was that the two hysteroscopic techniques were performed by different operators. This was because vaginoscopic approach is a relatively recent technique; therefore, it was not possible to select an operator with identical skills in the two techniques at our institute. Three operators with the highest skill were selected for carrying out the vaginoscopic technique. The skill level was based on the number of hysteroscopies performed, years of placement at the hysteroscopic unit and the frequency of visits to foreign centres in which vaginoscopy was routinely performed. Similarly, three operators deemed to have the highest skill in the traditional technique were also selected. This

ensured that the bias related to inter-operator differences was at its lowest level possible.

Data obtained showed that even if the median total pain scores were similar in both groups, the 95% confidence interval for the vaginoscopic group was significantly lower than that for the traditional group.

However, this difference, although statistically significant, was not clinically important. Indeed, as the mid-points of the 95% confidence interval ranges are 1.94 for vaginoscopic hysteroscopy and 2.18 for traditional hysteroscopy, that 0.24 difference between the two groups accounts for just over 4% of the range in the pain score from 1 to 5 and therefore cannot be clinically important.

In subgroup analysis, we observed a trend to have lower pain score values during Phase I in FN and MEN women undergoing vaginoscopic hysteroscopy, a finding that may be worth testing in a subsequent larger randomized controlled trial.

These data could be particularly relevant considering that patients undergoing hysteroscopy are often very anxious; so lowering the pain sensation in Phase I of this procedure could contribute to a better performance mainly in those patients (nulliparous and old women) who might otherwise require local or general anaesthesia (Bettocchi and Selvaggi, 1997).

No significant differences of duration of procedure were detected between the two hysteroscopic approaches.

In subgroup analysis, we observed a trend of reduction in time procedure in FN and MEN women undergoing vaginoscopic approach and in FM women undergoing traditional approach. These data might be tested in a subsequent larger randomized controlled trial.

These data are in disagreement with those of other authors (Sharma *et al.*, 2005), who have recently demonstrated that vaginoscopic hysteroscopy with either a 2.9-mm or a 4-mm 30° scope is significantly quicker to perform than the traditional technique independent of the reproductive status of patients.

However, our data can be explained by the fact that the use of a 0° hysteroscope that lacks foreblique viewing makes it more difficult and subsequently longer for the operator to detect and to get through the OUE, especially in cases of very anteverted or retroverted uteri.

In conclusion, our data demonstrate that when surgeons using vaginoscopic hysteroscopy with a semi-rigid minihysteroscope were compared with those using traditional approach and same instrumentation, the operating times and the patients' pain scores were similar. Further studies comparing rigid and semi-rigid hysteroscopes with vaginoscopic approach are needed to better evaluate the real impact of vaginoscopic approach on patients' compliance.

Acknowledgements

The authors thank Dr G. A. Tommaselli, Dr F. Farina and Dr C. Alviggi for their statistical counselling and to the midwife R. Perfetto for her continuous support during this work.

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Submitted on May 22, 2006; resubmitted on June 24, 2006; accepted on June 28, 2006

CHAPTER IV

TRADITIONAL TECHNIQUES OF “SEE AND TREAT” HYSTEROSCOPY (1995- 2006)

With ongoing developments in the field of hysteroscopy during the last fifteen years, hysteroscopic surgery is becoming safer and less invasive for the patient. Improved technology has enabled us to perform many operative procedures in an office setting without significant patient discomfort and with potentially significant cost savings.

The rationale assuring that most of these procedures can be performed easily without use of analgesia or anaesthesia lies in the anatomical characteristics of the uterus; indeed, the sensitive innervations of the uterus (**Fig.1**) starts from the myometrium out, while the endometrium and any fibrotic tissue present are not sensitive.

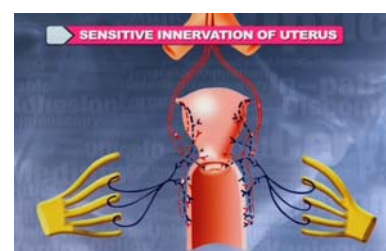


Fig.1

✓ ENDOMETRIAL BIOPSY

The standard technique of biopsy traditionally used is defined as a “punch” biopsy (**Fig.2**), where the biopsy forceps bite into the endometrium, and are then closed. The mucosa remains inside the jaws and partially around them. The instrument is then extracted through the operative channel while the hysteroscope remains inside the uterine cavity. However,



Fig.2



Fig.3

the instrument is then extracted through the operative channel while the hysteroscope remains inside the uterine cavity. However, during the process of extracting the instrument, due to the small diameter of the operative channel, the surrounding material is shaved away from around the tip (**Fig.3**). Thus the final amount of tissue to be sent to the pathologist is strictly related to the internal volume of the two jaws of the forceps, which very often results in an inadequate amount of tissue for histological diagnosis.

In order to routinely collect enough endometrium for a correct histological examination, Bettocchi modified such technique by proposing the so-called “grasp biopsy” (**Fig.4**). The biopsy forceps are placed with the jaws open, against the endometrium to be biopsied; they are then pushed into the tissue and along it for around 0.5-1cm, avoiding contact with the muscle fibers.



Fig.4

Once a large portion of mucosa has been detached, the two jaws are closed and the whole hysteroscope is removed from the uterine cavity, without pulling the tip of the instrument back into the channel. In this way, not only the tissue inside the forceps jaws but also the surrounding tissue protruding outside the jaws can be retrieved, thus providing the pathologist with a large amount of tissue. Even in patients with endometrial carcinoma, this surgical technique makes it possible to collect enough endometrium (also including its deeper layers) for a correct histological examination (**A. Di Spiezio Sardo, M. Guida, G. Bifulco, M. Borriello, C. Nappi. Could office endometrial biopsy be accurate as EBHR for assessing the preoperative tumor grade? Eur J Surg Oncol. 2007;33(8):1047-8.**)



Fig.5

7Fr instruments has the notable advantage of a wider opening and an increased volume for collected tissue



Fig. 6

(**Fig.5**). Among 5Fr instruments, the grasping forceps with teeth (even called “**crocodile**” forceps) (**Fig.6**) are preferred to spoon biopsy ones as they can collect a larger amount of tissue thanks to the double length of the two jaws and the presence of small teeth on both sides of the jaws to keep hold of the material obtained.

When the endometrium is atrophic and an atypical area needs to be biopsied, bipolar electrodes



Fig.7

might be used (**Fig.7**). The technique consists of drawing with the electrode a sort of square surrounding the target area; the sub-myometrial tissue is then identified and partially cut, allowing grasping forceps with teeth to remove the atypical area.

✓ POLIPECTOMY



Fig.8

Small endometrial and cervical polyps (< 0.5 cm) are preferably removed using 5Fr or 7Fr mechanical instruments such as sharp scissors and/or grasping forceps (**Fig.8**), primarily for cost reasons.

For endometrial polyps the technique consists of grasping its base with open jaws, to close them and to gently push toward the uterine fundus(**Fig. 9**)

Cervical polyps, however, have to be treated with sharp scissors because of their fibrotic base, which precludes the use of grasping forceps, which could leave some well-vascularized tissue (the base of the polyp) that can result in regrowth of the polyp.

Larger endometrial polyps require different techniques, according to the relation between polyp and internal uterine ostium sizes.



Fig.9

The polyps could be removed intact only if the internal uterine ostium is wide enough for their extraction. The base of the polyp might be cut with scissors or better by using a Versapoint twizzle electrode (**Fig. 10**). An alternative is presented by adopting the



Fig. 10

same technique used for smaller polyps, repeating it several times up to the detachment of the polyp from its base in the myometrium.

When the endometrial polyp has a larger size than the internal uterine ostium it cannot be removed intact otherwise its extraction might represent an arduous and lengthy process with low patient's satisfaction. These polyps have to be

sliced with the Versapoint twizzle electrode from the free edge to the base into two/three fragments, large enough to be pulled out through the uterine cavity using 5 Fr crocodile forceps or 7 Fr grasping forceps(**Fig.11**)



Fig.11

To remove the entire base of the polyp without going too deep in the myometrium, in some case the electrode can be bent by 25-30°, enough to obtain a hook electrode.

The bending of the electrode may be obtained by pushing it against the cervix or by the operator's finger and then introducing the hysteroscope in the uterine cavity with the electrode's tip just outside the operating channel. Large cervical polyps (> 0.5cm) usually require the Versapoint twizzle electrode to cut their fibrotic base.

✓ MYOMECTOMY

A technique similar to polypectomy is applied on totally intracavitary myomas (< 1.5cm) with the difference that, due to their higher tissue density, they are first divided into two half-spheres and then each of these is sliced (**Fig.12**) as described for polyps. Particular attention has to be paid in case of partially intramural myomas. To avoid any myometrial stimulation or damage of the surrounding healthy myometrium, the myoma is first gently separated from the pseudo-capsule using mechanical instruments (grasping forceps or scissor)



Fig.12

or the bipolar electrode in a mechanical way, as already described for “cold loop” resectoscopic myomectomy . Once the intramural section becomes intracavitary, it is then sliced with the Versapoint Twizzle electrode. Recently, this surgical techniques have been amply described by Attilio Di Spiezio Sardo and coll in a late review. (**A. Di Spiezio Sardo, I. Mazzon, S. Bramante, S. Bettocchi, G. Bifulco, M. Guida, C. Nappi Hysteroscopic myomectomy: a comprehensive review of surgical techniques. Hum Reprod Update, 2007: 1–19**).

Besides, Bettocchi, Attilio Di Spiezio Sardo and coll, have recently provided several evidences suggesting that submucous myomas should be always treated, independently on the presence of associated symptomatology. (**S. Bettocchi, C. Siristatidis, G.**

Pontrelli, A. Di Spiezio Sardo, O. Ceci, L. Selvaggi. The destiny of myomas: should we treat small submucous myomas in women of reproductive age? *Fertil Steril* 2007; 90(4): 905-910)

✓ METROPLASTY

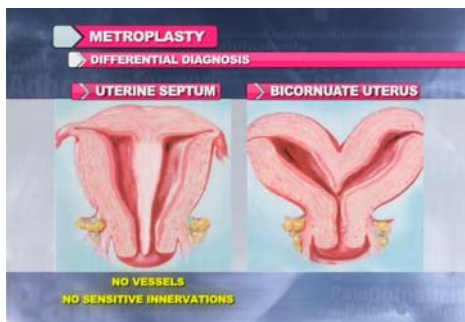


Fig.13

Recently Bettocchi and his colleagues (S. Bettocchi, O. Ceci, L. Nappi, G. Pontrelli, L. Pinto, M. Vicino. Office hysteroscopic metroplasty: Three “diagnostic criteria” to differentiate between septate and bicornuate uteri. *JMIG* 2007; 14: 324–328; Letter to the editor. *JMIG* 2008; 15(1): 125-6) have identified three diagnostic criteria to make a differential diagnosis

between bicornuate and septate uterus allowing a safe and effective office metroplasty without prior assessment of the true anatomy of the uterus. Such distinction (**Fig.14**) arises from the observation that the uterine septum, due to its fibrotic nature, is whitish, with no vessels and no sensitive innervations, while the wall of a bicornuate uterus, due to its muscle fibers, is pinkish, rich with vessels and with sensitive nerve terminals. Thus, when a double uterine cavity is diagnosed at hysteroscopy, the resection of the supposed septum should be started in its middle portion by means of sharp scissors or Versapoint twizzle electrode (mostly if bent!) and continued until the three septate uterus diagnostic criteria are present. On the contrary, the resection should be discontinued when at least two of the bicornuate uterus diagnostic criteria become evident.

✓ INTRAUTERINE ADHESIOLYSIS

Intrauterine adhesions, particularly those that are focal and thin can be easily divided in the middle with sharp hysteroscopic scissors. Whether diffuse or firm, the Versapoint twizzle electrode may be a valuable tool.

✓ CERVICAL ADHESIOLYSIS

Fibrotic processes may involve the external cervical ostium as well as the internal uterine ostium, thus resulting in a reduction of the cervical canal's diameter.

Indeed, in a recent revision of 5000 ambulatory hysteroscopies, performed at a Teaching Hospital Base, the authors demonstrated that cervical stenosis represents one of the principle causes of failed hysteroscopies (**A. Di Spiezio Sardo, A. Taylor, P. Tsirkas, G. Mastrogamvrakis, M. Sharma, A. Magos. Hysteroscopy: a technique for all? Analysis of 5.000 outpatient hysteroscopies. Fertil Steril 2008; 89(2):438-43**) The knowledge of the available techniques to treat such stenosis represents the pre-requisite to reduce the number of failed hysteroscopies. No sensitive nerve terminals or blood vessels have been demonstrated on the white fibrous tissue, thus allowing the use of 5-Fr or 7-Fr mechanical instruments.



Fig.15

The fibrotic ring may be cut at two or three point by using sharp scissors or may be stretched by grasping forceps first inserted within it with the jaws closed and then gently opened. (**Fig. 15**)

The criteria used to differentiate between septate and bicornuate uterus may help the operator to distinguish between fibrotic tissue and muscle and mucosa, thus avoiding the possibility to create a

false passage. The section of severe stenosis of the external cervical ostium may be also performed by means of a radial incision with the Versapoint Twizzle electrode. This technique allows to increase or even, in some cases, to create a point of access to the cervical canal.(**Fig.16**)



Fig.16

✓ HYSTEROSCOPIC STERILIZATION

Currently, one of the most widely used method of hysteroscopic sterilization is the Essure (**Fig.17**) system, that involves placement of a foreign object in the horns of the uterus, which stimulates scar tissue formation, and ultimately, a mechanical occlusion. There is then no way for the egg and the sperm to meet. Recent reports have shown the possibility to perform such procedure in an office setting, reducing the risks arising from general or local

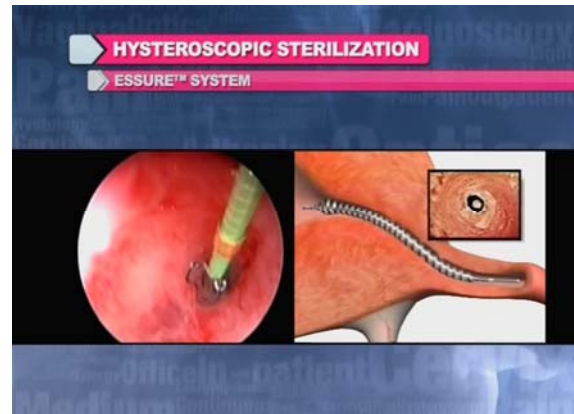


Fig.17

anaesthesia, and increasing its cost-

effectiveness.



Correspondence

Could office endometrial biopsy be accurate as EBHR for assessing the preoperative tumor grade?

Sir,

First of all, we would like to congratulate Cutillo and his co-workers as they have tried to throw light on the role of hysteroscopy in the pre-operative work-up of endometrial cancer.¹

According to their data, endometrial biopsy by means of the hysteroscopic resectoscope seems to be a “very accurate diagnostic procedure for assessing the preoperative tumor grade in patients with endometrial carcinoma” with a concordance with definitive pathologic examination of nearly 97%. Indeed the hysteroscopy resectoscope makes it possible to perform multiple, eye-mirated, 5-mm thick cancer biopsies, thus offering the pathologist “a surgical specimen which is highly representative of endometrial tumor”.

However a serious consideration arises from their study. As it emerges from their Materials and methods section, patients undergoing EBHR had been previously diagnosed with an early-stage endometrioid adenocarcinoma. In other words, it means that they had already undergone an endometrial assessment by the means of blind office endometrial biopsy or target office hysteroscopic biopsy or, at worst, by means of dilatation and curettage (D&C) under local or general anesthesia. Taking into account that all the patients then underwent first an EBHR under general anesthesia and second a definitive laparotomic surgery (with a median interval range between the two procedures of 10 days!), it results that every patient was subjected to three invasive procedures in a short time with at least two of them under general anesthesia!

Furthermore we should consider that most patients with endometrial carcinoma are in old age and the risks of two general anesthetics in a short time should not be underestimated.

As the main advantage of EBHR is to offer the pathologist an adequate specimen we propose to reach the same objective with a less invasive procedure and in an outpatient setting.²

To collect enough endometrium (also including its deeper layers) for a correct histological examination, we perform the so-called “grasp biopsy” by means of 5Fr grasping forceps inserted through the operative channel of a 4 mm continuous-flow operative office hysteroscope with a 2.0 mm rod lens (Bettocchi office hysteroscope “size 4”, Karl Storz, Tuttlingen, Germany). The grasping forceps are placed, with the jaws open, against the endometrium to be biopsied; then they are pushed into the tissue and along it for around 0.5–1 cm, avoiding touching the muscle fibers. Once a large portion of mucosa has been detached, the two jaws are closed and the whole hysteroscope is pulled out of the uterine cavity, without pulling the tip of the instrument back into the channel. In this way, not only the tissue inside the forceps jaws but also the surrounding tissue protruding outside the jaws can be retrieved, thus providing the pathologist with a large amount of tissue. Furthermore if the two jaws are placed profoundly in the endometrium to be biopsied, we should be sure to collect its deeper layers with a higher possibility that endometrial stroma tissue could also be represented in the biopsy specimen.

Furthermore if we are not satisfied with the endometrium collected with the “grasp biopsy” we perform wide biopsies of endocavitary lesions by means of 5Fr bipolar Twizzle electrodes inserted through the operative channel of the hysteroscope. These electrodes are connected via a flexible cable with a versatile electrosurgical system dedicated to hysteroscopy (Versapoint Bipolar Electrosurgical System, Gynecare, Ethicon Inc., NJ, USA).

We have already demonstrated that lowering the power of the generator to the mildest level and reducing the power setting by half (50 W), with the Twizzle electrode it is possible to produce minimal dissection of the tissue (resembling a precise “cut”), with minimal generation of bubbles obscuring the visual field, and with high patient tolerance.³

In conclusion we agree with Cutillo and his co-workers regarding the need to further test the EBHR “for the evaluation of tumor grade and histotype”, but we propose a randomized clinical trial comparing such technique not with D&C, but with standardized office hysteroscopic biopsy (“grasp biopsy” plus bipolar electrodes).

DOI of original article: 10.1016/j.ejso.2006.11.020.

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Accepted 15 January 2007

Hysteroscopic myomectomy: a comprehensive review of surgical techniques

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Hysteroscopic myomectomy currently represents the standard minimally invasive surgical procedure for treating submucous fibroids, with abnormal uterine bleeding and reproductive issues being the most common indications. While hysteroscopic myomectomy has been shown to be safe and effective in the control of menstrual disorders, its effects on infertility remain unclear. The review provides a comprehensive survey of all hysteroscopic techniques used to treat fibroids found completely within the uterine cavity (G0) and those with intramural development (G1 and G2). MEDLINE and EMBASE searches identified published papers from 1970. The choice of the technique mostly depends on the intramural extension of the fibroid, as well as on personal experience and available equipment. 'Resectoscopic slicing' still represents the 'gold standard' technique for treating fibroids G0, even if several other effective techniques including ablation by neodymium-yttrium-aluminum-garnet laser, morcellation and office myomectomy have been proposed. On the other hand, the present review clearly indicates that there is still no single technique proven to be unequivocally superior for treating fibroids G1 and G2. Most techniques aim at the transformation of an intramural fibroid into a totally intracavitary lesion, thus avoiding a deep cut into the myometrium. At present, the 'cold loop' technique seems to represent the best option as it allows a safe and complete removal of such fibroids in just one surgical procedure, while respecting the surrounding healthy myometrium.

Keywords: hysteroscopic myomectomy; fibroids; menstrual disorders; infertility; complications.

Introduction

Uterine fibroids (also known as myomas or leiomyomas) are the most common benign solid tumours found in the female genital tract. They occur in ~20–25% of women of reproductive age (Fernandez *et al.*, 2001; Valle and Baggish, 2007) causing 3–5% of gynaecology consultations (Vidal, 1998).

Uterine leiomyomas arise from the muscular part of the uterus. As they grow, they usually migrate to a place of lower resistance: towards the abdominal cavity, thus becoming subserous masses or following the path of the intrauterine cavity thus becoming submucous fibroids (5–10% of uterine fibroids) (Ubbaldi *et al.*, 1995).

Localization of uterine fibroids seems to be an important factor in determining frequency and severity of symptomatology. Indeed, submucous fibroids may induce severe clinical symptoms such as excessive bleeding, usually during menses, colicky dysmenorrhoea (as the uterus tries, by means of contractions, to expel fibroids), and are thought to predispose patients to reproductive

failure (Fernandez *et al.*, 2001; Litta *et al.*, 2003; Takeda *et al.*, 2004; Indman, 2006; Sutton, 2006; Valle and Buggish, 2007). Furthermore, submucous fibroids are associated with chronic endometritis, they may have a greater risk for malignant change (Valle and Buggish, 2007) and are source of pre-term delivery, abnormal presentation, post-partum haemorrhage and puerperal infections (Bernard *et al.*, 2000).

Most submucous fibroids occur at the corporeal sites of the uterine cavity. Some are fundal, others are anteriorly, posteriorly or laterally situated. Small fibroids may also arise from the cornual regions, thus interfering with the utero–tubal junction lumen. A few are located at the cervical canal (Valle and Buggish, 2007).

Hysterectomy and laparotomic excision have long been considered the two standard routes of surgical treatment for symptomatic submucous fibroids (Garcia and Tureck, 1984; Smith and Uhler, 1990; Verkauf, 1992; Sudik *et al.*, 1996; Glasser, 1997; Haney, 2000; Munoz *et al.*, 2003; Campo *et al.*, 2005).

In particular, hysterectomy has been routinely proposed to those patients in whom the desire to procreate had been satisfied, while the abdominal myomectomy has represented the only possible solution in young patients desiring a pregnancy.

However, the conservative approach requires the opening of the uterine cavity, which may be one of the factors responsible for altering the likelihood of subsequent conception (Berkeley *et al.*, 1983). Furthermore, such an approach may compromise any future parturition as it requires caesarean section; in addition, it may lead to the development of pelvic post-operative adhesions which may further reduce rather than enhance fertility (Buttram and Reiter, 1981; Starks, 1988; Ubaldi *et al.*, 1995).

The development of hysteroscopic techniques

The development of endoscopy has made these fibroids accessible and resectable from the inner surface of uterus (Walker and Stewart, 2005; Bradley, 2005).

At the beginnings of endoscopic surgery, the lesions were removed by somewhat rugged methods (e.g. ovum forceps were used to twist pedunculated fibroids off their pedicles and scissors were inserted outside the hysteroscopic sheath to cut the fibroid pedicle).

The first reported hysteroscopy myomectomy was performed in 1976, when Neuwirth and Amin resected a fibroid using an urologic resectoscope, monopolar current and 32% dextran 70 as distension medium.

In 1987, Hallez (1995) reported on the development of a gynaecologic resectoscope, changing the urologic instrument into a continuous-flow device with a 0° optic; cutting current was used but with 1.5% glycine as the distension medium.

During the last 20 years, thanks to advances in instruments and the refining of techniques, hysteroscopic myomectomy has acquired the status of 'surgical technique' and, at present it represents the standard minimally invasive surgical procedure for treating fibroids entirely or mostly located within the uterine cavity (Vercellini *et al.*, 1999; Takeda *et al.*, 2004).

Indications for hysteroscopic myomectomy

Abnormal uterine bleeding (AUB) represents the most common indication for hysteroscopic myomectomy in most publications reviewed with a percentage ranging from 60 to 84.1% (Neuwirth and Amin, 1976; Brooks *et al.*, 1989; Derman *et al.*, 1991; Indmann, 1993; Wamsteker *et al.*, 1993; Donnez *et al.*, 1994; Wortman and Dagget, 1995; Hallez, 1995; Phillips *et al.*, 1995; Glasser, 1997; Emanuel *et al.*, 1999; Hart *et al.*, 1999; Vercellini *et al.*, 1999; Munoz *et al.*, 2003; Loffer, 2005; Campo *et al.*, 2005; Marziani *et al.*, 2005; Polena *et al.*, 2007). Indeed, submucous fibroids have been advocated more than subserous and intramural ones as a cause of AUB, presumably due to distortion of the cavity and to an increase in the bleeding surface of the endometrium (Maher, 2003).

Although most women affected with fibroids are fertile, available evidence suggests that fibroids may interfere with fertility, with submucous fibroids being reported to exert the most detrimental effects on pregnancy rates (Pritts, 2001; Donnez and Jadoul, 2002; Benecke *et al.*, 2005; Somigliana *et al.*, 2007).

Even though this association is not supported by a clear biological rationale, several hypotheses have been suggested to explain

how submucous fibroids may cause infertility or repeated abortions. However, at present, none of these hypotheses is definitive (Somigliana *et al.*, 2007).

Fibroids might interfere with sperm migration, ovum transport or embryo implantation; these effects might be mediated by alteration of uterine cavity contour causing mechanical pressure or by the occurrence of abnormal uterine contractility (Buttram and Reiter, 1981; Richards *et al.*, 1998; Bettocchi *et al.*, 2002; Farrugia *et al.*, 2002; Oliveira *et al.*, 2004). Fibroids may also be associated with implantation failure or gestation termination due to focal endometrial vascular disturbances, endometrial inflammation, secretion of vasoactive substances or an enhanced endometrial androgen environment (Buttram and Reiter, 1981; Cicinelli *et al.*, 1995; Richards *et al.*, 1998; Ng and Ho, 2002).

Reproductive problems represent the second leading indication for intervention, though the lack of randomized studies does not allow any definitive conclusion to be drawn regarding the improvement of spontaneous fertility after hysteroscopic myomectomy (Donnez and Jadoul, 2002; Somigliana *et al.*, 2007; Stamatellos and Bontis, 2007).

Less frequent reported indications include dysmenorrhea (Hallez, 1995), aspecific pelvic pain (Munoz *et al.*, 2003) and asymptomatic submucous fibroid in a woman candidate to start hormone replacement therapy (Hallez, 1995).

With the present review, we offer gynaecologists with special interest in endoscopy information regarding the instrumentation required to perform hysteroscopic myomectomy and the diagnostic tools and medications commonly used for an appropriate pre-surgical evaluation. Furthermore, it provides a comprehensive survey of all techniques used to treat fibroids completely within the uterine cavity as well as those with intramural development. Finally, the effects on menstrual pattern and infertility and the operative and long-term complications have been reviewed.

Materials and Methods

This review includes medical papers published in the English language on hysteroscopic myomectomy since 1970 and identified through a MEDLINE and EMBASE search using combinations of medical subject heading terms: hysteroscopy, myomectomy, pharmacological agents, gynaecological surgery, surgical technique, fibroid, fibroid, loop, laparoscopy and resectoscope. All pertinent articles were retrieved and reports were then selected through systematic review of all references. In addition, books and monographs of different languages on hysteroscopy and gynaecological surgery were consulted.

Pre-surgical evaluation of submucous fibroids

As hysteroscopic myomectomy may be sometimes a highly complex procedure, its real feasibility must be thoroughly evaluated preoperatively in order to minimize the incidence of incomplete resection and the complications that might occur during procedure.

The most widespread investigative techniques for pre-surgical evaluation are office hysteroscopy, transvaginal ultrasound scanning (TVS) and sonohysterography (SHG) (Fedele *et al.*, 1991; Fukuda *et al.*, 1993; Dodson, 1994; Cicinelli *et al.*, 1995; Corson, 1995; Tulandi, 1996; Laifer-Narin, 1999; Perez-Medina

et al., 2000; Cheng and Lin, 2002; Clark *et al.*, 2002; Leone *et al.*, 2003, 2007; Trew, 2004; Lasmar *et al.*, 2005; Murakami *et al.*, 2005; Salim *et al.*, 2005; Vilos and Abu-Rafea, 2005; Sutton, 2006; Alborzi *et al.*, 2007).

Besides giving us the certainty of the presence of the submucous fibroid, office hysteroscopy also enables the assessment of the intracavity component of the mass, its localization, its relationship with the uterine structures, the characteristics of the endometrium as well as the presence of possible associated intracavitary pathologies. Furthermore, it provides subjective assessment of fibroid size and indirect information regarding the depth of myometrial extension (Fedele *et al.*, 1991; Corson, 1995; Emanuel and Wamsteker, 1997; Emanuel *et al.*, 1997, 1999; Wieser *et al.*, 2001; Clark *et al.*, 2002; Murakami *et al.*, 2005; Lasmar *et al.*, 2005; Sutton, 2006).

However, even if a protruding dome of fibroid is identified at outpatient hysteroscopy, there is the possibility that it could sink into the myometrium ('sinking fibroid') during a hysteroscopic procedure because of an increase in intrauterine pressure caused by the distension medium (Lin *et al.*, 2000; Murakami *et al.*, 2005).

TVS is not as useful as hysteroscopy in assessing the degree of intracavitary development of the fibroid. However, it is irreplaceable in the preoperative assessment as it provides two elements which would be otherwise unobtainable: the 'myometrial free margin' (thickness of the outer myometrial layer of the fibroid) as well as the presence of any other possibly associated pathology. For a submucous fibroid to be approached hysteroscopically, the 'myometrial free margin' should be at least 1 cm thick or in more expert hands at least a few millimetres thick. Scanning evidence of other associated pathologies (multiple fibroid, adnexial pathologies) may indicate the need for a different surgical approach. Furthermore, ultrasound scanning allows to evaluate the real size of the nodule (Lasmar *et al.*, 2005; Murakami *et al.*, 2005; Sutton, 2006).

SHG has been demonstrated to be superior to TVS in terms of diagnostic accuracy; furthermore, it allows to identify the exact location of the fibroid as well as the portion protruding into the cavity (Fukuda *et al.*, 1993; Cicinelli *et al.*, 1995; Farquhar *et al.*, 2003; Leone *et al.*, 2003, 2007; Salim *et al.*, 2005; Botsis *et al.*, 2006; Alborzi *et al.*, 2007). Although many authors report that SHG could reduce the number of diagnostic hysteroscopies for pre-surgical evaluation (Turner *et al.*, 1995; Bronz *et al.*, 1997; Saidi *et al.*, 1997; Williams and Marshburn, 1998; Bonnamy *et al.*, 2002; Leone *et al.*, 2003, 2007), this technique is limited by the inability or difficulty in obtaining tissue diagnosis (Botsis *et al.*, 2006).

In case of a large uterus, with multiple fibroids, or if ultrasound scanning is technically difficult (i.e. obese patients), magnetic resonance imaging (MRI) can provide valuable information, being also helpful in differentiating between fibroids and adenomyosis (Hricak *et al.*, 1986; Takeda *et al.*, 2004; Lasmar *et al.*, 2005; Murakami *et al.*, 2005; Indman, 2006). Costs have prohibited its general use in clinical practice (Valle and Buggish, 2007).

Recently, Takeda *et al.* (2004) have proposed the use of 'virtual hysteroscopy' for preoperative evaluation of submucosal fibroids. Virtual endoscopy is a non-invasive technology used to display the image of the cavity inside the organ by processing the images

acquired by a multislice helical computed tomography (CT) scanner using 3D computer graphics (3DCG) software as if one is observing the organ by real endoscopy.

Hysteroscopic classification of submucous fibroids

As the intramural extension of submucous fibroids may considerably vary, thus influencing the chance of achieving complete resection, a classification of different types of submucous fibroids was shown to be indispensable since the beginning of resectoscopic surgery for weighting the limits of surgical technique.

The classification developed by Wamsteker *et al.* (1993) and adopted by the European Society for Gynaecological Endoscopy (ESGE), which considers only the degree of myometrial penetration of the submucous fibroid, is currently worldwide used. According to this classification, a fibroid G0 is completely within the uterine cavity and appears only jointed to the cavity wall by a thin pedicle; a fibroid G1 has its larger part (>50%) in the uterine cavity; and a fibroid G2 has its larger part (>50%) in the myometrium (Wamsteker *et al.*, 1993; Salim *et al.*, 2005).

Lasmar *et al.* (2005) recently proposed a new preoperative classification of submucous fibroids which considers not only the degree of penetration of the fibroid into the myometrium, but also other parameters including the extension of the base of fibroid with respect to the wall of the uterus, the size of the nodule (cm) and the topography of the uterine cavity. A score ranging from 0 to 2 is given for each parameter and the patients are then allocated into one of the three groups of the classification on the basis of the total score (Table I). The authors found a higher correlation of this new scoring system with completeness of the myomectomy, time spent in surgery and fluid deficit, than scoring only based on the percentage of myometrial penetration (Lasmar *et al.*, 2005).

Preoperative hormonal treatment

Whether treatment with GnRH agonist before myomectomy offers any significant advantage is still a matter of debate (Lethaby *et al.*, 2001, 2002). However, a recent review by Gutmann and Corson (2005) reports that 'the most clinically relevant indication for preoperative GnRH agonist use appears to be in patients with submucous fibroids'.

Table I: Lasmar's pre-surgical classification of submucous myomas

Points	Penetration	Size, cm	Base ^a	Third	Lateral wall (+1)
0	0	≤2	≤1/3	Lower	
1	≤50%	>2–5	>1/3 to 2/3	Middle	
2	>50%	>5	>2/3	Upper	
Score	+	+	+	+	=

^aIt refers to the extension of the base of the nodule with respect to the uterine wall on which the myoma is located. Score 0–4 (Group I): low complexity hysteroscopic myomectomy. Score 5–6 (Group II): complex hysteroscopic myomectomy, consider preparing with GnRH analogue and/or two stage surgery. Score 7–9 (Group III): recommend an alternative non-hysteroscopic technique.

Benefits claimed include the following:

- (i) resolution of preoperative anaemia: these drugs create a state of amenorrhea, thus enabling patients suffering from menorrhagia to build up their blood counts and reducing the need for transfusion (Donnez *et al.*, 1989, 1992, 1993; Isaacson, 2003)
- (ii) reduction of endometrial thickness as well as the size and vascularization of fibroids (Donnez *et al.*, 1989, 1992, 1993; Mencaglia and Tantini, 1993). This results in an improved operator's visibility by limiting blood loss; furthermore, it leads to a reduced fluid absorption (through a reduction of uterine blood flow) (Parazzini *et al.*, 1998) and a reduced length and difficulty of surgery.
- (iii) possibility of surgical scheduling. Indeed, as patients do not necessarily need to be operated in the early proliferative phase, preoperative treatment also has a practical benefit in that it allows surgery to be performed at any time (Parazzini *et al.*, 1998)

Universally accepted guidelines on the indications and duration of pretreatment with GnRH agonist (administered either as a long-acting monthly intramuscular injection or with daily dosing) are lacking in the international literature.

Hallez (1995, 1996) does not recommend any preoperative treatment; Hart *et al.* (1999) does not believe analogue use to be a risk factor for submucous fibroid reintervention; Donnez *et al.* (1995) claims that fibroids up to 2 cm do not require any preparation, those ranging from 2 to 4 cm have to be treated for 3 weeks with a progestogen or danazol, while GnRH agonist should be reserved only for those fibroids >4 cm. Other authors consider a large size as a contraindication for GnRH agonist therapy as severe haemorrhage after the administration of these drugs has been described (Indman, 1993).

We agree with those authors who consider these drugs particularly indicated for those fibroids with a diameter of >3 cm and/or with intramural portion as well as for patients suffering from secondary anaemia (Romer, 1998; Tulandi and al-Took, 1999; Romer *et al.*, 2000; Valle and Buggish, 2007). A 6–8 weeks administration of GnRH agonist preoperatively is sufficient to shrink the fibroid by 30–50% (Donnez *et al.*, 1992; Perino *et al.*, 1993; Mencaglia and Tantini, 1993), for patients presenting with anaemia and a large submucous fibroid, such therapy can be prolonged up to 2–4 months to correct anaemia (in combination with iron supplement therapy) as well as to shrink the intrauterine lesion (Stamatellos and Bontis, 2007).

Evidence supporting the use of these drugs before hysteroscopic myomectomy only comes out from a few small [$n = 20$, Donnez *et al.* (1989); $n = 25$, Mencaglia and Tantini (1993); $n = 58$, Perino *et al.* (1993)] prospective studies. In the only one randomized study, Perino *et al.* (1993) have compared the post-operative outcomes following resectoscopic myomectomy for submucous fibroids <3 cm, showing a decreased volume of distension fluid, surgical time and bleeding in those patients ($n = 33$) preoperatively treated with GnRH agonist in comparison with controls ($n = 25$).

Conversely, it is well known that the preoperative treatment with these drugs is associated with some disadvantages including: (i) high costs; (ii) side effects (i.e. hot flushes, spotting);

(iii) increased recurrence rate (these drugs may render small fibroids less visible) (Fedele *et al.*, 1990) and (iv) increased risk of uterine perforation (due to a reduced myometrial thickness) (Bradley, 2002) and an increased risk of the 'sinking' phenomenon (due to a decreased elasticity of myometrial tissue caused by estrogen deficiency) (Lin *et al.*, 2000).

Furthermore, a recent retrospective study by Campo *et al.* (2005) suggests that preoperative treatment with GnRH agonist does not seem to offer any advantage in terms of short- and long-term outcomes. In particular, those patients treated with GnRH agonist had significantly longer surgical times, compared with untreated patients, which has been ascribed by the authors to an increased cervical resistance to dilatation. However, such data needs to be confirmed by larger randomized studies.

Instrumentation

The operating hysteroscope (resectoscope) is the instrument that allows the performance of a submucous myomectomy under direct and constant visual control. It includes a straight-forward telescope (0°) or a slightly fore-oblique 12–30° telescope with an outer diameter of 3–4 mm; an internal and an external sheaths of 24–27 Fr outer diameter (Table II) that provide a constant inflow and outflow of distension fluid for generating a continuous and efficient lavage system of the uterine cavity.

The operating hysteroscope contains a working element wherein electrosurgical (thermal loops and vaporizing electrodes) (Fig. 1) and mechanical instruments (cold loops) (Fig. 2) for the traditional resectoscopic surgery or laser fibres or a new Intra Uterine Morcellator (IUM) (Fig. 3) device can be attached.

The application of resectoscopic surgery has been made possible by using the electric current. The electrosurgical system can be monopolar or bipolar: in the monopolar one, from the extremity of the resectoscope (active electrode) the flow of current, in order to close the circuit, must reach the plate (passive electrode). The use of monopolar electrodes requires non-conducting distending solution (sorbitol 5% or glycine 1.5%). The use of a bipolar set of instruments, in which both electrodes are introduced into the thermal loop, would be much safer. In this way the current will only have to pass through the tissue with which the thermal loop comes into contact, thus minimizing the danger deriving from the random passage through the corporeal structures. An intrauterine bipolar diathermy allows the use of an electrolytic uterine distension medium (normal saline). The passage of the electrical energy from the thermal loop to the tissues determines the cutting or coagulation action of the resectoscope.

Table II. Main characteristics of the widely-used resectoscopes

Manufacturer	Diameter	Telescope	Electrosurgical system
Storz	26 Fr	0°, 12°, 30°	Monopolar Bipolar
Circon ACMI	25 Fr	12°, 30°	Monopolar
Wolf	27 Fr	30°	Monopolar Bipolar
Gynecare	27 Fr	12°, 30°	Bipolar
Olympus	26 Fr	0°, 12°	Monopolar Bipolar

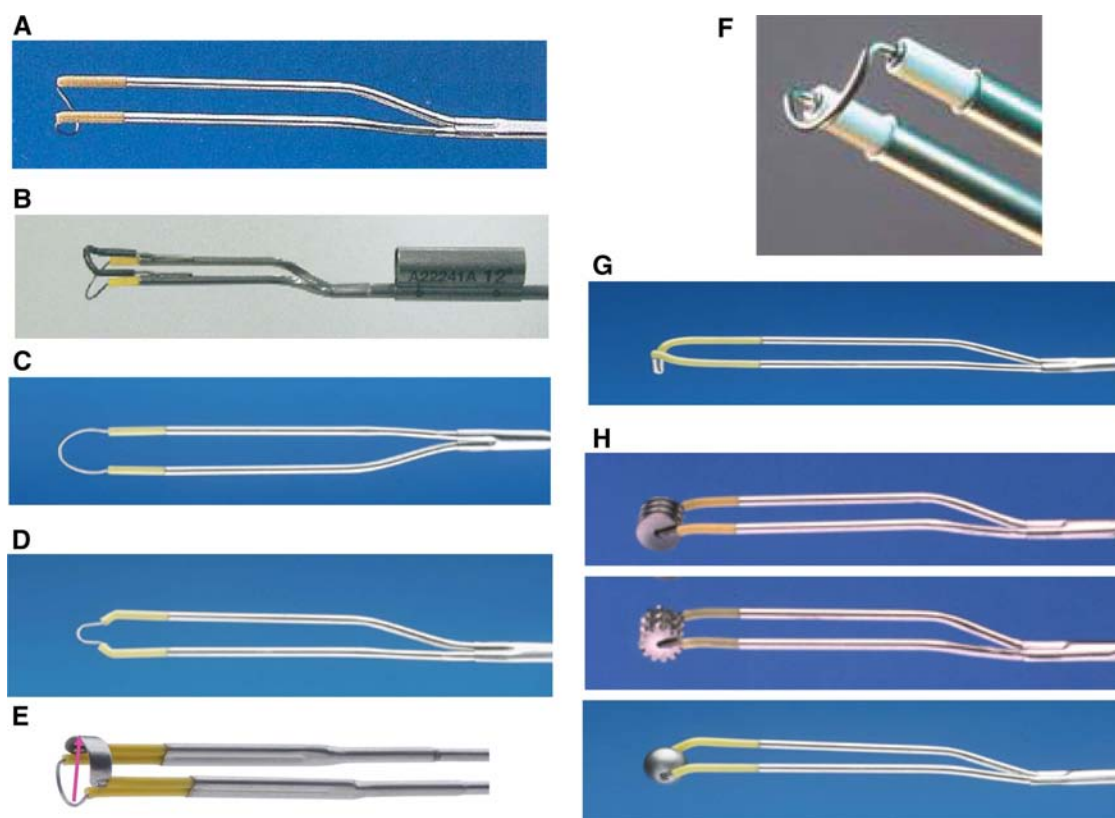


Figure 1: Conventionally-used thermal loops for resectoscopic myomectomy

(A) 24 Fr 30° U-shaped cutting loop for monopolar 26 Fr resectoscope (Karl Storz GmbH Co., Tuttlingen, Germany): it has a maximum cutting depth of 4 mm and represents the most frequently used loop; (B) 5 mm equatorial loop for monopolar 26 Fr resectoscope (Karl Storz GmbH Co); (C) 45° loop electrode with a short-arm safeguard (Olympus Medical System GmbH); (B) and (C) are used to treat submucous fibroids arising from uterine fundus; (D) 3 mm equatorial loop for monopolar 26 Fr resectoscope (Karl Storz GmbH Co): it is used to resect submucous fibroids located near the interstitial portions of the Fallopian tubes; (E) 8 mm 90° U-shaped cutting loop for bipolar 26 Fr resectoscope (Karl Storz GmbH Co): the direct current return via the electrode (arrow) prevents a current flow via the sheath; (F) Magnified view of 2.5 mm cutting loop for bipolar 27 Fr resectoscope (Gynecare; Ethicon Inc., Somerville, NJ); (G) Collin's Electrode (Karl Storz GmbH Co): it is a cutting knife electrode, conventionally used to perform hysteroscopic metroplasty; however it can also be employed to perform hysteroscopic myomectomy (i.e. enucleation *in toto*); (H) Vaporizing electrodes (Karl Storz GmbH Co): they can have a cylindrical or spherical shape or a multidentate surface; this design works like an array of electrodes which, whether provided with pure cutting energy of high power, can vaporize tissue quite quickly and effectively without generating the 'chips' created by loop resection

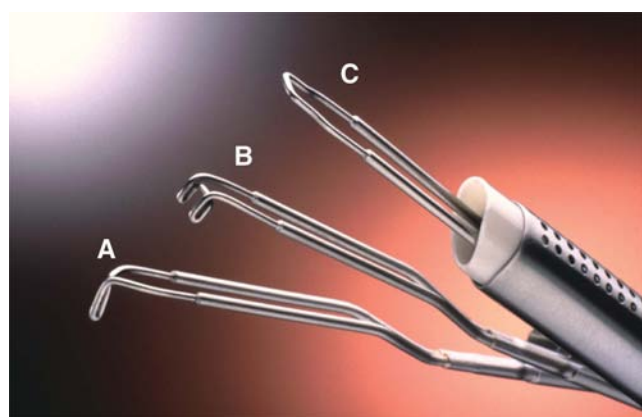


Figure 2: Mazzon's mechanical loops (Karl Storz GmbH Co) used for 'cold loop' myomectomy

(A) Pointed loop (Knife-shaped): used to hook and lacerate the connective bridges which join the fibroid and the adjacent myometrium; (B) Rake loop (rake shaped with teeth): nearly completely replaced by pointed loop; (C) Cutting loop (rectangular): used to identify the cleavage plane between the fibroid and myometrium

There are various types of thermal loops with different shapes and sizes (Fig. 1A–F).

The diameters of thermal loops for bipolar resectoscopes are usually smaller than loops for a monopolar instrument with the same outer diameter, thus increasing the time required for resection (Indman, 2006). The bipolar loop operates in a similar way to a monopolar electrode; however, as tissue contact is not necessary for activation, the electrodes do not 'stick' in the tissue while cutting (Stamatellos and Bontis, 2007).

The cold loops are structurally more robust than the others as they are used in a mechanical way without electrical energy to carry out the enucleation of the intramural component of the fibroid (Fig. 2).

The resectoscope can also fit bipolar and monopolar vaporizing electrodes (Fig. 1H); The power required to vaporize tissue is 150–300 W of pure cut current delivered by any electrosurgical generator (Brooks, 1995; Vilos and Abu-Rafea, 2005). The vaporizing electrodes are also useful mechanical tools to be used to dissect the fibroid from its bed without electrosurgical activation.

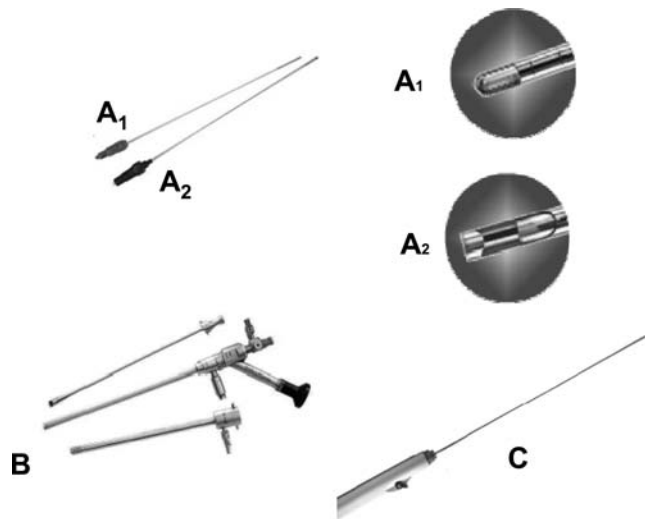


Figure 3: Intrauterine morcellator (IUM) (prototype: Smith & Nephew Endoscopy, Andover, MA)

It consists of a set of two metal, hollow, rigid, disposable tubes (A) that fit into each other and then are inserted into the working channel of a 9 mm operating hysteroscope (B). The inner tube rotates within the outer tube, driven mechanically by an electrically powered control unit and controlled by a foot pedal that activates rotation and regulates the direction of rotation of the inner tube. The control unit is connected to a handheld motor drive unit in which the IUM is inserted. Both tubes have a window-opening at the end with cutting edges. The rotary morcellator (A₁) is recommended for polypectomy, while the reciprocating one (A₂) for myomectomy. By means of a vacuum source (C) connected to the inner tube, the tissue is sucked into the window-opening and cut and 'shaved' as the inner tube is rotated. The removed tissue is discharged through the device and is available for pathology analysis

The transhysteroscopic approach for the treatment of submucous fibroid includes also the use of lasers and of a new instrument called IUM.

Although argon, krypton and neodymium-yttrium-aluminum-garnet (Nd:yAG) lasers have all been successfully used, only the latter has found widespread application in hysteroscopic surgery (Ubaldi, 1995), being very popular in the late 1980s and early 1990s. Two techniques 'touch' and 'non-touch' may be used in hysteroscopic Nd:yAG laser surgery (Goldrath *et al.*, 1981; Loffer, 1987). In the former, the laser fibre is in contact with the surface to be treated, whereas in the latter it is separated from it by a few millimetres. In hysteroscopic myomectomy both techniques are used (Ubaldi, 1995).

The 4–5 mm IUM (prototype: Smith & Nephew Endoscopy, Andover, MA) represents a new cutting device inserted into a straight working channel of a continuous flow 9 mm rigid operating hysteroscope (Fig. 3).

Hysteroscopic techniques

The choice of the technique for the hysteroscopic removal of submucous fibroids mostly depends on its type and location within the endometrial cavity. Furthermore, personal experience and the available equipment might then favour a particular technique rather than the other ones.

Fibroids completely within the uterine cavity (G0)

The operator has the possibility to choose among several alternative procedures: all of them are usually performed in the operating theatre under general anaesthesia, except office myomectomy.

Resectoscopic excision by slicing

The classical resectoscopic excision of intracavitary fibroid is carried out with the technique of slicing. It consists of repeated and progressive passages of the cutting loop, carried out with the standard technique (loop carried beyond the neoformation, with cutting only taking place during the backward or return movement of the loop). Excision usually begins from the top of the fibroid, progressing in a uniform way towards the base, also in the case of a pedunculated fibroid (Neuwirth and Amin, 1976; Mazzon and Sbiroli, 1997; Isaacson, 2003; Indman, 2006).

During the resection of the fibroid, particularly when there are voluminous neoformations or small cavities, the fragments sectioned and then accumulated into the cavity may interfere with a clear vision. Thus they must be removed from the uterine cavity by taking out the resectoscope after grasping the loose tissue elements with the loop electrode. Although the removal of tissue under visual control with the resectoscope is the most effective way, it requires a large number of steps which are tiring in the long run (Mazzon and Sbiroli, 1997; Emanuel and Wamsteker, 2005). Recently, a resectoscope with automatic chip aspiration (Resection Master by Gallinat, Richard Wolf GmbH, Knittlingen, Germany) has been developed. Thanks to an extremely effective pump with integrated pulse aspiration, the chips are aspirated immediately after they are produced and removed from the uterine cavity without the uterine water distension being impaired (Gallinat, 2005).

When dealing with the base of the fibroid, care must be taken to limit the surgical traumatism only to the area of the implant, thus avoiding the damage of the surrounding structures. As soon as the excision of the fibroid is finished, the base of the implant must be cleaned out until smooth and regular; the operation should be considered finished when the fasciculate structure of the myometrium is visualized.

It is well ascertained that intracavitary fibroids can be easily removed in a one-step procedure with fibroid size representing the main limiting factor. The operation may also be carried out by operating surgeons with average resectoscopic experience (Mazzon and Sbiroli, 1997; Isaacson, 2003; Indman, 2006).

Cutting of the base of the fibroid and its extraction

Ideally, when approaching a peduncolated fibroid, the basis of the pedicle might be cut by resectoscopic loop (Murakami *et al.*, 2005) or Nd:yAG laser with the 'no-touch' technique (Valle and Baggish, 2007) or vaporizing electrode (Glasser, 1997). The resected node is then usually extracted with forceps. The fibroid can be grabbed blindly with a Corson forceps (Thomas Medical, Inc., Indianapolis, IN) or under direct visualization with an Isaacson optical tenaculum (Karl Storz Endoscopy, Culver City, CA) (Isaacson, 2003). Some other reports suggest that the resected fibroid node should be left in place until the remnant fibroid is excreted spontaneously during the first menstruation after surgery (Donnez *et al.*, 1990; Isaacson, 2003). This is an attractive

procedure but limited by frequent side effects including continuous colicky pain and intrauterine infection (Darwish, 2003).

Ablation by Nd:YAG laser

For fibroids 2 cm or less in diameter the Nd:YAG laser fibre may be used to ablate the fibroid. The technique first coagulates the surface vessels with the defocused laser fibre. Then the fibre is dragged repetitiously over the fibroid until it is flattened (touch technique). The disadvantages with this method are the time expended to reduce the fibroid and the lack of a tissue specimen for pathologic evaluation (Donnez *et al.*, 1990; Gallinat *et al.*, 1994; Smets *et al.*, 1996; Valle and Baggish, 2007). Furthermore, laser equipment at present tends to be very expensive which significantly reduces its widespread use.

Vaporization of fibroid

The vaporization of fibroid is performed using spherical or cylindrical electrodes (Fig. 1H); the electrode is dragged along the surface of the fibroid until the nodule is reduced to a size compatible with removal by the means of Corson forceps or Isaacson optical tenaculum. The depth of vaporization depends on duration of contact, resistance (debris on the electrode) and wattage of the generator. It is important to move the electrode slowly across tissue, applying current only when moving in the direction towards the operator. Prolonged pressure in one spot exposed to this high current could result in uterine perforation (Glasser, 1997).

Fibroid vaporization has been reported to be significantly faster than traditional resectoscopic surgery (no fibroid chips to be removed) with an estimated blood loss <100 ml and a discrepancy between inflow and outflow volumes ranging 0–200 ml (Brooks, 1995; Vilos and Abu-Rafea, 2005).

The main disadvantage of vaporizing electrodes is the lack of tissue sample for pathology. While uterine sarcomas are very rare, unfortunately they are not homogeneous. Therefore, a simple sample prior to vaporization does not rule out the disease. Consequently, it is mandatory that no fibroid be vaporized in its entirety but that substantial portions been retrieved for microscopic examination (Brooks, 1995; Glasser, 1997; Isaacson, 2003).

Another disadvantage is related to the use of high power which produces numerous gas bubbles which enter the vascular system. Providentially, these bubbles dissipate rapidly in the blood; as long as the rate of formation does not exceed the rate of dissipation, there are no significant clinical sequelae. A constant monitoring of patient's end-tidal CO₂ together with a close cooperation between surgeon and anaesthesiologist is needed to avoid serious complications (Isaacson, 2003).

Morcellation by IUM

Contrary to some other alternative techniques that use heat, coagulation or vaporization, the morcellation by IUM represents a new alternative technique which preserves tissue for histological examination.

Recently, Emanuel and Wamsteker (2005) have conducted a retrospective comparison between this technique and conventional resectoscopy.

They have shown that morcellation by IUM was effective for the treatment of fibroid G0 and G1 and faster than conventional

resectoscopy. Indeed, the aspiration of tissue fragments through the instrument allowed the surgeons to save much time. However, further data are needed to evaluate long-term follow-up and to demonstrate whether this new technique might result in fewer fluid-related complications (physiological saline solution is used for distension and irrigation) and a shorter learning curve.

On the other hand, it should be underlined that this new technique cannot be used for the treatment of submucous fibroids with >50% intramural extension (G2).

Office hysteroscopic myomectomy

The development of smaller diameter hysteroscopes (<5 mm) with working channels and continuous flow systems has made it possible to treat several uterine pathologies in outpatient regimen without cervical dilatation and consequently without analgesia and/or local anaesthesia.

This new philosophy ('see and treat hysteroscopy') has reduced the distinction between a diagnostic and an operative procedure, introducing the concept of a single procedure in which the operative part was perfectly integrated in the diagnostic work-up (Bettocchi *et al.*, 2003).

Mechanical operative instruments (scissors, biopsy cup, grasping and corkscrew) have long been the only way to apply the see and treat procedure in an outpatient setting (Bettocchi *et al.*, 2004). The advent of bipolar technology, with introduction of electrosurgical systems dedicated to hysteroscopy and several types of 5 Fr electrodes, has increased the number of pathologies treated by office operative hysteroscopy, including fibroids <1.5–2 cm.

Endocavitary fibroids (G0) are first divided into two half-spheres and then each of these is sliced from the free edge to the base into two/three fragments (Fig. 4). These fragments must be large enough to be pulled out through the uterine cavity using 5 Fr. grasping forceps (Bettocchi *et al.*, 2002).

Few studies have investigated the effectiveness of this new approach (Farrugia and McMillan, 2000; Bettocchi *et al.*, 2002; Clark *et al.*, 2002) and are characterized by potential methodological weaknesses including the lack of a control group of women (Farrugia and McMillan, 2000; Bettocchi *et al.*, 2002; Clark *et al.*, 2002) and the relatively short-term follow-up (Farrugia and McMillan, 2000; Bettocchi *et al.*, 2002; Clark *et al.*, 2002). Larger prospective comparative studies are needed to better evaluate this promising approach in terms of symptom response and cost saving.

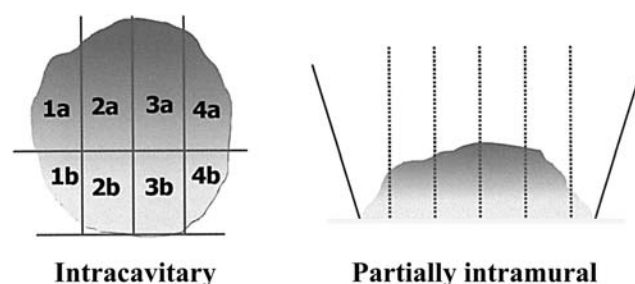


Figure 4: Slicing technique to treat totally intracavitary and partially intramural submucous fibroid in office setting with 5Fr bipolar electrodes 'a' refers to the first half-sphere and 'b' to the second. Modified from Bettocchi *et al.* (2002)

Fibroids with intramural development (G1-G2)

It is advisable to use expert operating surgeons for hysteroscopic resection of fibroids with intramural extension as it is technically difficult with a slow learning curve and it is associated with an higher risk of complications (Emanuel *et al.*, 1999). The intramural extension of submucous fibroids influences the chance of achieving complete resection in one surgical session.

Conventionally, fibroids G1 and G2 should not exceed 5–6 and 4–5 cm, respectively, to be removed hysteroscopically, even if reports of removal of larger fibroids are available in the English literature (Neuwirth, 1983; Fried and Hulka, 1987; Hamou, 1993; Donnez *et al.*, 1995; Phillips *et al.*, 1995).

Several techniques have been proposed for the treatment of such submucous fibroids, most of them sharing the objective of producing an intracavitary protrusion of the intramural component. The advantages and limits of the most widely-used techniques are shown in Table III.

Excision only of the intracavitary component

In the past, several authors have proposed a progressive resectoscopic excision of only the intracavitary component of those fibroids with extensive intramural involvement (Neuwirth, 1978). Indeed, it was believed that the endometrium would recolonize the surgically operated area and that the residual intraparietal component of the fibroid would remain in the thickness of the wall, behaving like an intramural fibroid (usually asymptomatic). However, the constant intracavitary expulsion and the subsequent volumetric increase of the residual intramural component of the fibroid lead to the persistence of the initial symptomatology. That explains the clinical uselessness of such a treatment and its consequent fall into disuse.

Complete excision of fibroid by a two-step procedure

The observation of the rapid migration of the residual intramural component of the fibroid towards the uterine cavity (Loffer, 1990), with the parallel increase of myometrial thickness during hysteroscopic myomectomy (Yang and Lin, 2001), is the basis of this treatment, which represents the logical evolution of the earlier treatment which involved the excision of the only intracavitary component of the fibroid.

The technique described by Donnez *et al.* (1990) represents an effective mixture of hormonal treatment and hysteroscopic laser surgery. After 8 weeks of preoperative GnRH agonist therapy, a partial myomectomy of the intracavitary portion of the fibroid is carried out. The Nd:YAG laser fibre is then directed, as perpendicularly as possible, at the remaining (intramural) fibroid portion with the aim to reduce its size by decreasing its vascularity (trans-hysteroscopic myolysis). After another 8 weeks course of GnRH agonist therapy, a second hysteroscopic myomectomy is performed to remove the remnant intramural portion of the fibroid protruded in the uterine cavity as a consequence of uterine shrinkage. This technique has been successfully reported in 12 patients by Donnez in his original paper (Donnez *et al.*, 1990), with a restoration of normal menstrual flow in all of them. In his largest series of fibroids with the biggest portion located into the uterine wall ($n = 78$), the author reports a success rate of 95% with only

four patients requiring a third-look laser hysteroscopy to completely remove the fibroid (Donnez *et al.*, 1995).

At present, most surgeons prefer to remove a fibroid through a two-steps procedure, by means of traditional resectoscopic surgery, as originally hypothesized by Loffer (1990). The technique consists of the following steps:

- (i) First surgical operation: excision only of the intracavitary portion of the fibroid, by means of the usual progressive resectoscopic excision. A hysteroscopic reassessment is carried out 20–30 days after the operation or after the first menstruation to verify that the intracavitary migration of the residual intramural component of the fibroid has taken place: once this has been verified, the second operation can be done.
- (ii) Second surgical operation: complete excision, by means of slicing, of the residual component of the fibroid, which has now become intracavitary.

Optionally, first and second surgical operation can be preceded by GnRH agonist therapy.

Complete excision of fibroid by a one-step procedure

Excision of intramural component by slicing

With this technique, after the usual progressive excision of the intracavitary portion of the fibroid, the operation continues with the slicing of the neoformation, included into the thickness of the uterine wall, until the operation is completed (Fig. 5). The main limit of this technique is the use of electrosurgery during the removal of the intramural component of the fibroid with the inevitable damage of the surrounding healthy myometrium (either directly during the cutting or indirectly because of thermal damage) and the increased risk of operative complications (such as perforation, bleeding, intravasation).

'Cold loop' myomectomy

This technique, developed by Mazzon (1995), is characterized by a sequence of three different operating steps:

- (i) *Excision of the intracavitary component of the fibroid*: this is carried out with the usual technique of slicing. It consists of repeated and progressive passages of the monopolar angled cutting loop, carried out with the standard technique. This action must stop at the level of the plane of the endometrial surface, so that the identification of the passage between the fibroid and the adjacent myometrial tissue is not impaired (cleavage plane).
- (ii) *Enucleation of the intramural component of the fibroid*: once the cleavage plane is identified the usual cutting loop of the resectoscope is substituted by a suitable blunt dissection cold loop. Usually the rectangular loop is used first. This loop, once inserted into the plane between the fibroid and myometrium, is used in a mechanical way along the surface of the fibroid (usually clearly recognizable by its smooth, white and compact surface), thus bringing about its progressive blunt dissection from the myometrial wall (Fig. 6A). Then the single tooth loop is used to hook and lacerate the slender connective bridges which join the fibroid and the adjacent

Table III: Advantages and limits of the most widespread techniques for hysteroscopic treatment of myomas G1-G2

Author (year)	Technique	Advantages	Limits
Loffer <i>et al.</i> (1990) Donnez <i>et al.</i> (1990)	Two-step myomectomy: the procedure can be performed only by means of traditional resectoscopic surgery (Loffer <i>et al.</i> , 1990) or by Nd:yAG laser (Donnez <i>et al.</i> , 1990).	- Safeness (possibility to operate at an intracavitary level)	- Two separate interventions - High costs (GnRH agonist therapy, Nd:yAG laser, two surgeries) - Only myomas with a reduced intramural development or of small dimensions can be treated with this technique. Indeed, in the case of myomas with a volumetrically significant intramural component, the part which remains after the first surgical operation may be excessively big: such a component, when migrating to the uterine cavity, will meet with resistance to its progression caused by the contralateral myometrial wall. As a result, during the second operation we will find a myoma which still has a significant intramural component, which will remain in the thickness of the wall at the end of the new excision only of the intracavitary part: it will therefore be necessary to carry out more surgical operations. However this limit might be solved by GnRH agonist therapy. - 'Sinking' phenomenon (due to GnRH agonist therapy) - Increased recurrence rate (due to GnRH agonist therapy)
Mazzon (1995)	'Cold loop' myomectomy	- Theoretically one intervention - Safeness (although the surgical action goes deeply into the uterine wall during enucleation with a cold loop, it always follows a reference plane (the surface of the intramural pole of the myoma) and constantly maintains the loop action under direct visual control; this means a smaller possibility of complications (perforation, bleeding) - Respect of the surrounding healthy myometrium avoiding any needless cutting of the muscular fibres adjacent to the surgical area and reducing the thermal damage deriving from the loop of the resectoscope. This avoids any negative effect on the likelihood of subsequent conception and the uterine wall resistance - Suitable also for large myomas - Suitable also in case of myometrial free margin <1 cm	- Availability of cold loops - Training and high experience
Lasmar <i>et al.</i> (2002)	'Enucleation <i>in toto</i> '	- Theoretical one intervention	- The success of the procedure is higher for myomas with a intramural development >50%
Litta <i>et al.</i> (2003)		- Safeness (possibility to operate at an intracavitary level) - Theoretical respect of the surrounding health myometrium	- The expulsion force of the myometrium is inversely correlated with the diameter of uterine cavity
Hamou (1993)	Hydromassage	- Theoretical one intervention - Safeness (possibility to operate at an intracavitary level)	- Need of electronically controlled irrigation and suction device - The contractile reaction of the myometrium to such manoeuvres is neither predictable nor standardizable

Continued

Table III: *Continued*

Author (year)	Technique	Advantages	Limits
Bettocchi <i>et al.</i> (2002)	Office hysteroscopic myomectomy	<ul style="list-style-type: none"> - Theoretical respect of the surrounding health myometrium - Office procedure - Reduced anaesthetic risks - Reduced costs - Theoretical one intervention 	<ul style="list-style-type: none"> - The migration of the intramural component of the myoma into the cavity is maximum for myomas with a reduced intramural development or of small dimensions - Availability of 5Fr bipolar electrodes and generator - Myoma G0-G1 < 1.5 cm - Limited by patient's compliance - Training and high experience
Indaman (2004)	Pharmacological-aided techniques (PGF-2 α or carboprost)	<ul style="list-style-type: none"> - Theoretical one intervention 	<ul style="list-style-type: none"> - The contractile reaction of the myometrium to such drugs is neither predictable nor standardizable
Murakami <i>et al.</i> (2003, 2006)		<ul style="list-style-type: none"> - Safeness (possibility to operate at an intracavitary level) - Theoretical respect of the surrounding health myometrium 	<ul style="list-style-type: none"> - Extreme contraction of the uterus can interfere with visualization and one's ability to manipulate the resectoscope in the small cavity - Need of laparoscopic monitoring (Murakami's technique) - Side effects drug-related (nausea, vomiting, diarrhea, fever, bronchospasm in patients with bronchial asthma)



Figure 5: Excision of intramural component by slicing: the electrosurgery is used to slice the neof ormation, included into the thickness of the uterine wall (Image kindly donated by I. Ardovino)

myometrium (Fig. 6B). During the entire phase of enucleation, electric energy must not be used in the thickness of the wall, and the loop must be used 'cold' or in a mechanical way.

- (iii) *Excision of the intramural component:* at the end of the enucleation phase, the intramural part of the fibroid is totally dislocated inside the uterine cavity. At this point it can be treated as a neof ormation with a total intracavitary development and therefore it can be completely and safely excised by means of the usual progressive excision using an angled cutting loop.

At present, studies evaluating of the effects of this technique are still lacking in the international literature. However, this technique is largely widespread through the Europe and since 1992, Mazzon himself has carried out >2000 hysteroscopies using this technique reporting good functional and anatomical results and a low complication rate (<2%). The fibroid was completely removed in one-step procedure in nearly 80% of cases (unpublished data).

'Enucleation in toto'

Litta's technique: an elliptic incision of the endometrial mucosa that covers the fibroid is performed with a 90° Collins electrode (Fig. 1G), at the level of its reflection on the uterine wall until the cleavage zone of the fibroid is reached. Connecting bridges between fibroid and surrounding myocytes are slowly resected. The effect of such action is that the fibroid protrudes into the cavity, thus facilitating its removal by traditional slicing. The fibroid is pushed into the uterine cavity, enabling the surgeon to work safely and completely resect the intramural component with an angled cutting loop. This technique has been successfully reported in 41 out of 44 women with submucous fibroids G2 ranging from 2 to 4 cm (means diameter 3.2 cm) and myometrial free margin >4 mm at ultrasound (Litta *et al.*, 2003).

Lasmar's technique: the Collins electrode is used in shape of a 'L', to dissect the endometrium around the fibroid until getting to it. At this time, the direct mobilization of the fibroid is started in all directions, doing the coagulation only of the vessels that are

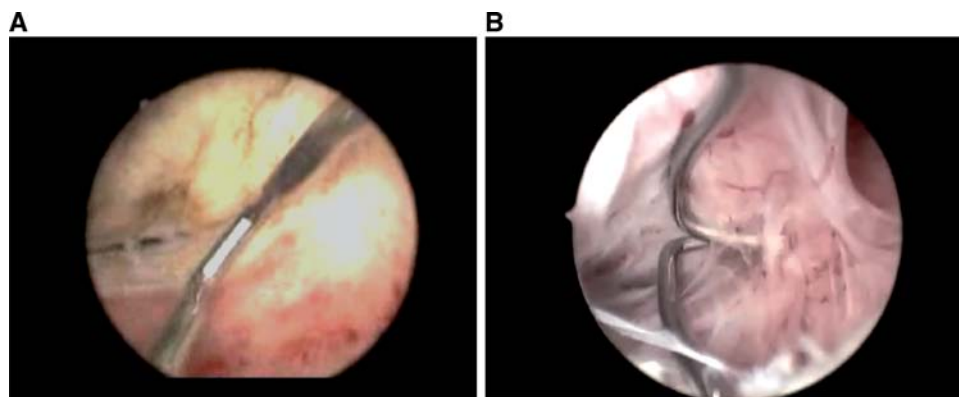


Figure 6: (A) The rectangular loop is inserted into the plane between the fibroid and myometrium to progressively dissect it from the myometrial wall (B) Connective bridges which join the fibroid and the adjacent myometrium are hooked by the single tooth cold loop (Images by I. Mazzon)

bleeding. When the fibroid is in the cavity it is possible to remove it with grasping forceps (small fibroids) or to slice it in several pieces using the Collins electrode. This technique has been successfully reported in 98 cases (50 out of 98: direct mobilization plus grasping; 46 out of 98: direct mobilization plus slicing) (Lasmar and Barrozo, 2002).

Technique of 'hydromassage'

Starting from the observation that the intramural portion of a submucous fibroid squeezes out of its base after contractions of the uterus during the removal of tissue chips (Loffer, 1990), Hamou (1993) proposed a 'fibroid massage' through rapid changes of intrauterine pressure using an electronically controlled irrigation and suction device (Endomat; Karl Storz GmbH Co., Tuttlingen, Germany). Indeed, interrupting and restarting the supply of distension liquid several times, myometrial contraction is stimulated, obtaining the maximum possible migration of the intramural component of the fibroid into the cavity. At present, series evaluating the effects of this technique are lacking in international literature.

'Manual massage' technique

At the beginning of 1990s, Hallez (1995) introduced a single-stage technique in which, after a partial myomectomy of the protruding dome of the fibroid, uterine contractions were induced by finger massage of the uterus (similar to obstetric manoeuvres as Crede's one), thus expelling the residual intramural fibroid into the uterine cavity and making it accessible for a safe hysteroscopic resection. Hallez (1995) reports good anatomical and functional results after resection with such technique of 222 submucous fibroids with intramural development.

'Two-resectoscope technique'

Lin *et al.* (2000) proposed a one-procedure hysteroscopic myomectomy by using two resectoscopes. A 7-mm resectoscope is first used to cut the capsule of the fibroid next to muscular layer of the uterus. This prevents the fibroid from sinking in the muscular layer as the procedure progresses. The fibroid is then dissected from the muscular layer. Then, after the fibroid has been dissected from the muscular layer, a standard resectoscope with a 9-mm external outer sheath is used to shave the body of the fibroid. A Lin fibroid grasper (Atom Medical Co., Tokyo, Japan) may be

used to pull the fibroid further into the intrauterine cavity. The procedure is continuously monitorized by ultrasonography. The index technique has been successfully reported in only two infertile women presenting with menorrhagia.

Office hysteroscopic myomectomy

Fibroids <1.5–2 cm, with a minimal intramural component, can be removed in outpatient setting using smaller diameter hysteroscopes and 5Fr mechanical and bipolar instruments. In these cases, to avoid any myometrial stimulation or damage of the surrounding healthy myometrium, the fibroid is first gently separated from the capsule using mechanical instruments (grasping, forceps or scissor) as described for 'cold loop' resectoscopic myomectomy. Once the intramural section becomes intracavitary then it is sliced with the bipolar electrode (Fig. 5B) (Bettocchi *et al.*, 2002).

Pharmacological-aided techniques

Several drugs may stimulate uterine contractions pushing the intramural part of the fibroid into the cavity, thus anticipating what generally happens spontaneously during the weeks following the operation. Murakami and colleagues (2003, 2006) proposed a transabdominal injection of prostaglandin F (PGF)-2 α under laparoscopic monitoring, while Indman (2004) reported the successful use of intracervical carboprost, a methyl analogue of PGF-2 α , in 8 out of 10 cases in which the drug was administered to facilitate resection of fibroids that otherwise could not be resected completely.

Global endometrial ablation

New instrumentation and the off-label use of some global (non-hysteroscopic) ablation techniques allow some selected patients with submucous fibroids, who have completed their family planning, to be treated only by endometrial ablation (Hickey and Farquhar, 2003; Loffer, 2006).

Conventional endometrial ablation techniques cannot be used when the uterine cavity is remarkably enlarged (>12 cm) and distorted as result of submucous or intramural myomas. Indeed, in such situation it is hard for most devices with a rigid intrauterine probe to access all areas of the endometrium.

Hydrothermal ablation system circulates free heated saline under hysteroscopic visualization and thus very readily adapts to

an irregular cavity. It has already been demonstrated to be safe and effective in treating women with menorrhagia and submucous fibroids up to 4 cm in diameter (Glasser and Zimmerman, 2003).

Microwave endometrial ablation (MEA) is based on a generator supplying microwave energy to a 8 mm hand-held reusable probe. This results in a reliable 5–6 mm depth of endomyometrial penetration. Recently, a thinner (4 mm) curved microwave probe has been developed, in order to accomplish the complete coverage of the uterine cavity, even in case of enlarged (12–16 cm in length) and distorted cavity as a result of large submucous fibroids (Kanaoka *et al.*, 2003, 2005). Available data about the outcome of MEA in patients with menorrhagia caused by submucous myomas are few but encouraging. The improvement of menorrhagia is accompanied with a significant shrinkage of myoma related to a necrotic degeneration recognizable by MRI 1–2 months after the procedure (Kanaoka *et al.*, 2003, 2005).

Effects of hysteroscopic myomectomy on menstrual pattern and infertility

No meta-analysis of the association of submucous fibroids and AUB has been performed; however, most studies have shown that hysteroscopic myomectomy is safe and effective in the control of menstrual disorders with a success rate ranging from 70 to 99%. Usually the success rate declines as the follow-up period increases; this could be due to a number of factors including the incomplete removal of fibroid (which could in time become larger and cause bleeding) as well as the occurrence of other dysfunctional factors as a cause of menorrhagia (Mazzon and Sbiroli, 1997).

The hysteroscopic technique (Table IV) adopted does not seem to significantly affect the success rate.

The failure of hysteroscopic treatment seems to be related to the growth of fibroids in other sites, the association of fibroids with adenomyosis and the incomplete treatment of partially intramural submucous fibroids (Donnez *et al.*, 1995). The complete resection of the intramural part of the fibroid is certainly advisable to improve the control of menorrhagia, with lower chance of subsequent recurrence (Wamsteker *et al.*, 1993; Parent *et al.*, 1994; Van Dongen *et al.*, 2006).

Furthermore, uterine size (Emanuel *et al.*, 1999; Hart *et al.*, 1999), fibroid size (Hart *et al.*, 1999) and the number of fibroids (Emanuel *et al.*, 1999) found at hysteroscopy seem to have an independent prognostic value for recurrence of AUB.

In women who have completed their family planning, good long-term results in controlling bleeding have been achieved by concomitant hysteroscopic endometrial ablation which leads to an amenorrhoeic status in up to 95.5% of patients (Brooks *et al.*, 1989; Derman *et al.*, 1991; Phillips *et al.*, 1995; Glasser, 1997; Loffer, 2000, 2005; Polena *et al.*, 2007).

The effects of hysteroscopic myomectomy on the reproductive outcome in infertile women have been investigated by several authors (Hunt and Wallah, 1974; Donnez *et al.*, 1990; Valle, 1990; Corson and Brooks, 1991; Goldenberg *et al.*, 1995; Preuthippan and Theppisai, 1998; Giatras *et al.*, 1999; Varasteh *et al.*, 1999; Vercellini *et al.*, 1999; Bernard *et al.*, 2000; Fernandez *et al.*, 2001; Pritts, 2001; Donnez and Jadoul, 2002; Munoz *et al.*, 2003; Shokeir, 2005; Stamatellos *et al.*, 2006; Somigliana *et al.*, 2007), but unfortunately the evidence thus far is not of the highest quality. Reported post-surgical pregnancy rate varies from 16.7 to

76.9% with a mean of 45%. This large variation may be mainly related to difficulty in controlling for multiple infertility factors, to sample size and follow-up discrepancies and to differences in patients' (i.e. age, primary or secondary infertility) and fibroid characteristics (i.e. number, size, intramural portion and presence of concomitant intramural fibroids) (Cheong and Ledger, 2007; Somigliana *et al.*, 2007).

Uterine fibroids as an isolated cause of infertility are very uncommon. Two papers (Buttram and Reiter, 1981; Verkauf, 1992), generally cited as sources of epidemiological data about this issue, reported that uterine fibroids as an isolated cause of infertility range from 1 to 2.4%. However, these studies do not provide a reliable estimate of the real impact of fibroids on infertility as routine diagnostic evaluations performed were not listed and they precede the advent and widespread use of new instrumentations (i.e. TVS and endoscopic procedures) (Somigliana *et al.*, 2007).

Several studies (Ubaldi *et al.*, 1995; Bernard *et al.*, 2000; Fernandez *et al.*, 2001) have shown that post-operative reproductive outcome is adversely affected by the presence of additional infertility factors. Particularly, Fernandez *et al.* (2001) reported in their retrospective series that the pregnancy rate was 41.6% when the fibroid was the only apparent cause, compared with 26.3% with the presence of one factor and 6.3% with two or more additional factors.

In another retrospective study (Bernard *et al.*, 2000) a statistically significant difference in delivery rate was found between patients with one fibroid and those with a number of fibroids equal or superior to two. Furthermore, the authors report that patients without an intramural fibroid associated had a significantly greater delivery rate and a significantly shorter delay of conception than those found in patients with associated intramural fibroids. These differences cannot be due to uterine cavity abnormalities as the associated intramural fibroids did not cause any distortion of the uterine cavity as assessed by an office hysteroscopy performed four weeks after resection. These results reinforce the hypothesis that other mechanisms associated with fibroids may contribute to infertility.

In a recent prospective study, Stamatellos *et al.* (2006) has reported increased fertility rates after hysteroscopic myomectomy of type 0 and type 1 fibroids in previously infertile women. Interestingly, in patients with type 2 fibroids fertility rate did not increase, in contrast with patients with type 2 fibroids who received expectant management (control group).

Fernandez *et al.* (2001) described higher pregnancy rates after the removal of larger fibroids, although the difference was not statistically significant. Indeed, the pregnancy rate after the removal of fibroids >5 cm in size was 57%, whereas it was 23% for fibroids <5 cm.

Finally, assessing the real impact of hysteroscopic myomectomy on subsequent fertility seems to be highly hampered by the fact that most studies addressing this issue were retrospective (Donnez *et al.*, 1990; Goldenberg *et al.*, 1995; Giatras *et al.*, 1999; Varasteh *et al.*, 1999; Vercellini *et al.*, 1999; Bernard *et al.*, 2000; Fernandez *et al.*, 2001; Munoz *et al.*, 2003) and did not have a control group (Donnez *et al.*, 1990; Valle, 1990; Hallez, 1995; Goldenberg *et al.*, 1995; Vercellini *et al.*, 1999; Giatras *et al.*, 1999; Bernard *et al.*, 2000; Fernandez *et al.*, 2001; Munoz *et al.*, 2003; Shokeir, 2005).

Only one study (Varasteh *et al.*, 1999) had a control group of infertile women and the authors showed that the removal of

Table IV: Bleeding control after hysteroscopic myomectomy (1976–2007)

Author	Cases (n)	Main indications (%)	Technique (n)	Follow-up years ^a	Bleeding control (%)
Neuwirth and Amin (1976)	5	80 AUB 20 Infertility	Resectoscopic excision of myoma by slicing	5	100
Brooks <i>et al.</i> (1989)	62	79 AUB 21 AUB+infertility	Resectoscopic excision of myoma by slicing (57) Resectoscopic excision of myoma by slicing with endometrial ablation (5)	>3 months	74
Derman <i>et al.</i> (1991)	156	90.4 AUB 9.6 Infertility	Resectoscopic excision of myoma by slicing (94) Endometrial ablation with or without resectoscopic myomectomy (62)	4 (1–16)	83.9 77.5
Indmann (1993)	51	100 AUB	Resectoscopic excision of myoma by slicing	(1–5)	94
Wamsteker <i>et al.</i> (1993)	51	100 AUB	Resectoscopic excision of myoma by slicing	1.7 (0.8–2.5)	94.1
Donnez <i>et al.</i> (1994)	366	100 AUB	Resectoscopic excision of myoma by slicing and Nd:YAG laser (two-step procedure)	2	89
Wortman <i>et al.</i> (1995)	75	100 AUB	Resectoscopic excision of myoma by slicing with endometrial ablation	(1–5)	84
Brooks (1995)	12	100 AUB	Hysteroscopic myomectomy by electrosurgical vaporization	(0.5–1)	100
Hallez (1995)	284	79 AUB 11 Infertility	Resectoscopic excision of myoma by slicing	(0.5–8.8)	76.3
Phillips <i>et al.</i> (1995)	208	100 AUB	Resectoscopic excision of myoma by slicing (120) Resectoscopic excision of myoma by slicing with endometrial ablation (88)	(0.5–6)	84.1 88.5
Glasser (1997)	35	100 AUB	Hysteroscopic myomectomy by electrosurgical vaporization (6) Hysteroscopic myomectomy plus endometrial ablation by electrosurgical vaporization (29)	2	97
Vercellini <i>et al.</i> (1999)	101	71 AUB 29 AUB+infertility	Resectoscopic excision of myoma by slicing	3.4 ± 1.9 ^b	70
Hart <i>et al.</i> (1999)	122	93 AUB 7 Infertility	Resectoscopic excision of myoma by slicing	2.3 (1–7.6)	81.9
Emanuel <i>et al.</i> (1999)	266	100 AUB	Resectoscopic excision of myoma by slicing	3.8 (0.1–8.6)	84.5
Munoz <i>et al.</i> (2003)	96	84 AUB 12 Infertility	Resectoscopic excision of myoma by slicing	2.8 (1–7)	88.5
Loeffler (2005)	177	91 AUB 9 AUB+infertility	Resectoscopic excision of myoma by slicing (104) Resectoscopic excision of myoma by slicing with endometrial ablation (73)	(1–15)	80.8 95.9
Campo <i>et al.</i> (2005)	80	79 AUB 17 Infertility	Resectoscopic excision of myoma by slicing	(0.5–2)	69.5
Marziani <i>et al.</i> (2005)	107	78 AUB 23 Infertility	Resectoscopic excision of myoma by slicing	(2–5)	80.9
Polena <i>et al.</i> (2007)	235	84.7% AUB 6.8% Infertility	Resectoscopic excision of myoma by slicing (with endometrial ablation in 37% of patients)	3.3 (1.5–5.5)	94.4

AUB includes menorrhagia, metrorrhagia, post-menopausal bleeding, menorrhagia or metrorrhagia on hormonal replacement therapy. ^aData are expressed as median (range) if not otherwise stated; ^bmean ± SD.

submucosal fibroids >2 cm carried a significant benefit in terms of pregnancy and live birth rates. However, the limited sample size (control group: $n = 19$; myomectomy group: $n = 36$) reduces the strength of these results.

Only a randomized controlled study would provide a definitive assessment of the advantages of such technique on reproductive outcomes and would be useful to confirm that fibroids are not purely coincidental with infertility (Donnez and Jadoul, 2002, Somigliana *et al.*, 2007); such a study should be performed comparing pregnancy rates between infertile women with submucous fibroids resected or left *in situ* (Pritts, 2001). However, such a study would be hard to justify because such lesions often cause menorrhagia, they require histologic diagnosis and they are likely to contribute to infertility (Varasteh *et al.*, 1999).

Also, technical factors such as the surgeon's skill and experience as well as the applied techniques surely play an important role (Stamatellos *et al.*, 2006). Thus, as similar studies are lacking in international literature, it might be interesting to evaluate whether the choice of a myometrial sparing technique would further increase the reproductive outcomes.

The advent of assisted reproductive techniques and in particular of IVF has offered a useful tool to elucidate the impact of fibroids on embryo implantation. However, there is no definite consensus on whether fibroids affect the outcome and should be removed prior to any attempt. Their location, followed by size, is considered the main factor determining this impact (Gianaroli *et al.*, 2005; Kolankaya and Arici, 2006).

Four meta-analysis (Pritts, 2001; Donnez and Jadoul, 2002; Benecke *et al.*, 2005; Somigliana *et al.*, 2007) have aimed to assess the impact of fibroids on IVF cycles.

Pritts (2001) reported significantly lower pregnancy (RR 0.32), implantation (RR 0.28), and delivery (RR 0.75) rates in patients with submucosal fibroids and abnormal uterine cavities in comparison with infertile controls without fibroids. Results from Donnez and Jadoul (2002) confirm a negative impact only of submucous fibroids on embryo implantation.

Conversely, Benecke *et al.* (2005) reported a negative impact also of intramural fibroids. Recently, Somigliana *et al.* (2007) performed an updated meta-analysis reporting significantly lower pregnancy and delivery rates for patients with submucosal fibroids [odds ratio (OR): 0.3; OR: 0.3] and intramural fibroids (OR: 0.8; OR: 0.7).

The impact of hysteroscopic myomectomy on IVF outcome has been less extensively investigated. Among the three studies evaluating the impact of previous myomectomy on IVF cycles (Seoud *et al.*, 1992; Narayan *et al.*, 1994; Surrey *et al.*, 2005), only two (Narayan *et al.*, 1994; Surrey *et al.*, 2005) include patients operated for submucousal fibroids.

Meta-analysis of these two studies reports that hysteroscopic myomectomy does not appear to negatively affect the chance of pregnancy in IVF cycles (Somigliana *et al.*, 2007). However, positive answers could be doubted, as they were based on two retrospective studies only, both of them characterized by a limited number of patients.

Operative and long-term complications

Hysteroscopic myomectomy is one of the most advanced operative hysteroscopic procedures as it is associated, particularly for complex cases, with a significantly higher rate of complications

than other hysteroscopic procedures (Jansen *et al.*, 2000; Propst *et al.*, 2000; Aydeniz *et al.*, 2002; Murakami *et al.*, 2005). Reported data show a rate of complication ranging from 0.3 to 28%, fluid overload and uterine perforation being the most frequent complications occurring during surgery (Loffer, 1990; Valle, 1990; Corson and Brooks, 1991; Derman *et al.*, 1991; Serden and Brooks, 1991; Pace, 1993; Wamstecker *et al.*, 1993; Hallez, 1995; Jansen *et al.*, 2000; Propst *et al.*, 2000; Agostini *et al.*, 2002; Darwish, 2003). Other intraoperative complications include bleeding, cervical trauma and air embolism, while late complications include post-operative intrauterine adhesion (IUA) (Wamstecker *et al.*, 1993; Hallez, 1995; Giatras *et al.*, 1999; Taskin *et al.*, 2000; Acunzo *et al.*, 2003; Guida *et al.*, 2004; Nappi *et al.*, 2007) and uterine rupture during pregnancy (Derman *et al.*, 1991; Yaron *et al.*, 1994; Darwish, 2003; Valle and Buggish, 2007).

Uterine perforation

Uterine perforation may occur during cervical dilatation, hysteroscope insertion and intramyometrial tissue resection. In particular, the risk of perforation increases in case of fibroids with intramural component whereas an aggressive uterine fibroid resection into the myometrium is carried out (Mazzon, 1995; Murakami *et al.*, 2005). In case of uterine perforation, the procedure should be terminated immediately and, if there is a mechanical perforation in which bowel damage is not suspected, the patient can be observed and discharged if stable (Indman, 2006). If a perforation occurs secondarily to an activated electrode then it should be assumed that there is a bowel injury until proven otherwise, and laparoscopy must be done without delay (Indman, 2006).

Intravasation and electrolyte imbalance

The most dangerous complication during hysteroscopic myomectomy is an excessive intravasation of the fluid used to distend and irrigate the uterine cavity. Severe fluid overload can cause pulmonary edema, hyponatremia, heart failure, cerebral edema and even death (Emanuel *et al.*, 1997). Fluid absorption occurs through the open veins of the fibroid and possibly through transperitoneal absorption from retrograde flow through the Fallopian tubes. Guidelines indicate that fluid intravasation of 750 ml during surgery requires planned termination of the operation (Loffer, 2000) and that the intervention must be immediately stopped when balance exceeds of 1000 ml (Munoz *et al.*, 2003) or, according to other authors, 1500–2000 ml (West and Robinson, 1989; Baumann *et al.*, 1990; Istre *et al.*, 1994). The risk factors for intravasation during hysteroscopic myomectomy are not completely elucidated because no studies have tested their independent contribution or relation to fluid loss. The main factor seems to be the intramural extension of the fibroid (Emanuel *et al.*, 1997); indeed, in cases of fibroids with deep intramural extension, intravasation will increase mainly because of damage to larger-sized vessels (Emanuel *et al.*, 1997). Other reported factors possibly associated with a higher risk of intravasation include the length of the operation (Corson *et al.*, 1994; Emmanuel *et al.*, 1997), the size of the fibroid (Maher and Hill, 1990) and the total inflow volume (Corson *et al.*, 1994).

Management of this risk relies on close monitoring of the fluid balance and interruption of the procedure before excessive fluid absorption occurs. The difference between the amount of inflow and outflow fluid (including also fluid leaking from the vagina) could be assessed by dedicated operating room personnel or by modern electronic balances and pumps (i.e. Hydromat Gyn and Equimat, Karl Storz GmbH Co., Tuttlingen, Germany; HysteroBalance/HysteroFlow, Olympus Medical System GmbH, Hamburg, Germany).

The use of normal saline combined with bipolar energy reduces the risk of hyponatremia (eliminating the problem of the accumulation of the free water), but an excessive intravasation (>1500 ml) still remains a risk and might cause cardiac overload (Murakami *et al.*, 2005).

Post-operative IUA

The incidence of post-operative IUAs represents the major long-term complication of hysteroscopic myomectomy ranging from 1 to 13% (Wamsteker *et al.*, 1993; Hallez, 1995; Giatras *et al.*, 1999). To minimize the risk of post-operative IUA, it is necessary to avoid forced cervical manipulation, and trauma of healthy endometrium and myometrium surrounding the fibroid; it is also advisable to reduce the usage of electrosurgery especially during the removal of fibroids with extensive intramural involvement (Mazzon, 1995) and multiple fibroids on opposing endometrial surfaces (Indman, 2006). An early second-look hysteroscopy after any hysteroscopic surgery is another effective preventive and therapeutic strategy (Wheeler and Taskin, 1993).

Several pharmacologic (conjugated estrogen, levonorgestrel-releasing intrauterine device) and barrier agents, including foley catheter, hyaluronic acid gel and hyaluronic acid and carboxymethylcellulose (Septrafilm) have been used to reduce IUA development. A recent review has clearly indicated that there is no single modality proven to be unequivocally effective at preventing post-operative adhesion formation for hysteroscopic surgery (Nappi *et al.*, 2007).

Uterine rupture during pregnancy

Uterine rupture may occur in a subsequent pregnancy after surgery invading the myometrium, perforation during entry or during surgery. Therefore when any of the above events occurs, it is important that the surgeon explains to the patient about the risk of uterine rupture in a subsequent pregnancy and to document this discussion clearly in the medical records (Valle and Buggish, 2007).

A recent review of the complications after hysteroscopic myomectomy only reports two cases of uterine rupture following such surgery (Derman *et al.*, 1991; Yaron *et al.*, 1994).

According to some authors the interval between uterine operation infringing on the myometrium and attempts for pregnancy should not be less than one year from the date of uterine surgery (Valle and Buggish, 2007). Although some surgeons believe that caesarean section should be preferred whenever you are dealing with fibroids with intramural development (Keltz *et al.*, 1998; Cravello *et al.*, 2004), currently there is lack of strong evidence to suggest this mode of delivery to reduce the risk of uterine rupture.

Conclusions

Hysteroscopic myomectomy currently represents one of the greatest advances in the field of hysteroscopic surgery. Ideally, it should result in the complete removal of the fibroid (reducing the chance of recurrence and re-growth) (Wamsteker *et al.*, 1993; Parent *et al.*, 1994; Van Dongen *et al.*, 2006) without traumatizing the normal surrounding uterine tissue.

It is well ascertained that fibroids developing completely within the uterine cavity can be easily removed in a single procedure with fibroid size representing the main limiting factor (Mazzon and Sbiroli, 1997; Isaacson, 2003; Indman, 2006).

Resectoscopic slicing still represents the standard widely-used technique for treating such fibroids (Neuwirth, 1995; Mazzon and Sbiroli, 1997; Isaacson, 2003; Gallinat, 2005; Indman, 2006) though several other techniques have been introduced. It is less expensive than laser treatment and quick to perform when you have adequate training. Recently, an innovative and effective device called IUM has been proposed and it may become in the near future a valid alternative to the traditional transcervical resectoscopic myomectomy (Emanuel and Wamsteker, 2005).

Furthermore, the development of smaller diameter scopes with working channels and continuous flow systems together with the establishment of bipolar technology, have made possible the outpatient treatment of small (<1.5–2 cm) totally intracavitary fibroids as well as those with minimal intramural development thus avoiding both cervical dilatation and any anaesthesia or analgesia (Bettocchi *et al.*, 2002; Clark *et al.*, 2002).

On the other hand, the resection of fibroids with intramural extension is advisable only for expert surgeons as it is technically difficult and has a higher risk of complications than other hysteroscopic procedures (Propst *et al.*, 2000). The frequency of complications and the chance of achieving the complete resection of the lesion at one surgical time, may widely vary depending on the extension of intramural component and the operative technique (Loffer, 1990; Valle, 1990; Derman *et al.*, 1991; Corson and Brooks, 1991; Serden and Brooks, 1991; Pace, 1993; Wamsteker *et al.*, 1993; Hallez, 1995; Jansen *et al.*, 2000; Propst *et al.*, 2000; Agostini *et al.*, 2002; Darwish, 2003; Van Dongen *et al.*, 2006). Furthermore, while differences in equipment do not seem to have significant effects on surgery for fibroids G0, advanced 'state of the art' equipment is necessary for carrying out safe hysteroscopic myomectomy for fibroids with intramural extension (Murakami *et al.*, 2005).

Several techniques have been developed to completely remove such fibroids, all of those aiming at the transformation of an intramural fibroid into a totally intracavitary lesion, thus avoiding a deep cut into the myometrium.

While G1 fibroids may be often completely removed in one step, as the uterus contracts and tends to expel the intramural component into the cavity during surgery, the removal of G2 fibroids may be much more problematic.

In such cases, despite of recent evidence indicating that an incomplete removal does not always necessitate subsequent surgery, patients should always be advised regarding the possibility of another surgical step (Van Dongen *et al.*, 2006).

The present review clearly indicates that there is still no single technique proven to be unequivocally superior to the others for treating fibroids with intramural development (G1-G2). The

two-step technique seems to be very effective and safe; however, the extended GnRH agonist treatment and repeated hysteroscopies can cause greater distress in patients. One-step myomectomy remains more desirable and the 'cold loop' myomectomy seems to represent the best option as it allows a safe and complete removal of such fibroids in just one surgical procedure, while respecting the surrounding healthy myometrium. This might reduce the risk of operative (i.e. bleeding, perforation) and long-term complication (i.e. IUA and uterine rupture).

Other techniques including 'enucleation *in toto*', 'hydromassage' and pharmacologic aided-techniques may be helpful to induce the shrinkage of the intramural portion in the uterine cavity, but the contractile reaction of the myometrium is neither predictable nor standardizable, and this represents an uncertain variable.

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Submitted on September 10, 2007; resubmitted on October 3, 2007; accepted on October 30, 2007

The destiny of myomas: should we treat small submucous myomas in women of reproductive age?

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By using their current knowledge and presenting what they consider to be the best available evidence, the investigators performed a thorough analysis aimed at demonstrating that a so-called wait-and-see approach is no longer acceptable in women of reproductive age with small (<1.5 cm) submucous myomas, especially if the lesion could be easily and safely removed by hysteroscopy in an outpatient setting, with minimal patient discomfort. (Fertil Steril® 2007; ■: ■–■. ©2007 by American Society for Reproductive Medicine.)

Key Words: Office hysteroscopy, fibroids, infertility, assisted reproduction techniques, myomectomy

Hysterectomy and laparotomic excision have long been considered the two standard routes of surgical treatment for symptomatic submucous myomas (1–5).

The development of endoscopy has made these myomas accessible and resectable from the inner surface of the uterus (6, 7). Currently, hysteroscopic surgery is considered to be the first-line conservative therapy for the management of symptomatic submucous myomas. It can be tailored to the woman's needs and geared toward alleviating her symptoms (8).

Resectoscopic myomectomy with monopolar or bipolar cutting loops still represents the standard surgical approach for the treatment of such myomas, with the first experiences being published almost 30 years ago (9, 10). However, such an approach has a number of disadvantages, including the need for an operating room and, subsequently, for personnel and more intensive postoperative surveillance, as well as the necessity of both cervical dilatation and general or epidural anesthesia. Furthermore, several quite-serious complications, such as hemorrhage, infection, genital tract trauma, and fluid overload (11), have been reported to occur in ≤5% of resectoscopic myomectomies.

In the last 15 years, the development of smaller diameter hysteroscopes (<5 mm) with working channels and continuous flow systems has made possible the treatment of most uterine and cervical pathologies under an outpatient regimen,

with no need for either cervical dilatation or any analgesia and/or local anesthesia.

This new philosophy (*see-and-treat hysteroscopy*) has reduced the differences between a diagnostic and an operative procedure by introducing the concept of a single procedure, in which the operative part is perfectly integrated in the diagnostic workup (12).

Mechanical operative instruments (scissors, biopsy cup, grasping, corkscrew) have long been the only way to apply the see-and-treat procedure in an outpatient setting (13). The advent of bipolar technology, together with the introduction of electrosurgical systems dedicated to hysteroscopy, as well as several types of 5-Fr electrodes, have led to a remarkable increase in the number of pathologies that are treated by office operative hysteroscopy, including submucous myomas of <1.5 cm in diameter, which long have represented the cut-off for office hysteroscopic treatment (14).

Data available in the international literature regarding the necessity of treating such small myomas (although they usually are asymptomatic), apart from the surgical route (referred to as office or resectoscope treatment), are scant and controversial. However, the current clinical trend clearly is shifted toward a wait-and-see approach (15, 16), and expectant management has been suggested as the norm (17, 18).

However, let us suppose, for a moment, that during a diagnostic hysteroscopy performed on a 30-year-old woman who is trying to conceive, we decide not to remove an accidental, small (<1.5 cm), submucous myoma. How could we confidently answer the patient then about the risks that such a lesion could impair her fertility? Could we absolutely exclude that the myoma would become bigger before or during

Received July 12, 2007; revised and accepted September 7, 2007.

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pregnancy, thus posing greater risk for complications either during gestation or during an operative procedure? And yet, let us consider a small submucous myoma in an asymptomatic 40-year-old woman who is undergoing diagnostic hysteroscopy after an ultrasonography that is suspicious for intrauterine growth. How could we reassure such a patient about the nature of the mass or, most important, about the future occurrence of any lesion-related symptom?

Using our current knowledge and presenting what we considered the best available evidence, we performed a thorough analysis aimed at demonstrating that a wait-and-see approach is no longer acceptable in women of reproductive age with small submucous myomas, even if they are asymptomatic, especially if the lesion may be easily and safely removed in an outpatient setting during the diagnostic workup, with minimal patient discomfort.

DESTINY OF MYOMAS

It is (or should be) widely accepted that even a 0.5-cm mass invading the uterine cavity may exert a more detrimental effect than a 3-cm lesion that is located in the uterine serosa. We will try here to explain that. The destiny of a myoma primarily depends upon the combination of its location, size, shape, and number. This is mainly due to the special features of the uterine cavity. Its form is that of an isosceles triangle with incurved sides. The length of the cavity in a woman of reproductive age is about 3 cm, with the breadth between the fallopian tubes' os being 1.7 cm, and <1 cm at the center of the cavity. The volume of the uterine cavity in its physical condition (with the walls collapsed) shows an average value of 1 mL, whereas in pregnancy, it can exceed 10 L (19, 20).

A so-called intramural myoma is not a permanent pragmatic entity. Most myomas arise right from the inner myometrial fibers of the uterine walls and show an intramural growth. Thus, they can be undetectable at laparoscopy and/or hysteroscopy, at ≤ 1.5 cm in size. Therefore, a purely intramural myoma represents a temporary status, and its growth is dependent on the existing hormonal conditions of the woman. Once the myoma starts to grow inside the myometrium, it can displace the adjacent muscle fibers (by producing dislocation, compression, and stretching, but not rupture), moving toward either the mucosa or the serosa. In the latter case, it may become detectable either in the uterine or the abdominal cavity.

Purely subserosal myomas usually have a longer existence, because they may grow inside the abdomen and reach a considerable size (even 10 cm in diameter, or more) before becoming symptomatic.

Whether they are intramural and submucous or purely submucous, the destinies of myomas in a woman of reproductive age are different. Indeed, life spans and biological behaviors of such lesions are rather different. However, in both cases, the earlier that symptoms appear, the quicker will be recognition and treatment.

Because myomas usually are spherical in shape, it is easy to calculate by simple mathematics both their volumes and surfaces (Figs. 1 and 2), as follows:

$$\text{volume} = 4/3 \pi r^3 \text{ and surface} = 4 \pi r^2, \text{ where } \pi = 3.14 \text{ and } r = \text{ray.}$$

We would like to focus the reader's attention on the following two simple observations. First, linear growth in the diameter of a myoma corresponds to squared growth in its surface and to cubic growth in its volume. And second, a submucous myoma with a diameter of 2 cm, demonstrating a volume of 3.57 cm³ and a surface of 11.34 cm², would exceed the volume and the surface of a normal uterine cavity.

Hormonal Influence on Myomas

As has been well established in the literature, myomas are estrogen-dependent tumors (21). In women of reproductive age, one could logically expect myomas to change in size. In this respect, and as soon as there exists for them the positive stimuli of estrogens, even small myomas (1 or 2 cm) have a high growth potential and may result in a lesion that is more difficult to treat. We are not aware of any evidence of differing growth potential according to the myoma's position (e.g., whether they are subserosal, intramural, or submucous). Likewise, there is no definitive answer that can be given a patient who wonders whether an asymptomatic myoma will ever cause symptoms in the future. Such an answer becomes even more uncertain when the question involves pregnancy-related complications, because hormonal variations become more evident in such a case.

Risk of Malignancy

Even though the risk of malignancy is rare, even the most experienced operator cannot exclude malignancy or premalignant lesions (i.e., atypical polypoid adenomyoma) from the histological analysis (22), especially when the morphologic appearance of a lesion is obscure (e.g., polypoid contour) (23). Furthermore, the lack of a histological analysis may lead to a dangerous diagnostic delay in detecting mesenchymal tumors, which usually show aggressive biological behavior.

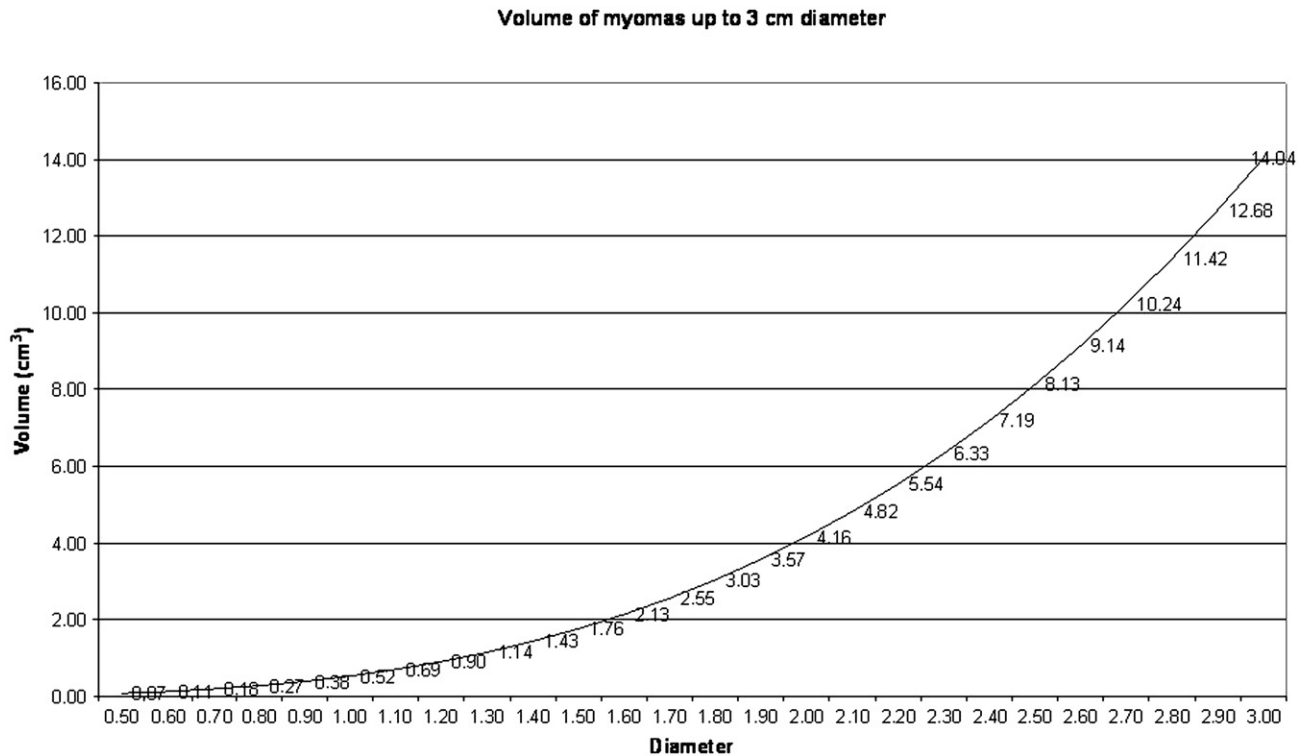
Myomas and Infertility

Uterine myomas also may be associated with female infertility that is caused by several incompletely clarified pathogenetic mechanisms (24–34). Their negative effects on fertility appear mainly to be dictated by their location and size (11, 35), with submucous myomas having more detrimental effects than intramural and subserosal ones (25, 28, 32, 34).

The percentage of women undergoing hysteroscopic myomectomy for infertility ranges from 11.6% to 32% (4, 37), with a reported postsurgical pregnancy rate varying from 16.7% to 76.9% (11, 28, 31, 32, 36–48).

FIGURE 1

Relation between myoma diameter and surface. Linear growth in the diameter of a myoma corresponds to squared growth in its surface.



Bettocchi. *Destiny of myomas. Fertil Steril* 2007.

However, the effects of hysteroscopic resectoscopic myomectomy on infertility still are unclear (10, 11). Indeed, assessing the real impact of such endoscopic technique on subsequent fertility appears to be hampered by difficulties in controlling for multiple infertility factors, by the varying number of submucous myomas resected, as well as by the presence of concomitant intramural fibroids (37, 49–51).

At present, it has yet to be ascertained whether small myomas that minimally distort the uterine cavity reduce fertility potential. Dieterich and colleagues (30) have reported that small myomas, which do not modify the morphology of the uterine cavity, appear not to affect conception outcomes, even in older women.

However, it is likely that as a submucous myoma gets bigger or invades further into the uterine layers, it will exert a more detrimental effect on fertility and will be more difficult to remove. Nevertheless, a definite response to this issue may be given only after appropriate prospective randomized studies have been conducted and the genetic mechanisms at the basis of myoma development and growth have been completely clarified.

In the meanwhile, we can state only that fertility issues are a sensitive area, in which every treatment option has to be extensively discussed with the subfertile couple, with the latter contributing essentially to the decision making process.

However, if the woman has a pathologic medical background (e.g., history of recurrent miscarriage or early pregnancy loss), the removal of these lesions should always be recommended.

Myomas and Assisted Reproduction Techniques

The advent of assisted reproductive techniques (ART) and in particular of IVF has offered a useful tool for elucidating the impact of myomas on embryo implantation. However, because there still is no definite consensus on whether myomas affect the outcome, they should be removed before any attempt. Their location, followed by their size, is considered to be the main factor determining this impact (52).

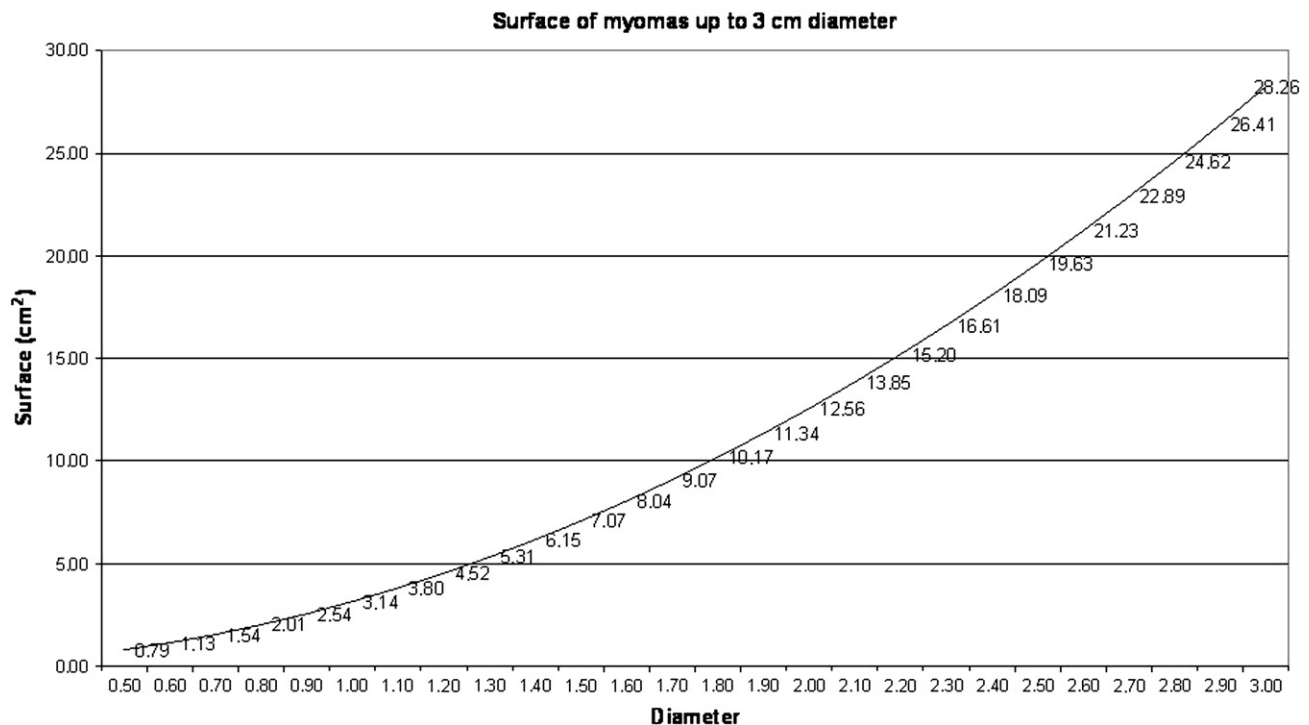
Four meta-analyses (31, 33, 53, 54) have aimed to assess the impact of fibroids on IVF cycles.

Pritts (31) reported significantly lower pregnancy rates (risk ratio, 0.32), implantation rates (risk ratio, 0.28), and delivery rates (risk ratio, 0.75) in patients with submucosal myomas and abnormal uterine cavities, in comparison with infertile control women without myomas. Results from Donnez and Jadoul (33) confirmed that only submucous myomas have a negative impact on embryo implantation.

Conversely, Benecke et al. (53) also reported a negative impact of intramural myomas. Recently, Somigliana et al.

FIGURE 2

Relation between myoma diameter and volume. Linear growth in the diameter of a myoma corresponds to cubic growth in its volume.



Bettocchi. Destiny of myomas. Fertil Steril 2007.

(54) performed an updated meta-analysis and reported significantly lower pregnancy and delivery rates for patients with submucosal myomas (respective odds ratios, 0.3 and 0.3) and with intramural myomas (respective odds ratios, 0.8 and 0.7).

The impact of hysteroscopic myomectomy on IVF outcome has been less extensively investigated. Among the three studies that evaluated the impact of previous myomectomy on IVF cycles (50, 55, 56), only two (50, 56) have included patients who were operated on for submucosal myomas.

A meta-analysis of those two studies reported that hysteroscopic myomectomy does not appear to negatively affect the chance of pregnancy in IVF cycles (54). However, such positive results may be in doubt, because they were based on only two retrospective studies, both of which were characterized by a limited number of patients.

To our knowledge, there have been no prospective studies comparing removal vs. nonremoval of submucous myomas of <1.5 cm diameter in women undergoing ART.

However, also considering the potential risk of failure, we believe that patients undergoing ART, especially those with unexplained infertility or with a history of recurrent implantation failures, need the best conditions before any treatment cycle. Further, in the case of infertile patients with a history of

recurrent implantation failures, a “special emphasis on correctable causes”, including myomas, has been suggested (57). The reasons for treatment are quite profound. Indeed, even if a submucous myoma is of small size, it may impair embryo implantation potential by causing endometrial changes, by altering myometrial vascularization and contractility, or simply by producing a mechanical compression.

In conclusion, we have presented the most apparent reasons for why submucous myomas, even if they are small and asymptomatic, should be treated in an office setting in women of reproductive age. We admit that much of the data referred to in this study are derived from an indirect approach, looking at the effect of fibroids on either causing symptoms or affecting reproduction.

Small myomas, being hormone-dependent benign tumors, have a high potential to grow and either become symptomatic or cause complications during natural or assisted conception and pregnancy. The clinician should always be aware of the biological effect of the hormonal changes and/or of high circulating levels of estrogens during a woman's reproductive life. In the menstrual cycle itself, the induced ovarian hyperstimulation during ART, as well as pregnancy, in most cases will enlarge myomas (58). In such cases, one could logically expect enlargement of a small and possibly asymptomatic myoma that is accidentally discovered in a diagnostic

workup. If so, the expected side effects and complications mentioned in this article would be much more difficult to treat later.

The evidence, so far, is not enough to justify a policy of not treating. Therefore, at present, the clinician's choice has to be influenced by the above-mentioned parameters. Nevertheless, every situation and patient must be judged separately; that is, management options must be biased toward the least risk of impairing fertility or of causing complications during pregnancy.

The use of large-diameter instruments such as resectoscopes, even in the presence of such small lesions, is not recommended because it requires cervical dilatation; local or general anesthesia; and an operating room with dedicated personnel, with correspondingly elevated health care costs.

However, office hysteroscopy appears to be an excellent method for the treatment of such lesions, because it has become easy to learn and perform. Moreover, with the aid of modern technology, it is accurate and offers the additional benefit of cost savings, shorter recovery, and minimal patient discomfort.

Nevertheless, currently, the effectiveness of office myomectomy has been demonstrated only in a few studies, which were characterized by potential methodological weaknesses, including the lack of a control group of women and a relatively short-term follow-up (14, 59, 60). Larger prospective comparative studies are needed to better evaluate this promising approach in terms of symptom response, complications, and cost savings.

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[Q22]

**1 The destiny of myomas: should we treat small
submucous myomas in women of reproductive
age?**

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A wait-and-see approach is no longer acceptable in
women of reproductive age when it comes to small
submucous myomas, even if they are asymptomatic.
This is especially the case if the lesion may be easily
and safely removed in an outpatient setting by using
hysteroscopy.

[Q23]

imaging techniques, as we recently supported in 2 studies on preoperative evaluation of submucous myomas [7,8]. Appropriate integration of sonography (diagnosis) and endoscopy (treatment) should enable our patients to benefit from the best possible minimal surgery required by their disease.

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doi:10.1016/j.jmig.2007.10.013

Response

To the Editor:

First of all, we thank Dr. Leone and Prof. Ferrazzi for their interest regarding our article [1]. Their insightful comments are worthy of our response to better clarify some issues.

It is unquestionable that ultrasound has revolutionized gynecology in that it allows us to see what we palpate, but also what we cannot palpate. Particularly, in recent years, it has been well-established that 3-dimensional (3D) ultrasound is an accurate and reproducible method for the diagnosis of congenital uterine anomalies. The superiority of 3D technique over conventional 2-dimensional (2D) ultrasound is in its ability to visualize the coronal plane of the uterus with both the internal and external uterine fundal contours. The 3D technique allows not only for description of the

anomaly but also measurements to be made (i.e., septum length, length of uterine cavity) [2].

However, with the same intellectual honesty, it cannot be denied that, currently, hysteroscopy has also made it possible to palpate (treat) under direct view (so it is not a blind surgery) those intrauterine structures that can only be indirectly seen at 2D or 3D ultrasonography.

Indeed, the development of smaller diameter scopes with working channels and continuous flow systems has introduced the concept of a single procedure in which the operative part is perfectly integrated with the diagnostic workup (see-and-treat hysteroscopy) [3,4]. According to this philosophy, in our study we have investigated "the possibility of performing metroplasty in an office setting . . . without any prior laparoscopic information." Our results have demonstrated if a double uterine cavity is diagnosed at hysteroscopy, we have the opportunity, instruments, technique, and criteria to differentiate double uteri and to safely treat only those suggestive of being uterine septa, independent of an earlier assessment of the true anatomy of the uterus.

However, we agree with Dr. Leone and Prof. Ferrazzi that, if available, 3D transvaginal sonography and post-processing technologies could avoid unnecessary hysteroscopies and laparoscopies. Unfortunately such technologies:

- 1) are still not available in many centers and, in the majority of cases, a uterine anomaly continues to be only suggested by 2D transvaginal sonography and then confirmed at hysteroscopy/laparoscopy or incidentally found at endoscopic view.
- 2) if available, are not always located in the same ambulatory center where the hysteroscopic procedure is performed.
- 3) at least in Italy, when the patient comes to a center, an appointment is made for a single procedure. It is very difficult to perform an additional examination if it is not scheduled prior.

In conclusion, the current study did not aim at demonstrating that hysteroscopy could replace ultrasound (or better, 3D ultrasound) but that, if 3D ultrasound is not available, one could diagnose correctly a septum with hysteroscopy.

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doi:10.1016/j.jmig.2007.11.002

Hysteroscopy: a technique for all? Analysis of 5,000 outpatient hysteroscopies

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Objective: 1) To investigate the relationship between operator experience and the success of outpatient hysteroscopy; and 2) to determine if the introduction of normal saline and the use of narrow-caliber hysteroscopes and vaginoscopic approach are associated with a lower failure rate.

Design: Retrospective study.

Setting: Teaching-hospital based outpatient hysteroscopy clinic.

Patient(s): Five thousand consecutive women undergoing outpatient hysteroscopy between October 1988 and June 2003.

Intervention(s): The hysteroscopies were carried out both by experienced operators and by trainees. Procedures were performed using 4-mm and 2.9-mm telescopes with 5-mm and 3.5-mm diagnostic sheaths, respectively. Between October 1988 and 1996, the uterine cavity was distended with CO₂ (CO₂ period), whereas normal saline was preferred after 1997 (1997–2003: saline period). Traditional technique of hysteroscope insertion and vaginoscopic approach were used depending on operator preference and experience and patient characteristics.

Main Outcome Measure(s): Success, failure, and complication rates.

Result(s): The hysteroscopies were successfully performed in nearly 95% of cases by 362 operators (mean 13.8 hysteroscopies per operator) with different levels of expertise. Failure and complication rates were 5.2% and 5.4%, respectively, without any significant difference between CO₂ and saline periods. Vasovagal attacks and shoulder pain were significantly higher during the CO₂ period. The success of outpatient hysteroscopy was negatively affected by postmenopausal status, nulliparity, need for cervical dilatation or local anaesthesia, traditional technique of hysteroscope insertion, and use of a 5-mm hysteroscope.

Conclusion(s): A high level of expertise is not a prerequisite to performing hysteroscopy on an outpatient basis. Recent advances in technique and instrumentation facilitate this approach and might encourage greater adoption by the wider gynecology community. (*Fertil Steril*® 2008;89:438–43. ©2008 by American Society for Reproductive Medicine.)

Key Words: Complication, experience, failure, outpatient hysteroscopy, success, vaginoscopy

Hysteroscopy can be regarded as the gold standard for the evaluation of the uterine cavity in cases of abnormal uterine bleeding, infertility, recurrent pregnancy loss, and suspected intrauterine out-growth (1, 2). It has replaced conventional cervical dilatation and curettage under general anesthesia, which has been shown to be diagnostically relatively inaccurate (3–6), for the investigation of abnormal uterine bleeding.

Hysteroscopy can be performed in the office setting (outpatient hysteroscopy) or as a day-case procedure, under general

anesthesia (inpatient hysteroscopy). Outpatient hysteroscopy has been shown to be as accurate as inpatient hysteroscopy. But compared with a traditional inpatient procedure, it has the advantage of reduced anesthetic risks, enhanced time-cost effectiveness, and patient preference (3, 7–8).

We believe the success of outpatient diagnostic hysteroscopy is based on three fundamental criteria: instrument quality, characteristics of the distension medium, and the ability and experience of the operators (9).

Recent technical advances, such as the introduction of small-diameter rigid and flexible hysteroscopes, have made it possible to perform hysteroscopy in the outpatient setting (10–13). Moreover the introduction of an atraumatic insertion technique (“no touch” technique or vaginoscopic

Received January 4, 2007; revised and accepted February 27, 2007.
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approach) has further minimized the patient’s pain and discomfort (11, 14–19).

Carbon dioxide (CO₂) and normal saline are the most commonly used distension medium for diagnostic hysteroscopy. Although CO₂ gas is generally well tolerated, uterine distension with normal saline has been shown to be more comfortable for the patient, to be more cost-effective, and to provide superior hysteroscopic views in cases of intrauterine bleeding (4, 13, 17, 20–22).

However, despite the high sensitivity and specificity, technical improvements, high patient acceptability, the low failure and complication rates, it has been estimated that only 15% of gynecologists in the United States routinely perform office hysteroscopy (23) and that only 36% of the members of the American Association of Gynecological Laparoscopists do so (24). Reasons given for this include a perceived paucity of patients who would benefit from the procedure, a duplication of procedures for patients who need surgery in the operating room, the expense of the capital equipment, poor reimbursements, and the perception that a high level of expertise is needed to perform the procedure (23). The scientific literature contributes to propagate the latter, because most studies on feasibility and safety of outpatient hysteroscopy state in the text that “all of the examinations were performed by one or a few experienced operators.”

We report the outcome and findings in 5,000 consecutive patients who underwent the examination in a teaching hospital-based outpatient hysteroscopy clinic. By definition, therefore, the hysteroscopies were carried out both by experienced operators and by trainees. Our analysis focused on: 1) the relationship between operator experience and the success of the procedure; and 2) determining if the introduction of normal saline and the use of narrow-caliber hysteroscopes and the no touch technique are associated with a lower failure rate.

MATERIALS AND METHODS

We conducted a retrospective review of 5,000 patients who underwent outpatient hysteroscopy between October 1988 and June 2003. The hysteroscopies were done at the John Radcliffe Hospital, Oxford (October 1988 to May 1990), and The Royal Free Hospital, London (June 1990 to June 2003). The study was approved by our Institutional Review Board, and all patients had given their informed consent for the hysteroscopy.

The most common indication for the procedure was abnormal uterine bleeding (84.7% of cases), and other reasons were subfertility (7.2%), check hysteroscopy after hysteroscopic surgery (3.5%), and lost intrauterine contraceptive device (1%) (Table 1). The women were defined as premenopausal, perimenopausal, and postmenopausal according to the following criteria: premenopausal—all women <45 years old with regular and/or irregular menstrual cycles; perimenopausal—women >45 years old with regular and/or irregular

TABLE 1	
Patient characteristics.	
Number of cases	5,000
Age, yrs (range)	44.2 (17–87)
Parity, mean	1.59
Nulliparous (%)	1,448 (29.8)
Menopausal status (%)	
Premenopausal	3,426 (68.5)
Perimenopausal	679 (13.6)
Postmenopausal	895 (17.8)
Current use of gynecologic medication (%)	1376 (27.5)
Hormonal	931 (18.6)
Nonhormonal	402 (8.0)
Both	43 (0.9)
None	3597 (72.3)
Previous uterine surgery (%)	859 (17.1)
Cesarean section	304 (6.1)
Myomectomy	170 (3.4)
Endometrial ablation	159 (3.2)
Cervical surgery	101 (2.0)
Others	125 (2.5)
Primary indication for hysteroscopy (%)	
Abnormal uterine bleeding ^a	4216 (84.7)
Subfertility ^b	360 (7.2)
Control after hysteroscopic surgery	174 (3.5)
Lost IUCD	48 (1.0)
Note: IUCD = intrauterine contraceptive device.	
^a Includes menorrhagia, intermenstrual bleeding, post-coital bleeding, and postmenopausal bleeding.	
^b Includes infertility and recurrent miscarriage.	
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menstrual cycles; and postmenopausal—women at least 1 year after the last menses or those who were taking estrogen replacement therapy.

Between October 1988 and April 1998 hysteroscopy was performed using a standard 4-mm telescope with a 30° fore-oblique lens and a 5-mm diagnostic sheath. After April 1998, hysteroscopy was performed using both the 4-mm telescope and the newer 2.9-mm optic with a 30° fore-oblique lens and a 3.5-mm diagnostic sheath (all instruments manufactured by Storz, Tuttlingen, Germany). Illumination was provided by a high-intensity cold light source via a fiber-optic lead. All the procedures were monitored using a video camera and a monitor.

Between October 1988 and 1996, the uterine cavity was generally distended with CO₂ (CO₂ period) via an electronic Hamou hysteroflator (Storz) adjusted to a flow rate of 45 mL/min and a pressure not exceeding 100 mm Hg. Following the results of our study in 1996 (13), we changed the distension medium to normal saline (1997–2003: saline period) infused at a pressure of 100 to 150 mm Hg by a pressure bag.

Patients were placed in the lithotomy position and an antiseptic solution was used to wash the vaginal cavity and the cervix. A bimanual examination was then performed to assess the size and position of the uterus. Diagnostic hysteroscopy was then performed using two different techniques:

Traditional technique: A Sims speculum was inserted into the vagina to visualize the cervix, and a vulsellum was then applied to the anterior lip of uterine cervix to create countertraction to facilitate the insertion of the hysteroscope.

No-touch technique: This was introduced in our clinic in 1999 and avoids the use of a speculum and a tenaculum. The hysteroscope is first introduced into the introitus of the vagina. The vagina is then distended with the saline distension medium. This facilitates visualization of the anatomy. The hysteroscope is then directed towards the cervix, the cervical canal, and then into the uterine cavity (14, 15, 19).

From 1988 to 1999, all hysteroscopies were performed with the traditional technique. After 1999, hysteroscopies were performed with either technique depending on operator preference and experience and patient characteristics. Whichever technique was used, the hysteroscope was guided through the endocervical canal and into the uterine cavity under direct vision. The cavity was then systematically examined, starting at the fundus and tubal ostia and finishing in the endocervical canal, which was examined in more detail during withdrawal of the hysteroscope. Cervical dilatation up to Hegar 4–6 and/or intracervical local anesthesia were carried out only when required. If this became necessary with the no touch technique, the hysteroscopy was continued using the traditional approach.

Endometrial biopsies were performed based on symptoms or abnormal hysteroscopic findings. Most biopsies were done using a small metal curette (1988 to 1996) or with a Pipelle de Cornier (1996 onwards; Laboratoire CCD, Paris, France). If a target biopsy was required, it was done using either 5-Fr biopsy forceps with an operative hysteroscope or a small metal curette. Minor surgical procedures were performed via 7-mm and 5-mm operative sheaths for 4-mm and 2.9-mm hysteroscopes, respectively, using flexible scissors or grasping forceps (all of the equipment manufactured by Storz). Minor surgical procedures involving the cervix (e.g., removal of IUD, cervical polypectomy) were performed with conventional instruments.

All hysteroscopies were defined as attempted or not attempted; the latter included cases where there was a contraindication or the patient chose to cancel the procedure. Hysteroscopies which were attempted were classified as successful (complete or incomplete) or failed according to the following criteria: complete—the entire uterine cavity including both tubal ostia were visualized; incomplete—the entire uterine cavity could not be examined (e.g., part of cavity was obscured by blood clots, fibroids, or other focal lesions, technical problems with the instruments, lack of distension); and failed—examination of the uterine cavity was not possible (e.g., because of pain, vasovagal attack, cervical stenosis,

extreme anxiety, heavy bleeding). Failed hysteroscopies were referred for investigation under general anaesthesia or for other investigations.

The hysteroscopic view, defined as the quality of the panoramic overview inside the uterine cavity, was defined as good or poor according to the following criteria: good—the view was of a high quality, allowing for a rapid assessment of the shape of the uterine cavity, the endometrium, and any focal lesions; poor—the view of the uterine cavity was of low quality, allowing for only slow identification of structural abnormalities.

Data collection was performed by four people (A.D.S., G.M., V.P., and P.T.) using a dedicated Access database (Microsoft, Redmond, WA). Data analysis was done using Access, Excel (Microsoft), and SPSS 9.0 (SPSS, Chicago, IL). Statistical significance was assessed using χ^2 and Fisher exact tests. All tests were two sided, and $P < .05$ was considered to be statistically significant.

RESULTS

The baseline characteristics of the 5,000 women are summarized in Table 1. Most women were multiparous and premenopausal and complained of abnormal uterine bleeding. The outcomes are shown in Table 2. In 98.2% of cases a hysteroscopy was attempted and in 89.7% completed. The hysteroscopic view was judged as good in 92.7% of successful hysteroscopies. The main reasons for canceling the hysteroscopy were high blood pressure before the procedure (18 cases), patient choice (16 cases), and severe anxiety (15 cases).

The hysteroscopies were performed by 362 different operators, the average number of hysteroscopies per operator was 13.8. A small percentage of operators (7.7%) performed >20 hysteroscopies (Table 3). The majority of hysteroscopies (72%) were performed by operators with lower experience (<50 hysteroscopies/operator).

The main reasons for failed hysteroscopies are shown in Figure 1.

Two thousand seven hundred fifty-four hysteroscopies were attempted in the CO₂ period (group A) and 2,156 in the saline period (group B).

TABLE 2		
Technical outcome of 5,000 outpatient hysteroscopies.		
	Attempted	Not attempted
Total	4,910 (98.2%)	90 (1.8%)
Complete	4,487 (89.7%)	—
Incomplete	163 (3.3%)	—
Failed	260 (5.2%)	—

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TABLE 3	
Operator experience.	
Number of hysteroscopies performed	Operators (%)
<20	334 (92.2)
20–50	20 (5.5)
>50	8 (2.2)

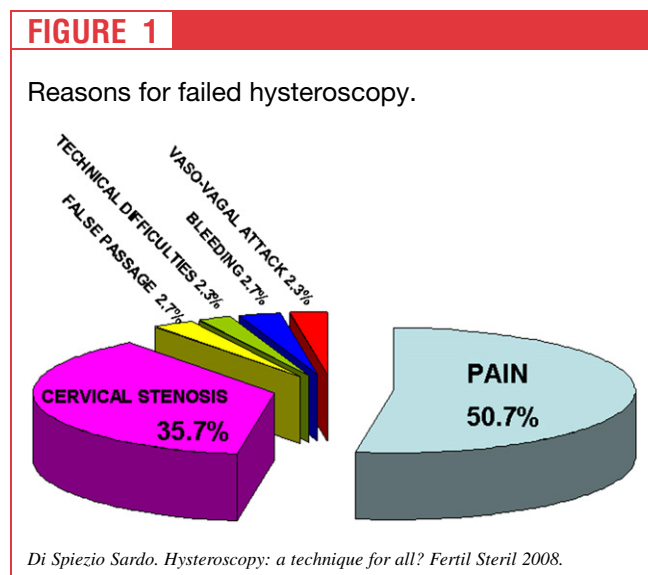
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One hundred thirty-five failed hysteroscopies (135/2,754; 4.9%) occurred in group A, and the other 125 (125/2,156; 5.7%) occurred in group B. No significant difference in failure rate was detected between the two groups ($\chi^2 = 1.94$; $P = \text{n.s.}$).

Failure of hysteroscopy was mainly influenced by postmenopausal status (7.6% vs. 4.8%; $\chi^2 = 11.0$; $P < .001$), nulliparity (6.2% vs. 4.8%; $\chi^2 = 4.4$; $P < .05$), need for cervical dilatation (6.6% vs. 3.5%; $\chi^2 = 24.9$; $P < .001$) or local anesthesia (7.4% vs. 3.0%; $\chi^2 = 49.4$; $P < .001$), traditional technique of hysteroscope insertion (5.5% vs. 0.9%; $\chi^2 = 33.8$; $P < .001$), and use of a 4-mm optic (4.9% vs. 2.7%; $\chi^2 = 7.3$; $P < .01$).

The most frequent complications during hysteroscopy procedure are shown in Figure 2.

The overall rate of complications was 5.4% (266/4,910). One hundred fifty-one complications (151/2,754; 5.48%) occurred in group A and 115 (115/2,156; 5.3%) in group B. No significant difference in complication rates was detected between the two groups ($\chi^2 = 0.05$; $P = \text{n.s.}$). Complications led to failed hysteroscopy in 54.8% of cases (146/266). Vasovagal attacks ($\chi^2 = 13.49$; $P < .001$) and shoulder pain ($\chi^2 = 9.57$; $P < .01$) were significantly higher in group A.



The occurrence of a complication during hysteroscopy was mainly influenced by nulliparity ($\chi^2 = 4.14$; $P < .05$), need for cervical dilatation ($\chi^2 = 27.64$; $P < .05$) or local anaesthesia ($\chi^2 = 42.51$; $P < .05$), traditional technique of hysteroscope insertion ($\chi^2 = 21.47$; $P < .05$), and use of a 4-mm optic ($\chi^2 = 4.33$; $P < .05$).

The 4-mm and 2.9-mm scopes were used in 84.7% and 15.3% of cases, respectively.

The traditional (group C) and the vaginoscopic technique (group D) for insertion of the hysteroscope were used in 81.9% and 18.1% of cases, respectively.

A lower percentage of failed hysteroscopies was detected in group D with either the 4-mm or the 2.9-mm scope, in comparison with group C (2.9 mm: 4.4% vs. 1%; $\chi^2 = 9.0$; $P < .01$; 4 mm: 5.1% vs. 0.5%; $\chi^2 = 16.5$; $P < .001$).

Five hundred forty-eight minor procedures were performed during hysteroscopy. The operative sheath with hysteroscopic flexible instruments (grasping, scissors, biopsy forceps) was used in 182 (33.2%) cases, for target biopsies ($n = 56$), polypectomies ($n = 83$), removal of intrauterine devices ($n = 30$), adhesiolysis ($n = 5$), and other minor procedures ($n = 8$).

Vaginal instrumentation (tenaculum, Kocher, biopsy forceps) after hysteroscopic examination of uterine cavity was used in 366 cases (76.8%) for biopsies ($n = 4$), polypectomies ($n = 316$), removal of intrauterine device ($n = 39$), adhesiolysis ($n = 6$), and other minor procedures ($n = 1$).

DISCUSSION

To the best of our knowledge, this is the first report in international literature of a large series of outpatient hysteroscopies in which the procedures were performed by a large number of operators with different levels of expertise.

In 1996, Nagele et al. (2) analyzed the outcome of the first 2,500 hysteroscopies performed in our department, with the main aim of demonstrating the feasibility and acceptability of outpatient diagnostic hysteroscopy.

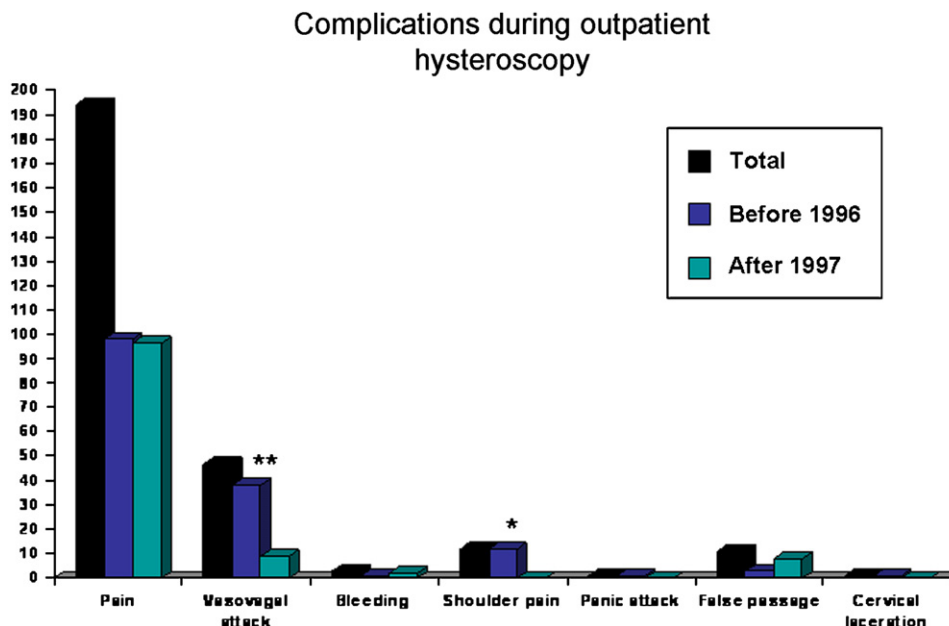
Our descriptive analysis of 5,000 hysteroscopies (including the 2,500 reported by Nagele et al.) fills a gap in the existing literature. Previously in the published studies, hysteroscopies were performed by one or a few experienced operators. The present data demonstrate that a high level of expertise is not a prerequisite to performing hysteroscopy on an outpatient basis.

In the present series, 362 operators with different levels of expertise successfully performed hysteroscopies in nearly 95% of cases. This success rate is in accordance with other large series performed by one or a few experienced operators (11, 14, 20, 25).

A limitation of the present study is the difficulty in evaluating the level of expertise of the operator. However, because most of the operators had performed fewer than 20

FIGURE 2

Complications during outpatient hysteroscopy. * $P < .01$ vs. after 1997; ** $P < .001$ vs. after 1997.



Di Spiezo Sardo. Hysteroscopy: a technique for all? *Fertil Steril* 2008.

hysteroscopies during a 15-year period, it could be hypothesized that they were likely to be doctors in training.

Our clinical experience suggests that if the first ten hysteroscopies performed by a trainee are closely supervised by an experienced operator it is possible to avoid any serious complication without lowering the success rate.

Recently, Campo et al. (25) investigated the relative importance of a surgeon's experience in a prospective multicenter randomized controlled trial. They discovered that experienced surgeons had better outcomes only when 5.0-mm conventional instruments were used. This was not the case when hysteroscopies were performed with minihysteroscopes (3.5 mm).

The present data also confirm this. The failure rate was significantly higher when using the 5-mm hysteroscope, suggesting that a narrow hysteroscope can overcome anatomic challenges and operator limitations.

The second objective of our analysis was to determine if the introduction of normal saline, smaller hysteroscopes, and the vaginoscopic approach have lowered the failure rate.

In 1996, Nagele et al. (13) compared patient acceptability and the clinical feasibility of the two most-used distension media (CO₂ and normal saline) in 157 patients undergoing outpatient hysteroscopy. Their results showed that procedure times were significantly longer for CO₂ (because of the occurrence of bubbles during the procedure) and that abdominal and shoulder tip pain was significantly higher. After the results of that study, all of the outpatient hysteroscopies in our

department have been performed using normal saline as the distension medium.

After 1996, other studies have confirmed that normal saline is more acceptable to patients (17, 22), is quicker to perform (22), and offers advantages in terms of good visualization of uterine cavity in the presence of blood clots, mucus, and debris and increasing confidence in diagnosis (21).

Our descriptive analysis did not show a significantly higher number of complications and failed hysteroscopies between the CO₂ and saline periods, suggesting that factors other than distension medium could exert a primary role in determining the success or failure of outpatient hysteroscopy.

However, two severe complications—vasovagal attack and shoulder pain—were significantly higher in the CO₂ period. Taking into account that these complications globally represent 22% of all of the complications reported in the present analysis, we believe that the use of normal saline has largely contributed to making the procedure safer and more acceptable to patients.

These results are in keeping with Agostini et al (26) who have recently evaluated the risk of vasovagal syndrome in 2079 women undergoing outpatient hysteroscopy. They showed that it is significantly higher with the use of CO₂, regardless of the indication for hysteroscopy, parity, and menopausal status of the patient.

Recent technical and instrumental improvements have significantly increased the feasibility and acceptability of hysteroscopy. The use of new thin telescopes (minitelescopes)

1–2 mm lower in caliber compared with conventional 4-mm ones improves the acceptability of the examination (11, 27); indeed, a 1- to 2-mm reduction in the telescope diameter and consequently in the total hysteroscope size (minihysteroscopes) reduces the section area of the instrument by about 50%–75%. This could well explain why minihysteroscopes are less painful than conventional ones (11, 28). Furthermore, in recent years, new techniques for the introduction of the hysteroscope into the external uterine orifice have been developed to reduce the patient's pain and discomfort.

The vaginoscopic approach is a nontraumatic technique, in which the hysteroscope is introduced into the vagina without a speculum and tenaculum (14, 15). The vagina is distended by the distension medium (normal saline) at the same pressure (60–80 mm Hg) used for the subsequent distension of uterine cavity (17). This approach has permitted complete elimination of any kind of premedication, analgesia, or anesthesia, making the procedure faster and complication free (11, 14). A recent review (16) has shown that diagnostic minihysteroscopy with vaginoscopic approach is accurate without significant discomfort or risk.

In a prospective randomized controlled study performed in our unit, Sharma et al. (29) demonstrated that vaginoscopic hysteroscopy is significantly faster to perform than the traditional technique. Although there was no difference in pain scores between the two techniques, local anesthetic requirements were least in those who underwent vaginoscopic hysteroscopy with a narrow-bore hysteroscope.

Data from our retrospective analysis confirmed that the use of minihysteroscopes and vaginoscopic approach is associated with significantly lower failure rates.

CONCLUSIONS

Outpatient hysteroscopy represents a simple and safe approach for intrauterine evaluation. The present large series shows that a high level of expertise is not a prerequisite. In addition, recent advances in technique and instrumentation facilitate this approach and, we believe, should encourage its higher adoption by the wider gynecology community.

Acknowledgements: The authors are grateful to Dr. F. Farina for his statistical counseling and Dr. Vasillis Pikoulas for his continuous support during the course of this work.

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CHAPTER V

NEW FRONTIERS OF SEE & TREAT HYSTEROSCOPY (2006-2008)

In 2002 Bettocchi proposed the scheme (**Fig.1**) of treatment indications for office procedures performed using modern hysteroscopes before and after introduction of bipolar instrumentation. Today, thanks to further technological advancement and increased operator experience, some other uterine, cervical and vaginal pathologies or conditions may be treated in an office setting. This represents the “new frontier of office operative hysteroscopy” (**Fig.2**).

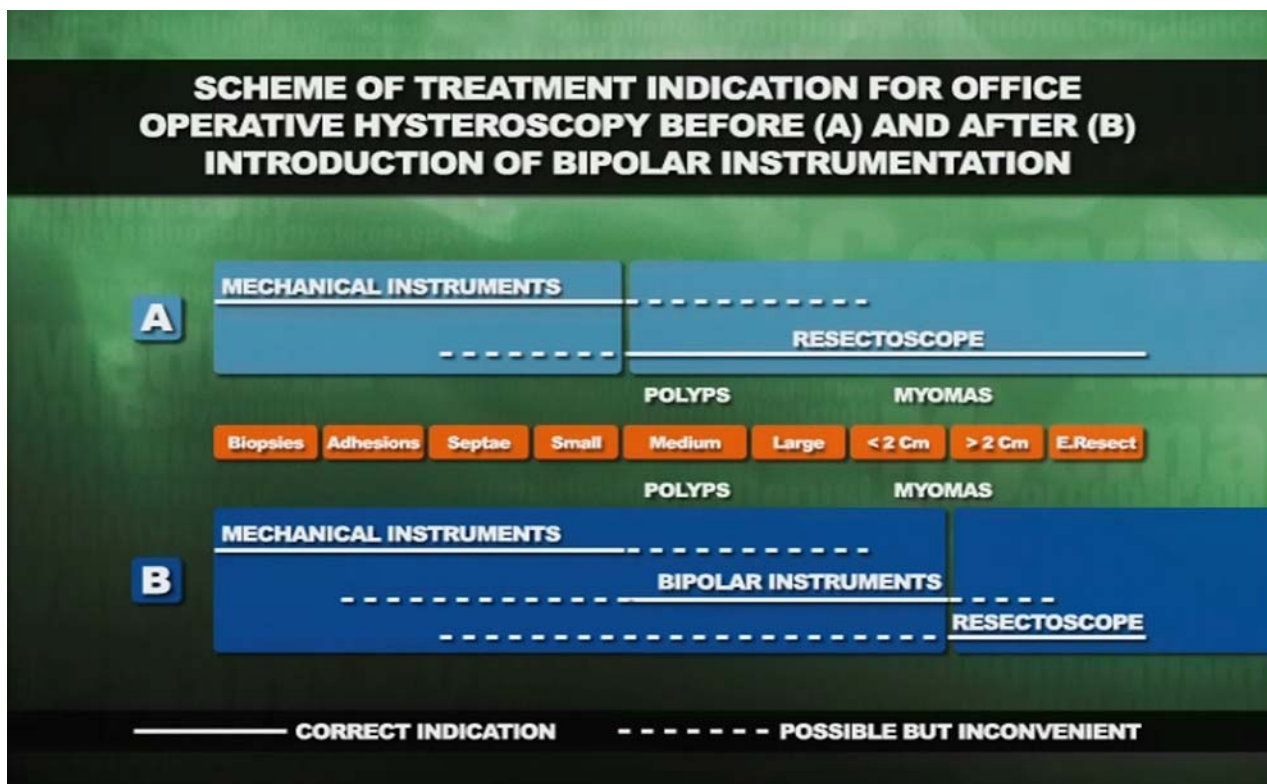


Fig.1

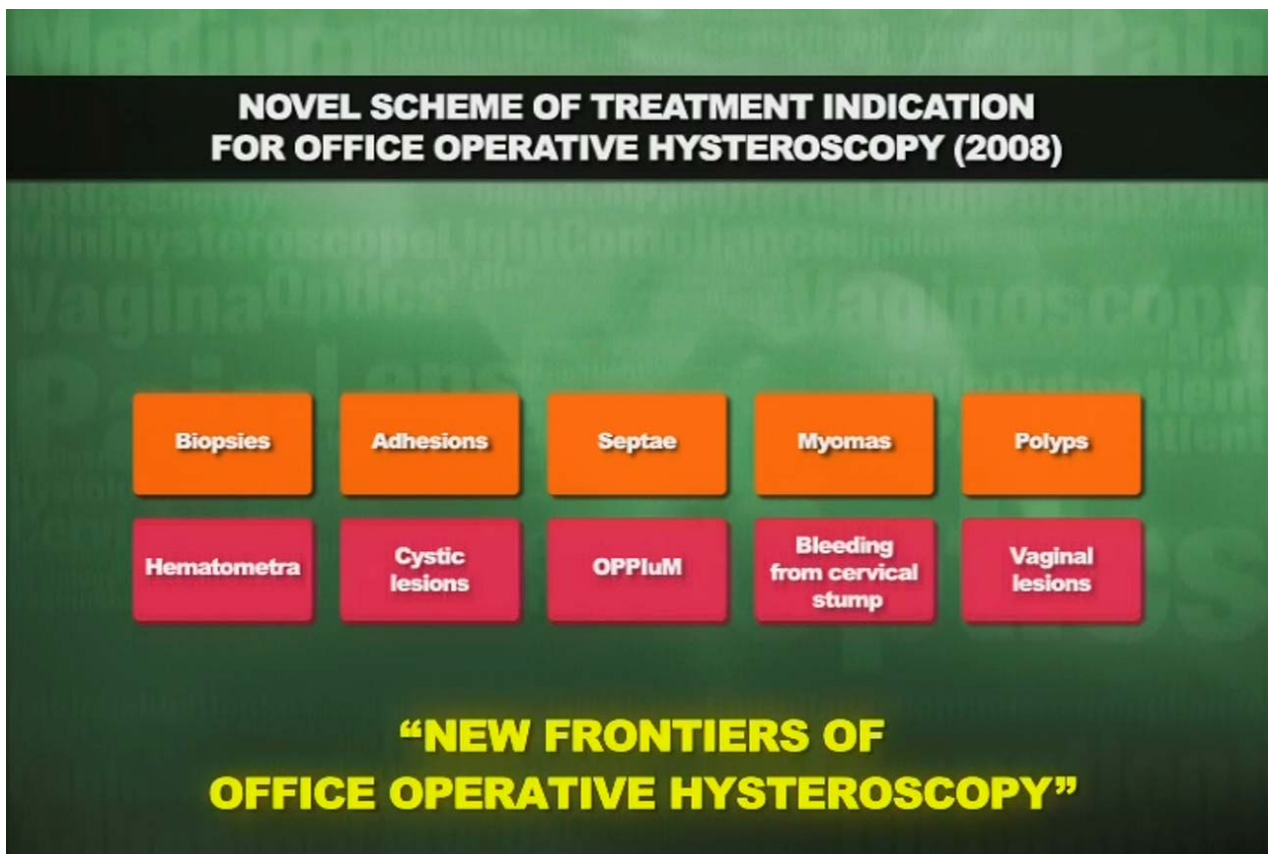


Fig.2

✓ TREATMENT OF VAGINAL POLYPS

Vaginal polyps represent an unusual, often underdiagnosed cause of abnormal uterine bleeding, mostly after sexual intercourse. Vaginoscopic approach is imperative to obtain an appropriate vaginal distension and to identify such lesions. Then these polyps can be easily removed by means of 5 Fr Versapoint twizzle electrode inserted through the operative channel of semirigid or rigid office continuous flow hysteroscopes. Recently, M. Guida, Attilio Di Spiezio and coll described a case of vaginal polyp (**M. Guida, A. Di Spiezio Sardo, C. Mignogna, S. Bettocchi, C. Nappi. Vaginal fibro-epithelial polyp as cause of postmenopausal bleeding: office hysteroscopic treatment. Gynecol Surg 2008; 5: 69–70**). Moreover, Attilio Di Spiezio e coll, published another study, reporting an exceptional case of vaginal endometriosis (**A. Di Spiezio Sardo, P. Di Iorio, M. Guida, M. Pellicano, S. Bettocchi, C. Nappi. Vaginoscopy to identify vaginal endometriosis. JMIG 2008, artiche in press**)

✓ SECTION OF LONGITUDINAL VAGINAL SEPTUM

Recently (**A. Di Spiezio Sardo, S. Bettocchi, S. Bramante, M. Guida, G. Bifulco, C. Nappi. Office vaginoscopic treatment of an isolated longitudinal vaginal septum: a case report. JMIG 2007; 14(4):512-5**) we have treated an isolated longitudinal vaginal septum (**Fig. 3**) in an outpatient setting by operative vaginoscopy in a 27-year-old virgin woman complaining of



Fig. 3

leucorrhoea and recurrent vaginal infections. At vaginal inspection, through the unbroken hymeneal membrane, a partial longitudinal vaginal septum in the upper half of the vagina was detected. The two hemivaginas were not obstructed. To ascertain whether the cervix was single or double, we performed a small incision on the esocervical surface with the tip of the bipolar electrode. As this mark was detectable from either side of the septum, we could confirm the presence of a single cervix. We then performed the resection of the septum by Versapoint Twizzle electrode, starting at its midpoint and progressively proceeding towards the vaginal apex.

The electric energy (VC3 50W) applied during the resection provided complete haemostasis.

The patient experienced only a mild pain during the resection of the upper portion of the septum because of the proximity of the vaginal wall which is well-known to be rich in sensorial neural terminations. However, analgesics were not required during nor immediately following the procedure.

✓ DIAGNOSIS AND TREATMENT OF SUPERFICIAL ADENOMYOSIS

Although office hysteroscopy cannot definitely diagnose or exclude adenomyosis (**Fig.4**), as its field of observation is limited to the endometrial surface, certain investigators (**A. Di Spiezio Sardo, M. Guida, S. Bettocchi, L. Nappi, F. Sorrentino, G. Bifulco, C. Nappi. Role of hysteroscopy in evaluating chronic**



Fig. 4

pelvic pain. Fertil Steril 2008; 90(4): 1191-6) have described some hysteroscopic findings which are suggestive of such pathology: an irregular endometrium with superficial openings, hypervascularization, strawberry pattern or cystic haemorrhagic lesions. In addition to the direct visualization of the uterine cavity and the possibility of obtaining histological specimens under visual control, hysteroscopy also offers the possibility to empty cystic haemorrhagic lesions by means of mechanical instruments or by Versapoint twizzle electrode.

✓ ABLATION OF CERVICAL STUMP

Office operative hysteroscopy may represent a therapeutic option in the case of cyclical or continuous bleeding in patients who have undergone subtotal hysterectomy. Giovanni Pontrelli, Attilio Di Spiezio Sardo and coll, reported the successful treatment of a 40-year-old woman with ongoing cyclical vaginal bleeding lasting 10 days after laparoscopic subtotal hysterectomy. Hysteroscopic vaporization of the endometrial stripe in the cervical stump was performed in an office setting, using a 5-mm Bettocchi double-channel operative hysteroscope armed with a bipolar electrode. **(G. Pontrelli, S. Landi, C. Siristatidis, A. Di Spiezio Sardo, O. Ceci, S. Bettocchi. Endometrial vaporization of the cervical stump employing an office hysteroscope and bipolar technology. JMIG 2007; 14: 767–769)**

Spring electrode (**Fig.5**), which provides a deeper and larger vaporization and coagulation (**Fig.6**) of the tissues may be used to vaporize residual endometrial islands present within the cervical stump. This procedure could require the use of conscious sedation, as the

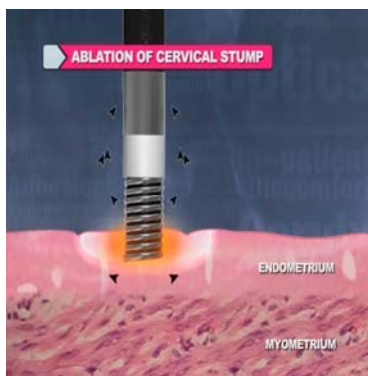


Fig.6



Fig. 5

vaporization of the residual endometrium, in order to be effective, has to reach the first 2-3 mm of the myometrium

✓ OFFICE PREPARATION OF PARTIALLY INTRAMURAL MYOMAS: OPPIUM

Resectoscopic removal of myomas with prevalent intramural extension is advisable to be performed only by highly experienced surgeons as it is technically difficult with a slow learning curve and it is associated with an higher risk of complications. Recently, we have developed



Fig 7

a technique to prepare such myomas in office in order to facilitate the subsequent resectoscopic procedure under general anaesthesia. It is called O.P.P.I.uM: Office Preparation of Partially Intramural Myomas. **(Fig. 7)** The endometrial mucosa which covers the myoma, is incised by means of scissors or 5 Fr bipolar electrodes along its reflection line on the uterine wall, up to the precise identification of the cleavage surface between the myoma and pseudo-capsula, thus facilitating the protrusion of the intramural portion of myoma into the cavity during subsequent menstrual cycles. This action may in turn facilitate the subsequent total removal of the lesion via resectoscopy, as the surgeon will deal with a lesion with prevalent intracavitary development, working more safely and quickly (**S. Bettocchi, A. Di Spiezio Sardo, M. Guida, E. Greco, L. Nappi, G. Pontrelli, C. Nappi. Office Preparation of Partially Intramural Myomas (OPPIuM): A Pilot Study: Golden Hysteroscope Award for the Best Hysteroscopy paper, 37th AAGL meeting, Las Vegas, 30 October-1 November 2008**)

✓ REPOSITIONING OF MISPLACED INTRAUTERINE DEVICE

Sometimes, an intrauterine device may be misplaced in the isthmic area, mainly due to incorrect positioning; in such instances, we can re-position it, by grasping it with forceps or simply by pushing the device's distal extremity with the tip of the hysteroscope.

✓ EMPTYING OF HEMATOMETRA

Hematometra is an accumulation of blood in the uterus. It is usually the result of developmental anomalies or may be secondary to cervical or vaginal obstruction .

Recently we have described the outpatient hysteroscopic emptying of a huge hematometra in a 13-years-old virgin patient affected by mosaic Turner's syndrome. Hysteroscopy was performed by means of a 5-mm continuous-flow operative office hysteroscope with a 2.9 mm rod lens optic (Bettocchi office hysteroscope "size 5", Karl Storz , Tuttlingen, Germany). The vaginoscopic approach (without speculum or tenaculum) was used to preserve the integrity of the hymen. Neither analgesia nor local anaesthesia were administered to the patient. Distension of the uterine cavity was obtained using normal saline solution and the intrauterine pressure was automatically controlled by an electronic irrigation and suction device (Endomat, Karl Storz, Tuttlingen, Germany). The intrauterine pressure was set at 45 mm Hg, being the balance of irrigation flow around 200 mL the uterine cavity determining a poor endoscopic vision. At this moment the vacuum pressure was increased up to 0.4 bar making the emptying of uterine cavity quick and easy. Nearly 300 cc of blood were aspirated in five minutes. The uterine cavity appeared morphologically normal. At ultrasound follow up examination performed two days later the complete resolution of the hematometra was observed. The success of the procedure was confirmed by the resolution of clinical symptoms (**A. Di Spiezio Sardo, C. Di Carlo, MC Salerno, S. Sparice, G. Bifulco, M. Guida, C. Nappi. Use of office hysteroscopy to empty a very large hematometra in a young virgin patient with mosaic Turner's Syndrome. Fertil. Steril 2007; 87: 417. e1-3**)

✓ EMPTYING OF UTERINE CYSTIC NEOFORMATIONS

Uterine cystic neoformations are rare but they should always be investigated in order to rule out a malignant lesion. The differential diagnosis of the uterine cystic mass include congenital malformation, leiomyomata cystic degeneration, adenocystic tumor, adenomyosis, echinococcus cyst and intramyometrial hydrosalpinges. The diagnostic work-up of these lesions include transvaginal ultrasonography, magnetic resonance imaging (MRI) and blood tests and it is essential to avoid any over or under-treatment. Office hysteroscopy might represent an helpful tool both for its diagnostic and therapeutic properties. Recently, Attilio Di Spiezio Sardo e coll, reported the hysteroscopic emptying

of a cystic- degenerated leiomyoma with a 5- Fr flexible needle inserted through the operative channel of a 5mm continuous- flow operative office hysteroscope in an outpatient setting. This needle is normally used in gynecology to instill intrauterine local anesthesia under a hysteroscopic view. The authors adapted it to drain a fluid- filled lesion, identifying a further application of this instrument (**A. Di Spiezio Sardo, M. Guida, G. Bifulco, S. Frangini, M. Borriello, C. Nappi. Outpatient hysteroscopic emptying of a submucosal uterine cystic lesion. JSLS. 2007; 11:136- 137)**)

✓ **DIAGNOSIS OF CERVICAL METAPLASIA OF ENDOMETRIUM**

Hysteroscopy can be useful also in infertile patients affected by Cystic Fibrosis. Indeed, Roberto Piccoli, Attilio Di Spiezio Sardo and coll, have recently described the case of an infertile female patient with cystic fibrosis who was diagnosed with endocervical metaplasia of the endometrium at diagnostic hysteroscopy and successfully treated with an oral estroprogestinic formulation. This report suggest a novel histological alteration possibly involved in affecting fertility in women with cystic fibrosis. (**R. Piccoli, A. Di Spiezio Sardo, L. Insabato, G. Acunzo, M. Guida, C. Nappi. Endocervical metaplasma of the endometrium in a patient with cystic fibrosis: a case report. Fertil. Steril. 2006; 85: 750 e 13-6)**)

✓ **REMOVAL OF UTEROVAGINAL PACKING**

Attilio Di Spiezio Sardo and coll, have reported on the successful hysteroscopic removal of uterovaginal packing, inserted during caesarean sections following uterine haemorrhage resistant to medical therapy. The packing could not be removed vaginally with sponge forceps as it had adhered to the uterine cavity. A hysteroscopic approach enabled identification and cutting with 5Fr scissors of the stitches fixing the packing to the uterine walls

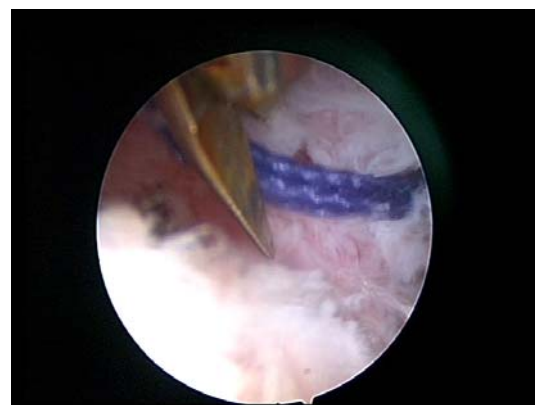


Fig. 8

(**Fig 8**), allowing straightforward removal in an outpatient setting and avoiding a repeated laparotomy (**S. Bettocchi, A. Di Spiezio Sardo, L. Pinto, M. Guida, M. Antonietta**

Castaldi, O. Ceci, C. Nappi. Outpatient hysteroscopic removal of gauze packing adherent to the uterine cavity: report of 2 cases. JMIG 2008, article in press)

In conclusion, provided we have the appropriate equipment, some basic rules should always be followed in order to perform a safe and effective office operative hysteroscopy:

- 1) To correctly identify and respect the indications and to apply the proper technique for each pathology detected
- 2) To maintain uterine muscle integrity at all times by avoiding touching, scratching or cutting the muscle fibres
- 3) To maintain a constant intrauterine pressure (lower than 70mmHg) and a clear intrauterine view during the overall procedure
- 4) To work with the active area of the instrument (either mechanical or electrosurgical) very close to the tip of the hysteroscope, thus avoiding loss of depth of view.

Vaginal fibro-epithelial polyp as cause of postmenopausal bleeding: office hysteroscopic treatment

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Received: 5 May 2007 / Accepted: 4 July 2007 / Published online: 17 August 2007
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Abstract We report on the case of a 72-year-old woman who underwent office hysteroscopy following an episode of postmenopausal bleeding. A vaginal fibro-epithelial polyp was diagnosed and removed by means of a 5 Fr bipolar electrode inserted through the operating channel of a 5 mm continuous flow office hysteroscope.

Keywords Hysteroscopy · Office · Vaginal polyp
Fibro-epithelial polyp

Introduction

When an organic cause of postmenopausal bleeding is suspected, a uterine or cervical lesion is usually searched for. Vaginal lesions represent an unusual, often underestimated, cause of postmenopausal bleeding. Among vaginal lesions, the fibro-epithelial polyp (FP) represents a rare benign growth that should not be mistaken for a malignant growth, especially embryonal rhabdomyosarcoma [1].

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Case

We report on the case of a 72-year-old woman who underwent office hysteroscopy following an episode of postmenopausal bleeding. The study was eventually approved by our Institutional Review Board.

Hysteroscopy was performed by a vaginoscopic approach (without speculum and tenaculum) using a 5 mm continuous flow office hysteroscope (Bettocchi Office Hysteroscope size 5; Karl Storz, Germany) with a 30° grade optic and an incorporated 5 Fr working channel. Normal saline solution was used for vaginal and uterine distension.

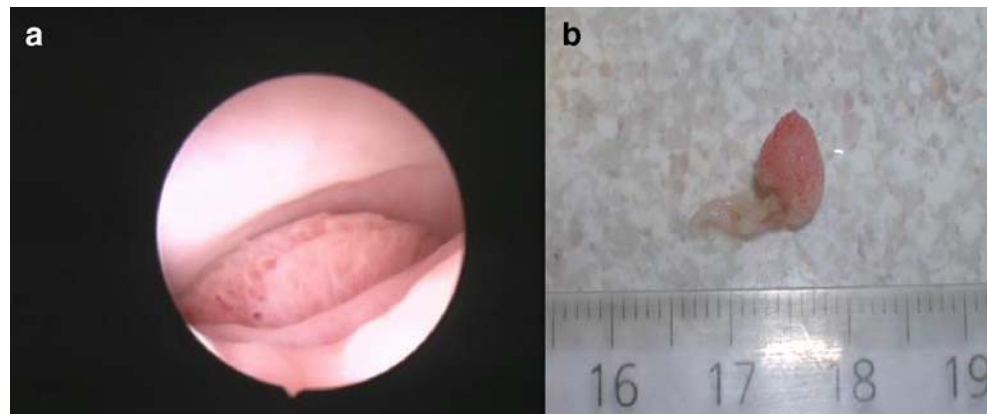
After a thorough inspection of the vagina, a polypoid lesion was detected in the proximal portion of the vagina near to the posterior cervical lip. The lesion was reddish, 1 cm in size, and with the appearance of a small “cauliflower” (Fig. 1). The uterine cavity and the endocervical canal showed no abnormalities.

The vaginal lesion was resected by means of a 5 Fr Twizzle bipolar electrode (Gynecare; Ethicon, NJ, USA) inserted through the operating channel of the hysteroscope. The electrode was connected through a cable with a versatile electrosurgical system dedicated to hysteroscopy [Versapoint Bipolar Electrosurgical System (Gynecare; Ethicon)]. No analgesic was required during or immediately after the procedure. The histological diagnosis was FP. At 6 months’ follow-up the patient did not complain of any vaginal bleeding.

Discussion

FP is an uncommon hamartomatous or benign neoplastic polypoid mass of the vagina, evoking a level of interest in

Fig. 1 a Endoscopic and **b** macroscopic appearance of the vaginal fibro-epithelial polyp



pathologists disproportionate to its frequency or significance. The mean age at diagnosis is approximately 40 years, with an age range varying from that of the newborn child to 77 years. The lesions are usually asymptomatic and are discovered incidentally, during pelvic examination, on the lateral wall of the lower third of the vagina [2].

Rarely, they can be associated with abnormal uterine bleeding, mostly after sexual intercourse. No report of FP as a cause of postmenopausal bleeding is available in the international literature.

The classical surgical resection of such lesions consists of excision by scissors after the application of a Kelly or Kocher forcep to prevent any blood loss. The availability of smaller diameter hysteroscopes with working channels and continuous flow systems, and the advent of bipolar electrosurgical technology, makes it possible to diagnose and eventually treat such benign vaginal lesions in the outpatient setting and also to diagnose and treat postmenopausal patients who might otherwise require general or local anesthesia [3, 4]. A vaginoscopic approach is

imperative to obtain an appropriate vaginal distension and to identify any lesion in the vaginal cavity [5, 6].

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Images in Endoscopy

Vaginoscopy to Identify Vaginal Endometriosis

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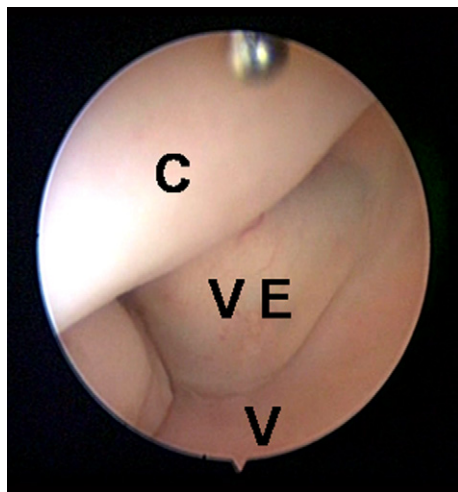


Fig. 1. Hysteroscopic view of polypoid vaginal endometriosis (VE) in the posterior vaginal fornix (V). C = Cervix.

The endometriotic implants that penetrate the retroperitoneal space for a distance of 5 mm or more are defined as deeply invasive endometriosis and typically involve the Douglas pouch (retrocervical endometriosis) and the rectovaginal septum. Vaginal endometriosis is usually considered a secondary implantation of endometriotic foci infiltrating pouch of Douglas or mostly rectovaginal septum.

We report on a 42-year-old woman referred to our department presenting with severe dyspareunia. Vaginal examina-

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Submitted July 14, 2008. Accepted for publication August 1, 2008.
Available at www.sciencedirect.com and www.jmig.org

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doi:10.1016/j.jmig.2008.08.001

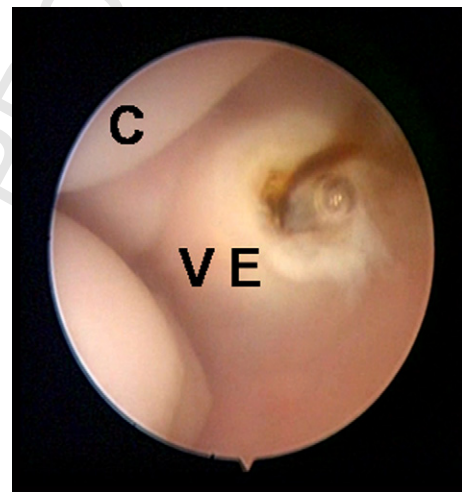


Fig. 2. A chocolate-like fluid starts to spill out from polypoid vaginal endometriosis (VE). V = posterior vaginal fornix; C = cervix.

tion only revealed multiple, soft irregularities in the posterior fornix.

To better visualize the deeper vagina, vaginoscopy was performed in the office, with a 4-mm continuous-flow office hysteroscope (Bettocchi Office Hysteroscope size 4; Karl Storz GmbH & Co., Tuttlingen, Germany) with a 30-degree-grade optic and an incorporated 5Fr working channel. Normal saline solution was used for vaginal distension. Vaginal pressure was maintained at a constant 30 to 40 mm Hg with an electronic pump for irrigation and aspiration (Endomat; Karl Storz GmbH & Co.). There was no need to close the vulvar labia with the fingers because the weight of the liquid is usually sufficient to distend the vagina.

Vaginoscopy showed the presence of polypoid, pedunculated, brownish lesions of a size of 0.5 to 1 cm in the posterior vaginal fornix (Fig. 1), which were drained (Fig. 2) with a 5Fr bipolar electrode. Five-French scissors

and grasping forceps with teeth were respectively used to cut and grasp some pieces of such lesions to be sent for histological examination.

Pathologic analysis of such specimens confirmed the clinical suspicion of endometriosis. The patient underwent laparoscopy, which showed a small nodular lesion of the rectovaginal septum that was completely excised.

It might be of paramount importance to inspect the vagina thoroughly in those women who complain of dyspareunia. Indeed the diagnosis of vaginal endometriosis may represent a great diagnostic challenge as very difficult to be assessed by physical examination. Operative vaginoscopy allows identification of vaginal lesions and obtaining specimens for histologic diagnosis.

UNCORRECTED PROOF

Office vaginoscopic treatment of an isolated longitudinal vaginal septum: A case report

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KEYWORDS:

Office hysteroscopy;
Rigid hysteroscope;
Longitudinal vaginal
septum;
Vaginostomy

Abstract. This case report describes a new treatment of an isolated longitudinal vaginal septum (LVS) by office operative vaginostomy with a 4-mm rigid hysteroscope in a 27-year-old virgin who reported leukorrhea and recurrent vaginal infections. This technique might represent an effective treatment of an LVS, mostly in patients with an intact hymen. This could allow the inclusion of vaginal lesions among the indications for office endoscopic procedures performed using operative hysteroscopes.

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Congenital anomalies of the vagina, cervix, and uterus (müllerian anomalies) arise from abnormal development during embryogenesis and are characterized by diversity in anatomic features, clinical presentation, and reproductive performance. They have been estimated to occur in 1% to 3% of women¹ and categorized by using various classification systems. A simple classification for müllerian duct anomalies was suggested by Buttram and Gibbons in 1979. In 1988, the American Fertility Society proposed a revised classification, categorizing müllerian duct abnormalities into seven classes.²

The cause of most müllerian anomalies remains unclear, but they could potentially be due to a failure of the fusion of the müllerian ducts and/or reabsorption of the septum. The

direction in which fusion of the müllerian ducts occurs, the process by which this is regulated, and whether the fusion occurs in a continuous manner are still unknown.

Longitudinal vaginal septum (LVS) is frequently associated with some uterine anomalies, especially with complete or partial high septum and didelphys uterus, while it is an isolated malformation less frequently.³

It is thought to develop as a consequence either of failure of fusion of the lateral müllerian ducts or of incomplete resorption of the vaginal septum, which may (complete) or may not (partial) extend throughout the full length of the vagina and may or may not be obstructive. The vaginal cavities on both sides of the septum are often asymmetric, and this finding may contribute to the under-diagnosis of this malformation.

Longitudinal vaginal septum is frequently asymptomatic and detected incidentally during routine gynecologic examination, hysteroscopy, or delivery. Sometimes, it may cause dyspareunia, menstruation complaints, serious hemorrhage due to its rupture during intercourse, or hygienic problems (inability to insert a tampon or persistent bleeding after its insertion) thus requiring surgical treatment. Furthermore, in patients who desire a child, vaginal septum

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Submitted November 6, 2006. Accepted for publication March 3, 2007.

resection might improve access to the cervix and avoid the risk of dystocia at delivery.

Resection of an LVS can be performed using the classic surgical procedure, consisting of excision by scissor after the application of 2 Kelly or Kocher forceps to prevent any blood loss. This traditional surgical method is successful in most patients, but it requires anesthesia and meticulous attention to dissection, suturing, and hemostasis to avoid injuries to bladder or rectum, subsequent bleeding, and scarring. Furthermore, traditional excision of the septum requires hymenotomy to be performed when an intact hymen is present.⁴

Another modality of treatment is represented by resectoscopy^{5–6} with fluid as distension medium. This technique, in addition to offering a higher magnification of the septum, provides a fibrous tissue distended by the intravaginal pressure, thus making easy its dissection along a safe line, away from the urethra or rectum. In this poorly vascularized tissue, the electric energy applied during the resection produces complete occlusion of the small vessels.

Though this technique may be of potential value to a virgin by preserving the integrity of the hymen, the wide diameter of the resectoscope and the restricted field of operation in the virgin complicate the operation, often requiring general anesthesia.

In recent years, with the development of smaller-diameter scopes with working channels and continuous-flow systems and the advent of bipolar electrosurgical technology, it has been possible to treat several uterine and cervical pathologies, as well as those patients who might otherwise require general or local anesthesia (i.e., women with intact hymens, postmenopausal women), as outpatient procedures. This new philosophy (“see-and-treat hysteroscopy”) reduces the distinction between a diagnostic and an operative procedure with a substantial decrease in health and social costs.⁶

In the case report, we describe the treatment of an isolated LVS in a patient with an intact hymen by office operative vaginoscopic using a 4-mm rigid hysteroscope.

Case report

A 27-year-old woman with an intact hymen was referred to the Department of Gynecology and Obstetrics and Pathophysiology of Human Reproduction of the University of Naples “Federico II” for leukorrhea and recurrent vaginal infections. She reported menarche at age 13, and she denied dysmenorrhea or menstrual irregularities.

The study protocol was approved by our institutional review board. A vaginal swab was done, but during the procedure the operator detected the presence of an unexpected and undefined lesion inside the vaginal cavity. A transabdominal ultrasound was negative for uterine, cervical, and vaginal pathologies, but the reliability of the result was hampered by the high body mass index (28 kg/m²) of

the patient. The vaginal swab resulted positive for gram-positive infection.

A vaginotomy was planned after 1 week of antibiotic therapy and was performed using a 4-mm continuous-flow office hysteroscope (Bettocchi Office Hysteroscope size 4; Karl Storz GmbH & Co., Tuttlingen, Germany) with a 30-degree optic and an incorporated 5F working channel. The oval profile and the small caliber of the hysteroscope facilitated the passage through a 7- to 8-mm hymeneal orifice.

No pharmacologic preparations or local anesthetics were administered before the examination. Normal saline was used for vaginal and uterine distension. Vaginal and intrauterine pressures were maintained at a constant 30 to 40 mm Hg using an electronic pump for irrigation and aspiration (Endomat; Karl Storz GmbH & Co.). There was no need to close the vulvar labia using the fingers because the weight of the liquid was sufficient to distend the vagina and provide a correct visualization of the portio.⁷

The electrosurgical instrument was the Versapoint Bipolar Electrosurgical System (Gynecare, Ethicon, Inc., Somerville, NJ), consisting of a dedicated bipolar electrosurgical generator and a 5F Twizzle electrode, which provides a precise and controlled vaporization (resembling cutting). We used the mildest vapor-cutting mode (VC3) that provides the lowest energy flowing into the tissue, with a power of 50 W.

At vaginal inspection through the unbroken hymeneal membrane, a partial LVS in the upper half of the vagina was detected (Figure 1). This septum did not reach completely the vaginal apex in its middle portion, thus making the 2 hemivaginas communicating at this level. Through this

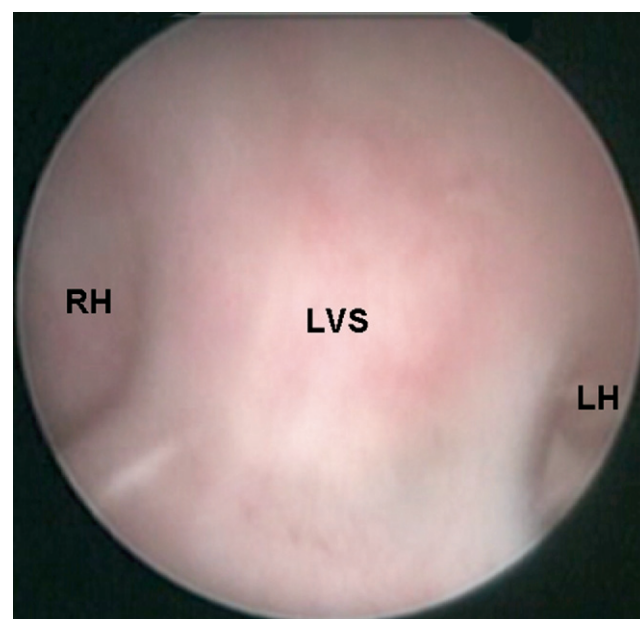


Figure 1 Vaginoscopic view of longitudinal vaginal septum (LVS) from the point right after the hymen orifice. RH = right hemivagina; LH = left hemivagina.

small passage, a cervix was detectable from each side of the LVS.

To ascertain if the cervix was single or double, we performed a small incision on the exocervical surface with the tip of the bipolar electrode; and as this mark could be detectable from each side of the septum, we could confirm the presence of a single cervix.

Then we began the resection of the septum by the Twizzle electrode, starting in its middle portion and proceeding progressively toward the vaginal apex. The electric energy (vapor-cutting mode, VC3) applied during the resection provided complete hemostasis. Successively, the uterine cavity and endometrial surface were inspected, and the tubal ostia were identified. The hysteroscope was then pulled back toward the internal uterine orifice to obtain a panoramic view of the whole cavity. We did not observe any anomalies of the uterus. The endocervical canal was inspected during the withdrawal of the hysteroscope, and an endocervical polyp measuring less than 0.5 cm was removed by a 5F grasping forceps (Karl Storz GmbH & Co.).

At the 3-month follow-up visit, the patient's symptoms were significantly improved, and a vaginal swab had a negative result. Vaginoscopy showed a normal vagina with a small scar in its middle portion, without wound retraction or stenosis.

Discussion

Currently, office hysteroscopy allows for an easy, precise, and cost-effective evaluation of the uterine cavity, cervical canal, and vagina.

However, it has been estimated that only 15% of gynecologists in the United States routinely perform office hysteroscopy. Reasons given include, among others, a duplication of procedures for patients who need surgery in the operating room and the expense of the capital equipment with relatively poor reimbursements from third-party payers.⁸

Indeed, diagnostic and operative hysteroscopy have long been considered separate entities, as they required different instruments and approaches, thus resulting in a large number of procedures being performed in the operating room, with significantly higher patient morbidity and health care costs.

Since the introduction at the beginning of the 1990s of new scopes with a diameter range between 1.2 and 3 mm, it has been possible to produce an operative hysteroscopic system with a diameter equal or less than 5 mm that allows the introduction of operative instruments. This made it possible to diagnose and treat most benign endouterine and endocervical pathologies simultaneously in a single procedure without analgesia or anaesthesia.⁷ Mechanical operative instruments have long been the only way to apply the see-and-treat procedure in an outpatient setting. The advent

of bipolar technology, with the introduction of several types of 5F electrodes, increased the number of conditions treated by office operative hysteroscopy, reserving the use of the resectoscope and the operating room to a few particular cases.⁹

While a large number of papers describing office hysteroscopic treatment of cervical and uterine pathologies are available in English-language literature, no study reporting the vaginoscopic treatment of vaginal septum or other vaginal lesions in an outpatient setting was found using a MEDLINE literature search with "vaginal lesions," "vaginal septum," "hysteroscopy," and "vaginoscopy" as keywords.

Several reports describe the hysteroscopic treatment of an LVS⁵⁻⁶ using a resectoscope and under general anesthesia. A few reports of foreign bodies, vaginal tumors, or vaginal adhesions removed by operative vaginoscopy are available in the English-language literature, but all the described procedures have been performed under general anesthesia.

To the best of our knowledge, this case report demonstrates the first successful treatment of a woman with an LVS by office operative vaginoscopy with a rigid 4-mm hysteroscope. The vaginoscopy was fast (it required no more than 10 minutes), safe, bloodless, and nearly painless with a high level of patient satisfaction both for her hymen remaining intact and successful outpatient treatment of her lesion with no analgesia or anesthesia. The absence of recovery time and an immediate return to normal activities completed the success of the procedure.

The patient experienced mild pain only during the resection of the upper portion of the septum because of the proximity of the vaginal wall, which is well known to be rich in sensorial neural terminations. However, no analgesic was required during and immediately after the procedure.

Sometimes the presence of a thick vaginal septum could make it difficult to identify a single or double cervix, therefore, we suggest the surgeon make a small incision on the esocervical surface with the tip of the bipolar electrode and then try to detect this mark from each side of the septum. Furthermore, as LVS is often associated with other müllerian anomalies, endoscopic inspection of both the endocervical canal and uterine cavity always has to be performed.

Conclusion

Whenever a new technique simplifies the treatment of a lesion without any serious complications, it deserves to be considered when such a lesion is detected. Office operative hysteroscopy has already demonstrated itself to be safe and effective in treating most uterine and cervical pathologies. The reported successful treatment of an isolated vaginal

septum by operative vaginoscopy, if confirmed by larger series, could allow the inclusion of vaginal septa and other vaginal lesions in the list of treatment indications for office procedures performed using operative hysteroscopes.⁹

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CLINICAL ARTICLE

Role of hysteroscopy in evaluating chronic pelvic pain

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Objective: To provide a survey of various gynecological conditions causing chronic pelvic pain (CPP) that might be diagnosed by hysteroscopy.

Design: Review article.

Setting: Departments of obstetrics and gynecology and of pathophysiology of human reproduction at a university in Italy.

Patient(s): Women affected by CPP.

Intervention(s): Hysteroscopy.

Main Outcome Measure(s): Effectiveness in diagnosing intrauterine pathologies that cause CPP.

Result(s): Hysteroscopy is highly effective in diagnosing various gynecological causes of CPP, including adenomyosis, chronic endometritis, Müllerian anomalies, retained fetal bones, endocervical ossification, and intrauterine abnormalities. Furthermore, hysteroscopy may play a primary role in the resolution of some of these conditions.

Conclusion(s): Because it can be executed safely without anesthesia or an operating room, office hysteroscopy may be indicated, together with the other noninvasive procedures such as transvaginal ultrasonography, as a first-level investigation in women who are affected by CPP. (Fertil Steril® 2007; ■: ■–■. ©2007 by American Society for Reproductive Medicine.)

Key Words: Chronic pelvic pain, hysteroscopy, laparoscopy, office

Chronic pelvic pain (CPP) represents the most single common indication for referral to gynecology clinics, accounting for 10%–40% of all gynecological visits and 50% of all diagnostic laparoscopies (1).

There is no universally accepted definition of CPP. However, according to the guidelines of the Society of Obstetricians and Gynaecologists of Canada, CPP can be defined as nonmalignant pain that is perceived in structures related to the pelvis; it must have been continuous or recurrent for ≥6 months (2).

Often, the etiology of CPP is not discernible. Many disorders of the reproductive tract, gastrointestinal system, urological organs, musculoskeletal system, and psychoneurological system may be associated with CPP in women. The most important gynecological causes of CPP include endometriosis, adenomyosis, chronic pelvic inflammatory disease, pelvic congestion syndrome, and intrauterine or cervical patholo-

gies (contraceptive device, leiomyomata, endometrial or cervical polyps, cervical stenosis, or chronic endometritis) (3).

Gynecological causes of CPP usually are detected by the patient's history, physical examination, transvaginal sonography (TVS), and laparoscopy (4, 5).

A thorough patient history may identify the cause of pain, as well as the factors that may exacerbate or alleviate it, its relationship to the menstrual cycle, and its different locations. The physician also should elicit a history of previous pelvic or abdominal surgery, previous pelvic infections, and other significant gynecologic disorders. The physical examination should include a comprehensive, multiorgan evaluation that concentrates on the lower abdominal and pelvic regions.

Noninvasive procedures such as TVS and magnetic resonance imaging (MRI) may provide important information, because they investigate both intrauterine and extrauterine environments, without significant patient risk or discomfort. In particular, TVS often is used as the first-line diagnostic tool in the evaluation of CPP, because it is relatively inexpensive and does not use ionizing radiation (6).

Okaro et al. (7) created the ultrasound term *soft marker* to indicate pelvic pathology in women with CPP, the soft

marker being the presence of immobile ovaries and/or specific tenderness and/or loculated pelvic fluid at TVS. They found such soft markers to indicate significant pelvic pathology, with a positive likelihood ratio of 1.9.

Magnetic resonance imaging commonly is considered when TVS is nondiagnostic or equivocal. Although MRI may be the best overall test for clearly evaluating abdominal and pelvic anatomy, it has some limitations: it is relatively expensive, images may be degraded by metal implants in the body, and there are some contraindications to having the test (e.g., ferromagnetic aneurysm clips or pacemakers) (6).

Some invasive procedures, such as laparoscopy, are major components in evaluating CPP, and many physicians believe that a workup is incomplete without this procedure. At present, gynecologists liberally use laparoscopy or microlaparoscopy under general anesthesia as the gold standard for the assessment of women with CPP. Laparoscopic observation of abdomen and pelvis will identify potential sources of CPP in most women. The most common findings at laparoscopy are pelvic endometriosis and adhesions (3). However, in $\leq 40\%$ of women with CPP, laparoscopy fails to identify any obvious cause for the pain (7, 8).

[Q4] There are a number of reasons that laparoscopy may fail to identify an organic cause of pain: the condition may not be visible at laparoscopy (i.e., adenomyosis, intrauterine pathologies, and so on), or an inexperienced surgeon may not recognize the disease, as with some forms of endometriosis (9). This results in an underdiagnosis of some gynecologic causes of CPP and, consequently, in an inappropriate referral of the woman and an inadequate treatment of the pain.

At this point, the following question spontaneously arises: can hysteroscopy provide significant information concerning the causes of CPP? In other words, can hysteroscopy diagnose some causes of CPP that otherwise may be hard to diagnose or that may not be detected when using TVS and/or laparoscopy?

[Q5] Although some clinicians already use hysteroscopy in the evaluation of CPP, other investigators refute its usefulness.

In the international literature, data are lacking on the prevalence of hysteroscopic findings in unselected women with CPP, with the exception of those reported by Nezhat et al. (4).

Those investigators have conducted a study on 499 women who are affected by CPP and are undergoing diagnostic laparoscopy, plus hysteroscopy to identify the potential causes of pain. Their work has shown that hysteroscopy is effective not only when laparoscopy fails but also in patients in whom laparoscopy is performed successfully. Indeed, independently of the pathophysiology of CPP, the investigators showed that approximately one third of patients with abnormalities diagnosed at laparoscopy had concomitant intrauterine pathology. Leiomyomas and cervical stenosis were the most common hysteroscopic diagnoses and were considered to be potential sources of CPP.

The aim of our analysis is to provide a survey of various gynecological conditions causing CPP that may be diagnosed by hysteroscopy.

ADENOMYOSIS

Adenomyosis is a common, benign gynecological disorder that is characterized by the heterotopic presence of endometrial glands and stroma within the myometrium, surrounded by smooth muscle proliferation.

It traditionally has been diagnosed by the pathologist on hysterectomy specimens or by means of invasive techniques, such as laparoscopic uterine biopsies.

However, the recent development of high-quality, noninvasive techniques (TVS and MRI) has renewed interest in diagnosing adenomyosis before any treatment (10).

Adenomyosis particularly is amenable to MRI diagnosis, with accuracy rates of $\leq 99\%$ (11–13). Compared with MRI, TVS is less sensitive for diagnosing such pathology, with sensitivity of 86%, specificity of 50%, and positive predictive value of 86% (11, 14).

Hysteroscopy has been demonstrated to be an important additional procedure for the evaluation of uterine pathology, even in the case of adenomyosis, because it offers the main advantage of direct visualization of the uterine cavity and the possibility of obtaining histological specimens under visual control (10, 15).

Recently, Molinas and Campo (16) proposed office hysteroscopy and TVS as first-line diagnostic tools in case of suspicion of adenomyosis.

Notwithstanding the fact that diagnostic hysteroscopy of the cavity cannot definitively diagnose or exclude adenomyosis, because its field of observation is limited to the endometrial surface, some investigators have described some hysteroscopic findings that are suggestive for such pathology: an irregular endometrium with endometrial defects (superficial openings), hypervascularization, a strawberry pattern, or cystic hemorrhagic lesions (10, 16, 17).

In particular, an irregular endometrial vascular distribution has been detected in more than half of patients (16). Ota and Tanaka (18) used morphological analysis of the endometrium to demonstrate that the mean surface area, total surface area, and total number of capillaries increased in the adenomyosis group, both in the proliferative and secretory phases. These findings strongly support the concept that endometrium is functionally abnormal in patients with adenomyosis. However, it should be emphasized that the superficial vascularization can be inspected correctly only by reducing the intracavitary pressure at the time of hysteroscopic examination.

In addition to the direct visualization of the uterine cavity, the hysteroscopic approach offers the possibility of obtaining histological specimens under visual control, allowing more accurate information to be obtained and correlations between

images and histopathology to be made. During hysteroscopy, target biopsies of the endometrium and underlying myometrium can be obtained, either with the mechanical-punch technique or with electrical-loop resection. Furthermore, the visual control before, during, and after the loop resection also may demonstrate typical signs for adenomyosis.

McCausland (19) first described the technique of myometrial biopsy through the hysteroscope with loop resection and reported a prevalence of adenomyosis of 66% in patients with abnormal uterine bleeding. That work also demonstrated a correlation between the depth of the lesion and the severity of the menorrhagia.

Furthermore, in a comparative study, Darwish et al. (20) demonstrated the superiority of loop resection over punch biopsy with rigid biopsy forceps.

At the moment, there is no consensus on the diagnosis of adenomyosis by hysteroscopic resectoscopic biopsy with respect to handling, orientation of the resected pieces, and depth of penetration (21); however, adenomyosis may be highly suspected when the following signs are found: [1] irregular subendometrial myometrium (whorled, fibrotic, and so on), [2] absence of typical myometrial architecture during the resection, and [3] intramural endometriomas (19, 20).

CHRONIC ENDOMETRITIS

Chronic endometritis is a subtle condition that is difficult to identify with noninvasive examinations. Indeed, it is not detectable by TVS and MRI and can be suspected only in patients who have complications such as adhesions, pyometra, or hydrometra. It may cause abnormal uterine bleeding, although in most cases it is asymptomatic or is accompanied by mild disturbances such as spotting and undefined CPP. A recent study has demonstrated that >70% of cases of chronic endometritis result from non-gonococcal, non-chlamydial infections, with common bacteria and mycoplasma representing the most frequent etiologic agents (22).

No general agreement exists in the literature about the diagnostic usefulness of hysteroscopy in the detection of chronic endometritis (23, 24).

Recently, Cicinelli et al. (25) described diagnostic criteria for chronic endometritis at fluid hysteroscopy with low pressure. Fluid hysteroscopy is more efficacious than is CO₂ hysteroscopy for detection of this entity; indeed, saline has no effect on endometrial microcirculation and provides smoother distension and continuous washing of the uterine cavity, allowing endometrial ingrowths to float.

The diagnostic criteria for chronic endometritis at fluid hysteroscopy are the following: stromal edema, focal or diffuse hyperemia, and endometrial micropolyps (<1 mm in size).

Stromal edema, mostly when combined with hyperemia, is a sign of inflammation that can be detected easily at fluid hysteroscopy, because the endometrial mucosa, although it

is in the proliferative phase, appears pale, whitish, and nonhomogeneously thick; in some cases it may fold, thus simulating a polyp.

Micropolyps, in particular, represent a very reliable sign of inflammation. They are small, vascularized ingrowths that are covered by endometrium and characterized by an accumulation of inflammatory cells (lymphocytes, plasma cells, or eosinophilic granulocytes) and edema in stroma; they probably are an expression of an active and strong endometrial reaction and of massive release of interleukine and local growth factors (26, 27).

The combination of hyperemia, edema, and micropolyps has a diagnostic accuracy of 93.4%, confirming hysteroscopy to be a reliable and useful technique for investigating chronic endometritis (25).

MÜLLERIAN ANOMALIES

Even if Müllerian anomalies usually are associated with infertility and abnormal uterine bleeding, it should be emphasized that some of them may cause CPP (28). Hysteroscopy together with laparoscopy may contribute to the diagnosis of such anomalies. Steinkamp et al. (29) recently reported the case of a non-communicating accessory uterine cavity as a cause of pelvic pain. Hysteroscopy together with TVS was useful for detecting the cavity.

Recently, Nawroth et al. (30) described a significantly higher incidence of endometriosis in patients with a septate uterus, suggesting that in such cases, a combined hysteroscopy and laparoscopy should be performed. If this association is confirmed in further, larger studies, additional CPP may support the decision to operate. Indeed, clinical experience suggests that hysteroscopic resection of the uterine septum (even without laparoscopic treatment of endometriosis) often is followed by a significant improvement in, or complete resolution of, severe dysmenorrhea.

INTRAUTERINE BONE STRUCTURES

The presence of intrauterine bone structures is a rare condition (31–35) that mostly is caused by retained fetal bone fragments, as a complication of induced abortion, spontaneous intrauterine fetal death, and missed abortion (36, 37). In some cases, it may be caused by metaplasia of mature endometrial stromal cells, in response to chronic inflammation or trauma (38, 39). It is interesting to note that the presence of retained fetal bones may be more common in cases of uterine anomalies (34, 40).

This situation may cause CPP, infertility, abnormal uterine bleeding, vaginal discharge, and passage of bony fragments in menstrual blood (31, 41).

Transvaginal sonography usually represents the first-line diagnostic tool. Retained bone fragments are displaced on an ultrasound as bright echogenic areas with posterior shadowing. Hysteroscopy has been demonstrated to be

effective for confirming the diagnosis and achieving the successful removal of fetal bones (35, 42–44), either with a resectoscope or with grasping forceps inserted through the operative channel of a hysteroscope (34, 40, 45).

ENDOCERVICAL OSSIFICATION

Endocervical ossification is an osseous metaplasia in the cervical canal, usually complicating chronic endocervicitis (46–48). The mechanism through which endocervicitis leads to endocervical ossification is still unclear; however, it has been hypothesized that the release of the increased amount of intracytoplasmic calcium after the death of the cervical cells may trigger further deposition of calcium and formation of macroscopic bone structures (46). These patients may have CPP, infertility, hypermenorrhea, and dysmenorrhea. The diagnosis is based on TVS and hysteroscopy, which is useful for confirming the diagnosis as well as for treating the pathology. During hysteroscopy, the presence of white-colored endocervical fragments with a sponge-like aspect and hard consistency at contact with the tip of the hysteroscope supports the diagnosis of endocervical ossification and chronic endocervicitis (46).

INTRAUTERINE ABNORMALITIES

Some uterine abnormalities may cause CPP. These include cervical stenosis, intrauterine adhesions, polyps, and submucosal myomas (49). In case of cervical stenosis and adhesions, pelvic pain usually is caused by the occurrence of different sizes of hematometras, with consequent increase of the intrauterine pressure.

Large polyps and submucosal myomas may cause pain, especially when the uterus tries, by means of contractions, to expel them.

Some of these intrauterine lesions (i.e., polyps, submucosal myomas, hematometra) may be easily diagnosed with TVS, whereas other abnormalities may only be suspected or not diagnosed (i.e., intrauterine adhesions, cervical stenosis).

At present, office hysteroscopy commonly is regarded as the gold-standard technique in any situation in which a major or minor intrauterine or cervical anomaly is suspected or has to be ruled out (50). Furthermore, several investigators have demonstrated that most intrauterine and cervical lesions also may be successfully treated by hysteroscopy in the outpatient setting, during the diagnostic workup (*see and treat*) (51–53).

DISCUSSION

The term *office setting* refers to the performance of hysteroscopy, either diagnostic or operative, on an outpatient basis, while the patient is not in the operating room. Improvements in office hysteroscopy, both in technology and technique, such as the use of saline solution as distension medium (54), the availability of high-resolution mini-endoscopes

(55), and the atraumatic insertion of the instruments (56), have led to the development of its current form. It is, therefore, now recommended as a first-line diagnostic tool for the evaluation of abnormal uterine bleeding (57) and infertility (58), because it is associated with minimal patient discomfort, excellent visualization, and very low complication and failure rates (58).

Moreover, as an operative tool, the new-generation office hysteroscope has the advantages of including an operative channel of ≥ 5 Fr, which enables the simultaneous diagnosis and treatment (*see and treat*) of various uterine and cervical pathologies in an outpatient setting (56–60).

Office hysteroscopy can be considered to be a valid diagnostic instrument for numerous pathological conditions causing CPP that can be hard to diagnose by, or that may not be diagnosed by, noninvasive techniques (TVS or MRI) or even by laparoscopy (i.e., chronic endometritis, intrauterine pathologies, Müllerian anomalies, superficial adenomyosis) (16, 51–53, 61, 62). Furthermore, it should be emphasized that a negative laparoscopy does not mean that there is no disease or that a woman has no physical basis for her pain (3).

Moreover, office hysteroscopy may play a primary role in the resolution of many causes of CPP, such as Müllerian anomalies (28, 62, 63), intrauterine bone structures (34, 35, 40, 42–45), endocervical ossification (46), and intrauterine abnormalities (51, 52, 62).

For these reasons, although laparoscopy still represents the gold standard for the assessment of women with CPP, hysteroscopy may be considered a useful technique, mostly when the cause of CPP remains a diagnostic dilemma (4, 7).

Nowadays, the validity of hysteroscopy has been well demonstrated. However, unfortunately, most gynecologists still are unable to take advantage of the many potentialities of this technique or do not perform hysteroscopic procedures in the office setting.

Because it can be executed safely without anesthesia and has high patient compliance, office hysteroscopy may be indicated, together with the other noninvasive procedures such as TVS, as a first-level investigation in women affected by CPP. This could reduce the number of unnecessary laparoscopies that are performed in women with CPP.

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[Q21]

[Q22]

1 Role of hysteroscopy in evaluating chronic pelvic pain

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Our analysis shows the efficacy of hysteroscopy in
diagnosing several gynecological causes of chronic
pelvic pain.

UNCORRECTED PROOF

Endometrial vaporization of the cervical stump employing an office hysteroscope and bipolar technology

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KEYWORDS:

Office hysteroscopy;
Subtotal hysterectomy;
Cervical stump;
Bleeding

Abstract. We report the successful treatment of a 40-year-old woman with ongoing cyclical vaginal bleeding lasting 10 days after laparoscopic subtotal hysterectomy. Hysteroscopic vaporization of the endometrial stripe in the cervical stump was performed in an office setting, using a 5-mm Bettocchi double-channel operative hysteroscope armed with a bipolar electrode.

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Subtotal hysterectomy continues to represent a justifiable alternative to total hysterectomy for benign gynecologic conditions, being associated with a reduced rate of complications (i.e., damage to surrounding pelvic organs, vaginal prolapse, hematomas, blood loss, wound infections), a shorter operative time, and more rapid recovery.^{1,2} However, the theoretical advantage of subtotal versus total hysterectomy in terms of better preservation of sexual satisfaction in young patients, because of less disturbance of the cervical and upper vaginal innervation,³ was not confirmed by recent more robust evidence.⁴ The main clinical arguments against subtotal hysterectomy are the risk for development of cancer in the cervical stump and the possibility of abnormal bleeding related to the pres-

ence of even small islands of residual endometrial tissue in the cervical stump.²

Nevertheless, the risk for development of a neoplasia in the cervical stump should no longer be considered a reason for preferring total to subtotal hysterectomy because the likelihood is low (less than 1%),⁵ and cervical screening has already been shown to be effective in the follow-up of these patients.⁶ On the other hand, the incidence of cyclical or continuous bleeding after subtotal hysterectomy ranges between 1% and 31.4% in different series^{1,7} and negatively affects the quality of life of those women who could expect to stop menstruating after such major surgery, as well as potentially complicating the use of hormone replacement therapy.² To minimize this complication, during surgery diathermy is usually applied to the top of the endocervical canal with the aim of destroying any cycling endometrium.⁸ This modality, however, has not been proven to prevent future bleeding episodes.⁷ Thakar et al¹ proposed that formal reverse conization, including the cervical epithelium together with the transformation zone, as well as any residual endometrium, could minimize this complication during a laparotomic subtotal hysterectomy.

The authors have no commercial, proprietary, or financial interest in the products or companies described in this article.

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Submitted April 27, 2007. Accepted for publication June 1, 2007.

In the presence of intermittent or continuous bleeding after the procedure, laparotomic, laparoscopic, or vaginal trachelectomy with or without laser treatment or medications (progestins or combined hormone replacement therapy) are currently performed. Although successful in most cases, such surgical options require the use of general anesthesia and are associated with significant morbidity, apart from their high cost.⁹ In this report, we propose an alternative option for the treatment of abnormal bleeding after subtotal hysterectomy, with a 5-mm hysteroscope and 5F bipolar electrodes.

Case report

A 40-year-old multiparous woman was referred to our department for persistent cyclical vaginal bleeding of 10 days duration, arising nearly 2 months after laparoscopic subtotal hysterectomy. The latter had been performed for menorrhagia in the presence of a uterus with multiple myomas, the largest of which was 6 cm in diameter. Her history was unremarkable for malignancy or significant medical conditions. She had undergone a resectoscopic myomectomy at age 38 for menorrhagia without any significant improvement of her symptoms. Laparoscopic subtotal hysterectomy was therefore preferred because the patient was still experiencing heavy bleeding, but she maintained that the whole uterus not be removed, for fear of a possible decline in the quality of her sexual activity. Diathermy to the top of the endocervical canal was performed at the end of the laparoscopic procedure.

Two months later, the patient started to experience persistent cyclical bleeding from the cervical stump and therefore underwent vaporization of the remaining endometrial tissue by means of a 5-mm hysteroscope and a bipolar electrode. Prior institutional review board approval and informed consent from the patient were obtained.

Transvaginal ultrasonography performed before the procedure excluded a hematoma over the apex of the cervical stump or pelvic diseases. Hysteroscopy was performed by G.P. with a 5-mm continuous-flow operative office hysteroscope with a 2.9-mm rod lens (Bettocchi Office Hysteroscope; Karl Storz, Tuttlingen, Germany). The vaginoscopic approach (without speculum and tenaculum) was used, and distension of the endocervical canal was obtained with normal saline solution. Pressure within the cavity was automatically controlled by an electronic irrigation and suction device (Endomat; Karl Storz); the pressure was set at 45 mm Hg, being the balance of an irrigation flow around 200 mL/min and a vacuum of 0.2 bar. The electrosurgical instrument used for the vaporization of the residual endometrium was the VersaPoint Bipolar Electrosurgical System (Gynecare, Ethicon Inc., Somerville, NJ), consisting of a dedicated bipolar electrosurgical generator and a 5F spring electrode inserted through the 5F operative channel of the hysteroscope (Figure 1). The mildest vapor cutting mode

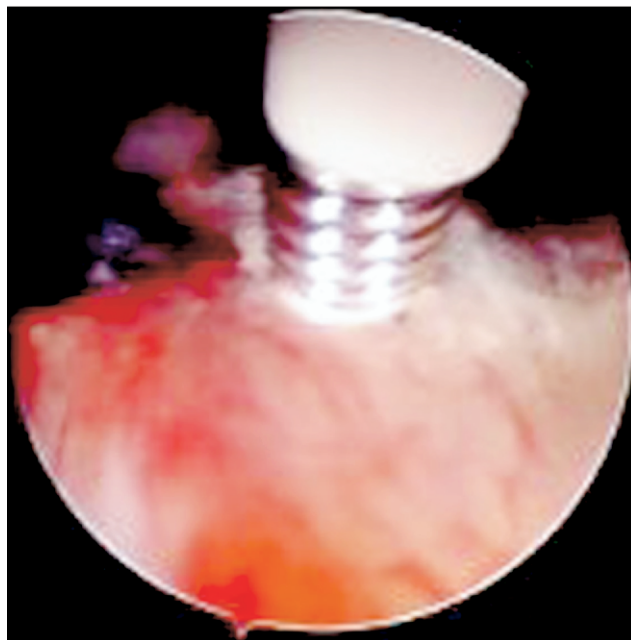


Figure 1 A spring electrode inserted through the 5F operative channel of the hysteroscope is used to vaporize a 2-mm endometrial stripe identified in the proximal portion of the cervical stump.

(VC3) with a power of 50 W was used to minimize the energy flowing into the tissue and to reduce the generation of bubbles. Conscious sedation was achieved by administering midazolam 10 mg and fentanyl 100 μ g intravenously. A 2-mm endometrial stripe was identified in the proximal portion of the cervical stump. The procedure was performed with the patient in Trendelenburg position to keep the bowel away from the fundus of the cervical stump.

The overall procedure was quick (operative time: 12 minutes), bloodless, and free from intraoperative or postoperative complications. The patient's immediate return (2 hours after) to normal activities bear witness to the success of the procedure.

At 2-month follow-up, the patient's symptoms were significantly improved. She reported only 1 episode of spotting lasting for 3 days, nearly 1 month after the procedure. At the 6- and 12-month follow-up appointments, she did not complain of any bleeding. Transvaginal ultrasonography performed at the 12-month visit did not detect any occult accumulation of blood or pelvic abnormalities.

Discussion

To the best of our knowledge, this is the first report of successful treatment of abnormal bleeding from the cervical stump with an office hysteroscope and bipolar technology. The patient had undergone laparoscopic subtotal hysterectomy followed by diathermy of the top of the endocervical canal. However, the procedure was ineffective because the patient experienced persistent cyclical vaginal bleeding 2

months after the procedure. This was probably related to the “blind” nature of laparoscopic diathermy, which cannot ensure complete destruction of the residual endometrial islands located in the cervical stump.

Several reports have already demonstrated that the VersaPoint system can be safely used to treat benign intra-uterine and cervical lesions.¹⁰ On the basis of these previous studies and our clinical experience, we decided to apply our see-and-treat philosophy to treat this problem of cervical stump-related abnormal bleeding.

The main difference as compared with our previously reported experience¹⁰ was the use of conscious sedation. The use of the latter was based on the idea that to be effective, vaporization of the residual endometrium had to reach the first 2 to 3 mm of the myometrium and that such an approach was expected to be painful for the patient. The Spring electrode was preferred to the Twizzle and Ball ones, because it provides a deeper and wider vaporization/coagulation of the tissues. The procedure was quick, bloodless, and free from intraoperative or postoperative complications. In additional cases, intraoperative ultrasound guidance might be recommended to ascertain that the apex of the endometrial echo is treated as completely as possible while maintaining a safe distance from the bowel or bladder.

The high magnification of the endoscopic view ensured a correct identification of the residual endometrium and its complete vaporization (Figure 2). The correct power setting of the VersaPoint, together with the use of an electronic irrigation and suction device, restricted bubbles in the endocervical canal and ensured a clear, satisfactory view throughout the procedure.

The effectiveness of the procedure was demonstrated by the absence of any bleeding at the follow-up appointments and by the negative transvaginal ultrasound findings at the 12-month visit. The patient was very satisfied both with the successful treatment of her condition and the immediate return to normal activities. In additional cases, even if symptom free, an ultrasound scan performed at 6 and 12 months is strongly recommended to make certain there is no retrograde accumulation of blood or fluid. In fact, the index technique could cause sclerosis of the distal endocervical canal, and any trapped bleeding occurring proximal to a stenotic endocervix could result in an accumulation of blood that might or might not provoke symptoms as a hematometra.

Larger prospective randomized trials comparing our innovative approach to standard surgical approaches are needed to test its feasibility and effectiveness. If such studies confirm our promising results, our technique may in the future replace both more-invasive surgical approaches and

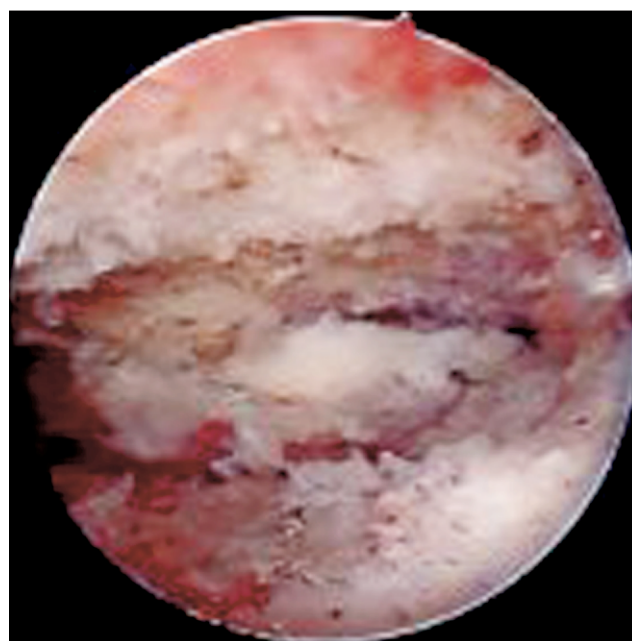


Figure 2 Hysteroscopic view of cervical stump after endometrial vaporization.

less-cost-effective medical approaches to the treatment of bleeding of the cervical stump after subtotal hysterectomy.

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Title

Office Preparation of Partially Intramural Myomas (OPPIuM): A Pilot Study

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24 **Précis**

25 Office Preparation of Partially Intramural Myomas (OPPIuM) is an novel hysteroscopic technique
26 which leads to the conversion of submucous myomas with intramural development into totally or
27 prevalent intracavitary ones in nearly 90% of cases, thus facilitating subsequent resectoscopic
28 myomectomy.

29

30 Abstract

31 **Objective:** To assess the safety and efficacy of a novel hysteroscopic technique for the Office
32 Preparation of Partially Intramural Myomas (OPPIuM) for the subsequent resectoscopic
33 myomectomy.

34 **Design:** Pilot study.

35 **Setting:** University of Bari, Naples and Foggia.

36 **Patients:** Thirty-one fertile women (ages 30-48 yrs) diagnosed at office hysteroscopy as having
37 symptomatic submucous myomas > 1.5cm with intramural development (G1 and G2) scheduled for
38 resectoscopic surgery.

39 **Interventions:** OPPIuM technique consists of an incision of endometrial mucosa covering the
40 myoma by means of scissors of 5Fr bipolar electrodes along its reflection line on the uterine wall,
41 up to the precise identification of cleavage surface between the myoma and pseudo-capsula. This
42 action may trigger the protrusion of the intramural portion of myoma into the cavity during the
43 following menstrual cycles thus facilitating the subsequent total removal of the lesion via
44 resectoscopic surgery. All patients underwent a follow-up in-patient hysteroscopy after two
45 menstrual cycles before resectoscopic surgery was performed.

46 **Measurements & Main Results:** OPPIuM technique was successfully performed in all cases. The
47 mean diameter of successfully prepared myoma was 3.1 ± 1.0 cm. At follow-up hysteroscopy the
48 conversion of such myomas with intramural development into totally or prevalent intracavitary
49 lesions was observed in 87% (27/31) of cases. In two out of three cases of failure the diameter of
50 the myoma was > 4 cm. One patient was excluded from the study because of the occurrence of
51 spontaneous total expulsion of the myoma at the following menstrual cycle.

52 **Conclusions:** Our preliminary findings seem to support the safety and effectiveness of this novel
53 technique by reporting the conversion of myomas with intramural development > 1.5 cm into totally
54 or prevalent intracavitary ones in nearly 90% of cases. This action may allow surgeons to perform

55 resectoscopic surgery more safely and quickly as dealing with prevalent intracavitary lesions.

56 However further studies are mandatory to validate its use in daily practice.

57

58 **Key words:** OPPIuM, intramural myomas, hysteroscopy, resectoscopic myomectomy, submucous

59 myomas.

60

61

62 **Introduction**

63

64 With ongoing developments in the field of hysteroscopy during the last fifteen years, hysteroscopic
65 surgery is becoming safer and less invasive for the patient. Improved technology has enabled us to
66 perform many operative procedures in an office setting without significant patient discomfort and
67 with potentially significant cost savings. Indeed, today hysteroscopy is considered the gold standard
68 not only for visualizing the cervical canal and the uterine cavity, but also for treating a number of
69 benign uterine pathologies including polyps, sinechiae and myomas (1-2).

70 At the present time, submucous myomas < 1.5 cm with total (G0) or mostly (>50%) intracavitary
71 development (G1) may be successfully treated in outpatient setting with 5Fr mechanical and bipolar
72 instruments. The procedure has been already described elsewhere by our group. (3). On the
73 contrary, when dealing with myomas greater than 1.5 cm or with those characterized by prevalent
74 (> 50%) intramural development (G2), it seems reasonable to plan a resectoscopic myomectomy
75 possibly preceded by a 3 months of Gonadotropin Releasing Hormone analogue (GnRHa)
76 treatment.

77 Resectoscopic myomectomy for G0 and G1 myomas is not a complex procedure, being feasible
78 even for surgeons with average hysteroscopic experience. On the contrary resectoscopic
79 myomectomy for G2 myomas is a difficult procedure to be performed only by surgeons skilled in
80 hysteroscopy. Indeed it is associated with a significant risk of complications which is proportional
81 to the degree of intramural development of the myoma. Furthermore, the larger is the myoma and
82 its intramural development, the more likely is the need for splitting the procedure into different
83 surgical steps (4).

84 A wide number of techniques have been proposed for the treatment of partially intramural myomas
85 via resectoscopy. Among those, the “*cold knife myomectomy*” developed by Mazzon (5) and the
86 “*enucleation in toto*” described by Litta (6) seem to comply most with the necessary requirements
87 of safety and efficacy.

88 Therefore, proceeding from those techniques, we have recently developed a novel procedure to
 89 prepare submucous myomas > 1.5cm with partially intramural development (G1 and G2) in
 90 outpatient setting with miniature hysteroscopes (*Office Preparation of Prevalent Intramural*
 91 *Myomas: OPPIuM*) in order to facilitate the subsequent resectoscopic removal under general
 92 anaesthesia.

93

94

95

Materials and Methods

Patients

This study prospectively enrolled thirty-one women of reproductive age (range 30-48 yrs) hysteroscopically diagnosed with submucous myoma and referred to any of the three participating University hospitals (Bari, Naples and Rome) from January 2007 to January 2008. To be eligible for inclusion, patients with an hysteroscopic diagnosis of a single submucous, partially intramural (G1 or G2) myoma >1.5 cm, must have had symptoms (abnormal uterine bleeding, pain, infertility) for which they had been scheduled for treatment via resectoscopy. Women sonographically diagnosed as having a free myometrium margin < 0.8 cm, those with multiple or asymptomatic lesions, or with other uterine or adnexal pathologies as well as those affected by any major systemic disorders were excluded. All centers received research ethics approval for this study, and subjects gave their informed consent.

Baseline data recorded at inclusion included age, race, BMI, reproductive history, infertility work-up, educational status (surrogate for socioeconomic status), symptoms, transvaginal ultrasound (TVS) characterization of the lesion and the free myometrium margin, and hysteroscopic grading of the lesion (G0, G1, G2 type) according to the European Society of Hysteroscopy classification (7).

Interventions

a) Transvaginal ultrasound scanning

Preoperative transvaginal ultrasound scanning (TVS) was performed in all patients to provide accurate informations concerning the characteristics of the submucousal myoma to be operated on and to exclude other coexistent uterine or adnexal pathologies. Ultrasonographic measurements were performed by a trained physician using a 5.0- to 9.0-MHz multi-frequency transvaginal probe (Voluson 730 Expert; General Electrics Medical Systems, Paris, France) during the first half of the

menstrual cycle. The size of the myoma was defined by the mean of the three diameters as measured on both the longitudinal (length and anteroposterior diameters) and transverse (transverse diameter) planes. The location (anterior, fundus, or posterior wall) and type (I, intramural extension less than 50%; II, intramural extension equal to or greater than 50%) of the submucous myomas as well as the diameters of the entire uterus (length, thickness and width) were also measured. In addition, the thickness of the myometrium remaining between the deep edge of the myoma and the serous peritoneum (free myometrial margin) was measured by TVS and a safety margin of at least 0.8 cm was set.

b) Office Hysteroscopy

An office hysteroscopy was performed during the early proliferative phase of the menstrual cycle. All the procedures were performed by three skilled hysteroscopist (one per each center: A.D.S., L.N, and S.B.) by means of a 4mm continuous-flow office hysteroscope (Bettocchi Office Hysteroscope, Karl Storz, Tuttlingen, Germany) with a 2.9 mm rod lens optic. The vaginoscopic approach, without speculum and tenaculum was used and no analgesia or anesthesia was administered to the patient. Distension of the uterine cavity was obtained using saline solution and the intrauterine pressure was automatically controlled by an irrigation-suction electronic device (Endomat, Karl Storz, Tuttlingen, Germany) set at 45 mm Hg, being the balance of an irrigation flow around 200 mL/min and a vacuum of 0.2 bars. The location, size, and grading of the submucous myoma according to the European Society of Hysteroscopy classification (7) were recorded.

145 *c) OPPIuM*

146 The OPPIuM technique was performed at the time of the office hysteroscopy. The endometrial
147 mucosa covering the myoma was incised by means of 5Fr scissors or bipolar Versapoint Twizzle
148 electrode (Gynecare; Ethycon Inc., NJ, USA) along its reflection line on the uterine wall, up to the
149 precise identification of the cleavage surface between the myoma and pseudo-capsula (**Fig.1**). This
150 action was aimed at facilitating the protrusion of the intramural portion of myoma into the cavity
151 during the following menstrual cycles. No hormonal therapy was administered to the patient either
152 before or after the procedure.

153 The OPPIuM procedure was considered successfully completed as soon as the cleavage surface
154 between the myoma and the pseudo-capsula was clearly visualized for the intracavitary extension of
155 the myoma.

156

157 *4) VAS score*

158 A visual analogic scale (VAS) score on a 100-mm scale was used to assess the intensity of pain
159 experienced during and after the procedure (on which 0 indicated absence of pain and 100 the worst
160 pain possible). The patients were asked to quantify pain three times, at the introduction of the scope
161 into the cavity (VAS1), at the time of incision of the pseudocapsule (VAS2) and 30 minutes after
162 the procedure (VAS3).

163

164 *5) Follow-up diagnostic hysteroscopy*

165 Follow-up data were obtained from a second diagnostic hysteroscopy performed in the early
166 proliferative phase after two menstrual cycles. Although the procedure was carried out in in-patient
167 setting and under general anaesthesia, the same hysteroscope and set-up (pressure, flow, suction)
168 used for the office procedure were selected and the hysteroscopic grading of the submucous myoma

was re-assessed in order to evaluate the protrusion of the possible intramural portion of the myoma into the uterine cavity.

6) Resectoscopic myomectomy

Immediately after the follow-up diagnostic hysteroscopy, the resectoscopic excision of the myoma was carried out with the classical technique of slicing using a 27Fr bipolar resectoscope (Gynecare; Ethycon Inc., NJ, USA). The technique consisted of repeated and progressive passages of the cutting loop, carried out with the standard technique (loop carried beyond the neoformation, with cutting only taking place during the backward or return movement of the loop). Excision began from the top of the myoma, progressing in a uniform way towards the base. When dealing with the base of the myoma, care was taken to limit the surgical traumatism to the area of the implant, thus avoiding the damage of the surrounding structures. As soon as the excision of the myoma was finished, the base of the implant was cleaned out until smooth and regular; the operation being considered finished when the fasciculate structure of the myometrium was visualized. Operating time was calculated from the introduction of the resectoscope into the uterine cavity to the visual reassessment of myoma resection completion. Fluid balance was recorded throughout the entire procedure by measuring the inflow and outflow fluid from the continuous flow resectoscope. Patients were fully counselled regarding the risks of operative hysteroscopy prior to the intervention and any complication occurring either during or after the procedure was recorded.

Data analysis

Statistical analysis was performed using the SPSS 9.0 (SPSS Inc.; Chicago, IL, USA). The Shapiro-Wilk's test was performed to evaluate data distribution of all variables. VAS scores and mean diameters of the myomas showed a normal distribution and a Student's t-test for paired samples was

193 used to compare such values. Data were expressed as mean \pm standard deviation (SD) unless stated
194 otherwise. Statistical significance was set at $p < 0.05$.

195

196

Results

The mean age of the enrolled women was 41 years (range 30-48 years). Fifteen patients (48.3%) were nulliparous and 20 patients (64.5%) had a history of pelvic operations including 6 (19.3%) caesarean sections and 14 (45.1%) pelvic surgeries. Indications for treatment were abnormal uterine bleeding ($n= 20$) and/or infertility ($n= 10$) and/or pain ($n= 8$). By ultrasound examination all detected myomas were single and submucous, being 7/31 (22.5%) located on the anterior wall, 12/31 (38.7%) on the posterior wall and the remaining 12/31 (38.7%) on the uterine fundus. Fifteen (48.3%) out of the thirty-one myomas to be treated were hysteroscopically classified as being G1, whilst the remaining 16 (51.7%) were graded as G2 (Table 1).

The mean diameter of the myomas as measured by ultrasound was 3.1 ± 1.0 cm (Table 1). No statistically significant differences were observed between the mean diameters of G1 and G2 myomas (2.76 ± 0.98 vs 3.3 ± 0.89 $p>0.05$).

OPPIuM technique was successfully performed in all cases being the procedure considered completed when the cleavage surface between the myoma and the pseudo-capsula was clearly visualized for the intracavitary extension of the myoma.

The mean VAS2 score was slightly, but not significantly increased in comparison with VAS1 score (33.0 ± 13.1 mm vs 31.7 ± 12.2 mm). The mean VAS3 score (19.7 ± 9.6 mm) was significantly lower than VAS1 and VAS2 ($P< 0.05$).

At follow-up hysteroscopy the conversion of myomas with partially intramural development into totally (G0) or prevalent (G1) intracavitary lesions was globally observed in 87% (27/31) of cases (Table 1). For G1 myomas the conversion into G0 lesions was observed in all cases (100%). However, in one patient diagnosed as having a 1.8 mm, anteriorly located, G1 submucous myoma the spontaneous total expulsion of the myoma occurred at the following menstrual cycle as demonstrated either by follow-up hysteroscopy and intraoperative ultrasound. The office preparation of G2 myomas succeeded in 13/16 (81.2%) cases, resulting in 10 G1 (76.9%) and 3 G0 (23.1%) lesions, respectively. In three cases of failure the myomas, originally classified as G2, were

still graded as G2 at follow up hysteroscopy. In two of those cases myoma size was > 4 cm (Table 2).

Resectoscopic myomectomy was successfully performed in a single surgical procedure in all cases in which OPPIuM technique succeeded. The mean operating time was 23.7 ± 8.8 min. No intra-operative complications were reported (Table 1). All patients were discharged within 24 hours of hospital stay.

In all the cases of failure, as soon as we realized the lesions to persist as G2 myomas, we preferred to approach them by means of a monopolar resectoscope (Karl Storz, Tuttlingen, Germany) which may fit cold loops for enucleating the intramural portion of myoma. However, in two cases the resectoscopic myomectomy required a second surgical step to avoid fluid overload syndrome.

Discussion

The development of small diameter (4-5mm) continuous flow hysteroscopes equipped with an operative channel enabled the treatment of many intrauterine pathologies in an “office setting” without cervical dilatation and consequently without anesthesia or analgesia and using saline solution as distention media (1-2,8).

Indeed, submucous myomas with a mean diameter < 1.5 cm may be treated in office setting if totally intracavitary (G0) or with an intramural part < 50% (G1) (3), while actually gold standard treatment for myomas bigger than 1.5 cm or with an intramural part greater than 50% (G2) is resectoscopy eventually after 3 months therapy with GnRH analogues

Nevertheless, hysteroscopic resection of myomas with intramural extension is advisable for expert operating surgeons as it is technically difficult with a slow learning curve and it is associated with an higher risk of complications (9). Indeed, hysteroscopic myomectomy is associated with a significantly higher rate of complications than other hysteroscopic procedures, being fluid overload and uterine perforation the most frequent complications occurring during surgery. Other intraoperative complications include bleeding, cervical trauma and air embolism, while late complications include postoperative intrauterine adhesions and uterine rupture during pregnancy (4).

Several techniques have been proposed for the treatment of such submucous myomas, most of them sharing the objective to turn a partially intramural myoma into a totally or prevalent intracavitary lesion, thus avoiding a deep cut into the myometrium (4)

In the past, several authors have proposed a progressive resectoscopic excision of the only intracavitary component of those myomas with extensive intramural involvement (10), but the constant intracavitary expulsion and the subsequent volumetric increase of the residual intramural component of the myoma, leading to the persistence of the initial symptomatology, made such a treatment fall into disuse.

Nowadays the complete excision of a partially intramural myoma can be performed in different ways by using either one-step or two-step techniques. The two-step technique, developed by Donnez (11) and Loffer (12), seems to be very effective and safe; however it requires an extended GnRHa treatment and repeated hysteroscopies, which can cause greater distress in patients.

Among one-step techniques, *cold loop myomectomy* and *enucleation in toto* are widely accepted as being safe and effective techniques. The *cold loop myomectomy*, developed by Mazzon (5), is characterized by a sequence of three different operating steps: 1) *Excision of the intracavitary component of the fibroid*, which is carried out with the usual technique of slicing; 2) *Enucleation of the intramural component of the fibroid*, which starts once the cleavage plane is identified and provides the use of a suitable blunt dissection cold loop. During the entire phase of enucleation, electric energy is not used, as the loop is only used in a mechanical way; 3) *Excision of the intramural component by slicing*, which begins at the end of the enucleation phase, as soon as the intramural part of the fibroid is totally dislocated inside the uterine cavity. At present, the *cold loop myomectomy* seems to represent the best option as it allows a safe and complete removal of such myomas in just one surgical procedure, while respecting the surrounding healthy myometrium. However the use of such technique requires adequate training, high experience and the availability of cold loops, which are manufactured by a single company (Storz, Germany) and may fit only the monopolar resectoscope.

The *enucleation in toto*, developed by Litta et al. (6) provides that an elliptic incision of the endometrial mucosa that covers the fibroid is performed with a 90 degree Collins electrode at the level of its reflection on the uterine wall until the cleavage zone of the fibroid is reached. The effect of such action is that the fibroid protrudes into the cavity, thus facilitating its removal by traditional slicing.

Proceeding from those techniques, we have recently developed a novel technique to prepare submucous myomas > 1.5cm with partially intramural development in outpatient setting with miniature hysteroscopes in order to facilitate the subsequent resectoscopic removal under general

anaesthesia. Such technique is simple to be performed in that it may be carried out either by means of mechanical instruments (5Fr scissors) or bipolar electrodes whether available. It provides that the endometrial mucosa covering the myoma is incised by means of 5Fr scissors or bipolar Versapoint Twizzle electrode along its reflection line on the uterine wall, up to the precise identification of the cleavage surface between the myoma and pseudo-capsula. This action is aimed at facilitating the protrusion of the intramural portion of myoma into the cavity during the following menstrual cycles. Indeed, as elsewhere demonstrated (6), the elliptic incision of endometrial mucosa covering the intact myoma (i.e. without the removal of the intracavitary portion) permits the expulsion forces of the uterine wall to maintain their maximum value until expulsion starts.

In our series, OPPIuM technique demonstrated to be effective as it resulted in the conversion of myomas with intramural development into totally or prevalent intracavitary ones in nearly 90% of cases. This action allowed surgeons to perform resectoscopic surgery in less than 30 minutes on average, with reduced risks related to a prolonged anaesthesia. Furthermore, as dealing with prevalent intracavitary lesions, surgeons were able to remove those lesions in a single surgical step without any intraoperative complications.

The rationale assuring that intrauterine lesions may be treated in outpatient setting without any analgesia or anaesthesia lays in the anatomical characteristics of uterus. Indeed, uterine sensitive innervation starts from the myometrium out while fibrotic tissue and endometrium are not innervated (1). One of the main concerns arising when we ideated OPPIuM technique was the fear to inflict pain to patients when going too deep within the myometrium. However in our preliminary data, the mean VAS score at the time of incision of the pseudocapsule was not significantly increased in comparison with that describing the pain experienced by the patients at the time of the introduction of the scope into the cavity. According to our preliminary clinical experience the correct identification of the all anatomical layers represents the main prerequisite for the success of the procedure. Indeed, whether after the incision of the endometrial mucosa the pseudocapsula is

correctly identified, the deep stimulation of myometrial innervation can be avoided, thus further minimizing patients' discomfort.

In all failed cases, submucous myomas had a prevalent intramural extension; in addition, two of those had a mean diameter > 4 cm. Such data seem to support the hypothesis that a greater (> 4 cm) myoma size in the presence of prevalent intramural development may negatively affect the likelihood of success of the procedure.

Apparently, such hypothesis is in disagreement with Litta et al (6) who showed that when a myoma with more than 50% intramural involvement is incised, the expulsion force increases, reaching its maximum value when during surgery the intramural part reaches 50%.

However the small sample size does not allow to draw any definitive conclusion and larger studies are mandatory to address this issue.

Conclusion

Our findings seem to support the safety and effectiveness of this novel technique by reporting the conversion of myomas with intramural development into totally or prevalent intracavitary ones in nearly 90% of cases. This action may allow surgeon to perform resectoscopic surgery more safely and quickly as dealing with prevalent intracavitary lesions.

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- 363
- 364

Table 1. Main characteristics of treated myomas and outcomes of OPPIuM technique and resectoscopic surgery

	TVS Characterization		Hysteroscopic Grading		Resectoscopic Data		
	Size (mean diameter)	Location	Office hysteroscopy (before OPPIuM)	Follow-up hysteroscopy (after OPPIuM)	One-step procedure	Operating time (min)	Intraoperative complications
1°	1,8	A	G1	-	-	-	-
2	1,7	A	G1	G0	YES	12	-
3	1,8	L	G2	G0	YES	13	-
4*	4,7	F	G2	G2	NO	74 [§]	-
5	3,1	F	G1	G0	YES	25	-
6	3,3	F	G2	G1	YES	33	-
7	4	F	G2	G1	YES	40	-
8	3,1	P	G1	G0	YES	18	-
9	3,2	P	G2	G1	YES	26	-
10	3,2	L	G1	G0	YES	17	-
11	3,1	A	G1	G0	YES	24	-
12	3,8	F	G1	G0	YES	23	-
13*	4,4	F	G2	G2	NO	65 [§]	-
14	3,7	P	G2	G1	YES	26	-
15	3,3	A	G2	G1	YES	30	-
16	2	P	G2	G1	YES	16	-
17	1,9	P	G1	G0	YES	14	-
18	1,6	L	G1	G0	YES	12	-
19	2,2	F	G2	G0	YES	15	-
20	4	F	G2	G1	YES	44	-
21	4,9	A	G1	G0	YES	32	-
22	2,9	P	G2	G0	YES	22	-
23	4,4	L	G2	G1	YES	37	-
24	1,6	A	G1	G0	YES	12	-
25	3	F	G1	G0	YES	22	-
26	3,1	A	G1	G0	YES	24	-
27	3,7	P	G1	G0	YES	28	-
28	2,7	F	G2	G1	YES	30	-
29*	3,1	P	G2	G2	YES	36	-
30	1,8	P	G1	G0	YES	16	-
31	4,2	L	G2	G1	YES	29	-

A: anterior wall; P: posterior wall; F: uterine fundus; L: lateral walls. Myomas are classified in G0, G1 and G2 type according to the European Society of Hysteroscopy classification (G0 myoma is completely within the uterine cavity; a G1 myoma has its larger part (> 50%) in the uterine cavity; and a G2 myoma has its larger part (> 50%) in the myometrium)

° Spontaneous total expulsion of the myoma

* Failed OPPIuM technique

§ Sum of operating times of two surgical procedures

378

379 **Legend of figures**

380

381 **Figure 1.** OPPIuM technique: a) Incision of endometrial mucosa which covers the myoma by
382 means of 5 Fr bipolar electrode b) Identification of the cleavage surface between the myoma and
383 pseudo-capsula.

Use of office hysteroscopy to empty a very large hematometra in a young virgin patient with mosaic Turner's syndrome

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Objective: To describe the successful management of a hematometra using a 5-mm continuous flow operative office hysteroscope.

Design: Case report.

Setting: University of Naples "Federico II."

Patient(s): A 13-year-old virgin patient affected by mosaic Turner's syndrome (45 X; 46 XX) was referred to the emergency room of the Department of Obstetrics and Gynecology after an episode of severe pelvic pain with metrorrhagia. A large hematometra was detected by transabdominal ultrasound scanning.

Intervention(s): Vaginoscopic hysteroscopy performed in outpatient setting.

Main Outcome Measure(s): Complete resolution of the hematometra and related clinical symptoms.

Result(s): Vaginoscopic approach avoided general anesthesia and preserved the integrity of her hymen. A chocolate-like fluid started to spill out from the uterine cavity as soon as the tip of hysteroscope passed through the internal uterine ostium. A transabdominal ultrasound performed 2 days later showed resolution of the hematometra. Success of the procedure was confirmed by the resolution of all clinical symptoms.

Conclusion(s) In selected cases, with intact outflow tract, outpatient vaginoscopic hysteroscopy might represent the therapeutic technique of choice in case of hematometra, even in the case of virgin patients. (Fertil Steril® 2007;87:417.e1–3. ©2007 by American Society for Reproductive Medicine.)

Key Words: Hematometra, hysteroscopy, Turner's syndrome, vaginoscopic approach

Turner's syndrome is the most common sex chromosome abnormality in female patients, occurring in about 50 per 100,000 live-born girls. In about 50% of cases, karyotype analysis reveals the complete loss of one X chromosome (45X), whereas the remaining patients display a multitude of chromosomal abnormalities, including partial absence of one X chromosome or mosaicism (1). The degree of mosaicism may not predict the severity of the phenotype. The main genital abnormalities associated with Turner's syndrome are gonadal dysgenesis and uterine and fallopian tube infantilism. Nearly 15% of these girls have spontaneous menstrual periods (1).

No previous case of hematometra in patients with Turner's syndrome has been reported in the international literature. This report describes a 13-year-old virgin patient

and its successful management using vaginoscopic outpatient hysteroscopy.

CASE REPORT

A 13-year-old virgin patient was referred to the emergency room of the Department of Obstetrics and Gynaecology after an episode of severe pelvic pain with metrorrhagia. The patient provided an informed consent to perform the study. The study was eventually approved by our Institutional Review Board.

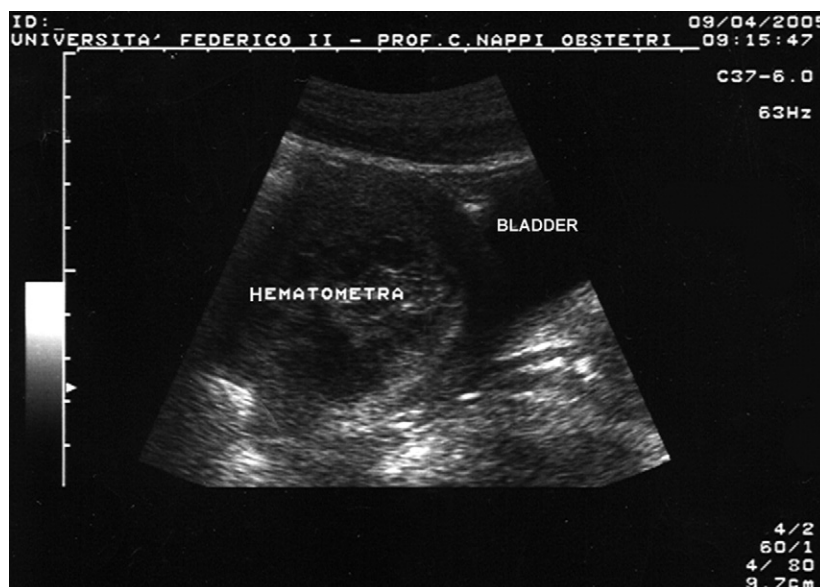
At the age of 5 years, after genetic study performed for growth retardation, the patient was diagnosed with mosaic Turner's syndrome (45 X; 46 XX). Since the age of 6 years, she was successfully treated with the growth hormone at the dosage of 0.38 mg/kg/week (Saizen, Serono, Rome, Italy). Spontaneous breast development and pubic hair growth occurred at the age of 10 years. Puberty progressed normally, resulting in a spontaneous menarche at 12.75 years of age, 3 months before her admission to the Department of Obstetrics and Gynaecology. According to her mother, her first men-

Received January 23, 2006; revised and accepted April 28, 2006.

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FIGURE 1

Transabdominal ultrasound scanning showing an anteverted uterus with an increased volume (LD: 82 mm, APD: 48 mm, TD: 63 mm) and an acute angle of flexion. The cavity appears to be totally filled by a transonic layer (hematomethra).



Di Spiezo Sardo. Hematometra, Turner's Syndrome, and hysteroscopy. *Fertil Steril* 2007.

menstrual episode was regular in terms of duration and amount, without pelvic discomfort. Approximately 1 month later, she started to complain of pelvic cramps, which required analgesic treatment. The patient reported no other episodes of menstrual-like bleeding until the episode of metrorrhagia, which required admission to this Department. A physical examination revealed discomfort with diffused tenderness of the lower abdomen. Transabdominal ultrasound scanning showed an anteverted uterus with a greater than normal volume (Longitudinal diameter (LD): 82 mm, Antero-postero diameter (APD): 48 mm, Transverse diameter (TD): 63 mm) and an acute angle of flexion. The cavity was totally filled up by a transonic layer. The ovaries were not visible (Fig. 1).

Hysteroscopy was performed by A.D.S. with a 5-mm continuous flow operative office hysteroscope with a 2.9-mm rod lens (Bettocchi office hysteroscope: Karl Storz, Tuttlingen, Germany). The vaginoscopic approach (without speculum and tenaculum) was used to preserve the integrity of the hymen. Neither analgesia nor local anesthetics were administered to the patient. Distension of the uterine cavity was obtained using normal saline solution and the intrauterine pressure was automatically controlled by an electronic irrigation and suction device (Endomat; Karl Storz). The intrauterine pressure was set at 45 mm Hg, the irrigation flowed at about 200 mL/min, and a vacuum was set at 0.2 bar. Endoscopic vaginal and cervical explorations were normal. As soon as the tip of the hysteroscope passed through the

internal uterine ostium (IUO), which was moderately stenotic, a chocolate like fluid started to spill out from the uterine cavity resulting in poor endoscopic vision. At this moment the vacuum pressure was increased to 0.4 bar, making emptying of uterine cavity easier and faster. Approximately 300 mL of blood were aspirated in 5 minutes.

An ultrasound performed 2 days later showed complete resolution of the hematometra. The success of the procedure was confirmed by the resolution of the clinical symptoms. During the next 2 months the patient experienced normal, regular, painless menstrual cycles.

DISCUSSION

Failure of the female genital tract to develop may result in genital outflow tract obstructions. Because of the absence of an outlet for menstrual flow, menstrual blood accumulates in the vagina (hematocolpos) and uterus (hematometra) with the onset of menstruation (2). The most common symptoms associated with the presence of an hematometra are lower abdominal pain radiating to the lower back, discomfort, and sense of fullness in the pelvis. A suprapubic tender mass often is palpable as a result of uterine enlargement and upward displacement. Urinary retention or constipation can occur because of compression of the distended uterus (3).

This case report demonstrates a successful management of an hematometra in a 13-year-old virgin patient affected by mosaic Turner's syndrome using a standard rigid 5-mm

continuous flow operative office hysteroscope in an uncommon situation. Apart from moderate stenosis of IUO and an anteverted uterus with a remarkable reduction of the flexion angle, there were no other significant pathological intrauterine findings (e.g., sinechiae, isthmic or cervical occluding lesions). Our main ethiopathogenetic hypothesis was that such a reduced uterine flexion angle, associated with a moderate stenosis of IUO, could have caused an acquired obstruction to her menstrual flow, resulting in the progressive development of a large hematometra.

A MEDLINE literature search using Turner syndrome, hematometra, and genital abnormalities as key words failed to identify other reported cases of an hematometra in a patient with Turner's syndrome. Whether the syndrome might have contributed to the genesis of the hematometra is thus questionable.

In 2001, the vaginoscopic approach to hysteroscopy was introduced in our clinic. The vaginoscopic approach is a nontraumatic procedure, in which the scope is introduced into the vagina without speculum and tenaculum (4, 5), the vagina being distended by distension medium (normal saline) at a pressure of 60–80 mm Hg, which is the same pressure used for the subsequent distension of the uterine cavity. This approach has permitted complete elimination of premedication, analgesia, or anesthesia, making the procedure rapid and without complications. Furthermore, hysteroscopy can be performed in outpatient setting in patients who otherwise might require general anesthesia, such as older women with somewhat stenotic vaginas and virgin patients (5). In our patient, the vaginoscopic approach allowed us to avoid general anesthesia and to preserve the integrity of her hymen.

The instruments used for vaginoscopy in children include hysteroscope, cystoscope, urethroscope, otoscope, panendoscope, and even a nasal speculum. Among the hysteroscopes, the flexible ones are not only easy to use but also convenient, safe, and effective. In the current case a standard 5-mm rigid hysteroscope was used as is normal in the outpatient setting.

The small caliber and the irrigating fluid used to balloon the vagina allowed for the successful performance of the hysteroscopy while retaining the integrity of the hymen in the young girl. The use of Endomat made the procedure quick and easy with a clear endoscopic view during most of the procedure. However, although electronic irrigation and suction device was not available in our case, we recommend connecting the hysteroscopic outflow channel to a cannula and set for surgical aspiration (Bioservice Medical Devices, Bioservice S.p.A., Italy).

Because we believed that a moderate stenosis of the IUO might have contributed to the pathogenesis of the hematometra, we decided to enlarge the IUO by moving the hysteroscope gently from side-to-side and also by opening the two branches of a 5-Fr grasping forceps inserted through the hysteroscopic operative channel. The overall procedure was referred to by the young patient as moderately uncomfortable, with a moment of pain when the tip of the hysteroscope passed through the IUO. However, no analgesic was required during and immediately after the procedure.

In conclusion, in selected cases, with intact outflow tract, outpatient vaginoscopic hysteroscopy could represent the therapeutic technique of choice in case of hematometra, even in case of virgin children, because it is safe, convenient, effective, and easy to perform.

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Outpatient Hysteroscopic Emptying of a Submucosal Uterine Cystic Lesion

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ABSTRACT

Background: Uterine cystic neoformations are rare, but they should always be investigated to differentiate a benign from a malignant pathology. Transvaginal ultrasonography, MRI, and blood tests are the main investigations for diagnosing these lesions, avoiding over- or undertreatment. Hysteroscopy might represent a helpful tool both for its diagnostic and therapeutic properties.

Methods: We report the hysteroscopic emptying of a cystic-degenerated leiomyoma with a 5-Fr flexible needle inserted through the operative channel of a 5-mm continuous-flow operative office hysteroscope in an outpatient setting.

Results: The cystic lesion was successfully emptied. The histopathological result of the target biopsies performed on the cystic wall was cystic degeneration of a leiomyoma.

Conclusion: This needle is normally used in gynecology to instill intrauterine local anesthesia under a hysteroscopic view. We adapted it to drain a fluid-filled lesion, identifying a further application of this instrument.

Key Words: Flexible needle, Hysteroscopy, Leiomyoma, Uterine cyst.

INTRODUCTION

Cystic neoformations of the female reproductive system are very common in the ovarian tissue, while rare in the other organs.

The differential diagnosis of the uterine cystic mass includes congenital malformation, leiomyomata cystic degeneration, adenocystic tumor, adenomyosis, echinococcus cyst, and intramyometrial hydrosalpinges.¹⁻⁴

We report the successful hysteroscopic emptying of a cystic-degenerated leiomyoma with a 5-Fr flexible needle (Karl Storz, Tuttlingen, Germany) in an outpatient setting.

CASE REPORT

A 39-year-old female, para 4, was admitted to our department after complaining of severe lower abdominal pain for the last year. On physical and gynecological examinations, no pathological finding was detected. Transvaginal sonography (TS) revealed an intramural anechogenic lesion in the uterine fundus 18.2 x 19.6mm in size surrounded by a hyperechogenic ring (**Figure 1**). This cystic mass was suspected to be a gestational sac, but serum β HCG dosage was negative.

Tumor markers were within the normal range. An outpatient diagnostic hysteroscopy was performed. The uterine cavity was regular with the exception of an atypical area of vascularization, corresponding to the cystic mass detected on TS.

The patient was discharged with a diagnosis of suspicious adenomyosis and was advised to document her pain episodes in a diary. She was scheduled for a repeat TS and CA125 dosage after 3 months. Mefenamic acid was prescribed for further episodes of pain.

However, the patient was referred to the emergency room of our department nearly one month later following a severe episode of dysmenorrhea. Repeat TS revealed that the cystic mass had become submucosal. A repeat outpatient hysteroscopy was performed using a 5-mm continuous-flow operative office hysteroscope with a 2.9-mm rod lens (Bettocchi office hysteroscope, Karl Storz, Tuttlingen, Germany). The vaginoscopic approach (without speculum and tenacu-

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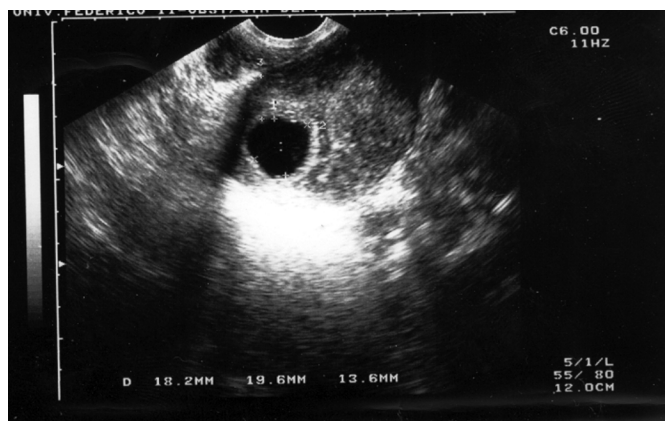


Figure 1. Intramural anechogenic lesion (18.2 x 19.6 mm) in the uterine fundus surrounded by a hyperechoic ring.

lum) was used to improve the patient's compliance. Saline solution was used as the distending medium. Neither analgesia nor local anesthesia was administered to the patient.

A translucent lesion apparently blood filled was detected at the uterine fundus. Because the cystic wall was thin, the cyst was emptied by using a flexible needle (1.7 mm and 80 cm length; Karl Storz, Tuttlingen, Germany) introduced through the 5-Fr operative channel (Figure 2). Nearly 5 mL of hematic fluid were drained. Several target biopsies were performed on the cystic wall. The hystopathological result was cystic degeneration of leiomyoma. A TS performed one month later showed that the anechogenic image in the uterus had completely disappeared. At the

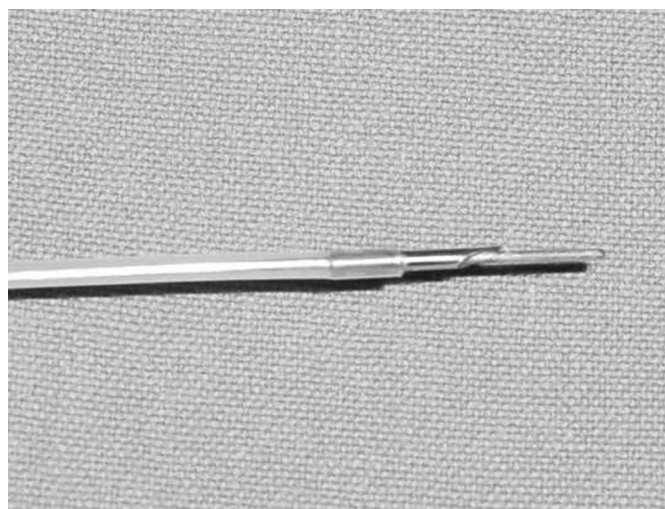


Figure 2. Distal tip of the 5-Fr flexible needle (Karl Storz, Tuttlingen, Germany).

3-month follow-up visit, the patient's symptomatology was remarkably improved.

DISCUSSION

Every uterine cystic mass should always be investigated to differentiate a benign from a malignant pathology.⁵ Transvaginal ultrasonography, MRI, and blood tests (ie, β HCG and tumor markers) are the main investigations for diagnosing these lesions, avoiding over- or undertreatment.⁶⁻⁸

Hysteroscopy can be a helpful tool both for its diagnostic and therapeutic properties. Moreover, the possibility of performing target biopsies allows a hystopathological diagnosis.

CONCLUSION

In this report, we have described the possibility of emptying a blood-filled uterine submucosal lesion in an outpatient setting by using a flexible needle inserted through the 5-Fr operative channel of a 5-mm continuous-flow operative office hysteroscope.

The index needle is normally used in gynecology to instill intrauterine local anaesthesia under a hysteroscopic view. We adapted it to drain a fluid-filled lesion, identifying a further application for this instrument.

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Endocervical metaplasia of the endometrium in a patient with cystic fibrosis: a case report

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Objective: To report the case of an infertile female patient with cystic fibrosis who was diagnosed with endocervical metaplasia of the endometrium at diagnostic hysteroscopy and successfully treated with an oral estrogen-progestin formulation.

Design: Case report.

Setting: University hospital.

Patient(s): A 27-year-old infertile female patient with cystic fibrosis.

Intervention(s): Hysteroscopy with multiple random biopsies was performed at the time of the first visit and after a 10-month cycle with an oral estrogen-progestin formulation.

Main Outcome Measure(s): Hysteroscopic evaluation with target biopsy; histological examinations of endometrial specimens.

Result(s): Our patient benefited from a 10-month cycle with an oral estrogen-progestin formulation. At the control visit we noticed a significant improvement in the hysteroscopic appearance of her endometrium, and the histological examination confirmed the complete reversion of the metaplastic alterations previously observed.

Conclusion(s): The present report suggests a novel histological alteration possibly involved in affecting fertility in women with cystic fibrosis. In addition, the positive response to the estrogen-progestin treatment observed in our patient poses new questions regarding the relationship between ovarian hormones and cystic fibrosis transmembrane conductance regulator protein regulation, offering interesting perspectives for a hormonal therapy in the treatment of subfertility in women with cystic fibrosis. (Fertil Steril® 2006;85:750e13–6. ©2006 by American Society for Reproductive Medicine.)

Key Words: Infertility, cystic fibrosis, endocervical metaplasia, endometrium, hysteroscopy

Cystic fibrosis (CF) is the most frequent lethal autosomal recessive disease among Caucasians (1). It is characterized by defective production of the cystic fibrosis transmembrane conductance regulator (CFTR) protein (2) (a complex channel regulating the passage of chloride and, indirectly, sodium and water across luminal cell membranes), which results in thickened and desiccated secretions throughout most of the exocrine glands and tissues, including the reproductive tract.

Because the life expectancy for individuals with CF has dramatically improved over the past 50 years, the issues of fertility and reproductive health have become increasingly important. Up to 98% of men are infertile due to the congenital bilateral absence of the vas deferens with consequent obstructive azoospermia. The effects of CF on female fertility are less clear. Unlike in men, reproductive tract anomalies have not been described in women affected by CF, nor has any evidence been presented of a "global" reduction in CF female fertility. It is generally reported that subfertility might be attributable to the reduction in cervical mucus water content due to the defective expression of CFTR

protein in the cervix of CF patients. This might result in a thick, tenacious mucus plug interfering with sperm motility and penetration (3, 4). In addition, menstrual irregularities, ovulatory disturbances, and amenorrhea are quite common findings in female CF patients (5–7).

Nevertheless, recent reports have interestingly demonstrated that CF patients, although undernourished and suffering from chest disease and/or irregular menstrual patterns, can still conceive and successfully carry out their pregnancies (8, 9).

To our knowledge, this is the first reported case in the international literature of a female patient with CF who was diagnosed with endocervical metaplasia of the endometrium at diagnostic hysteroscopy performed for abnormal menstrual pattern and infertility.

CASE REPORT

In January 2004, a 27-year-old woman with CF was referred to the hysteroscopy clinic of University Hospital "Federico II" of Naples for menstrual pattern abnormalities and infertility. Our patient provided informed consent for the performance of this study. The study was eventually approved by our institutional review board.

Since the age of 5 years, the patient had suffered from progressive respiratory and gastrointestinal complaints,

Received January 12, 2005; revised and accepted July 22, 2005.

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which had led to the diagnosis of CF at the age of 16 (sweat electrolytes: Na = 152 mEq/L, Cl = 144 mEq/L).

Since then, steatorrhea due to pancreatic insufficiency and malabsorption had been thoroughly controlled by means of medical therapy, as demonstrated by the stability of her body mass index at approximately 19 kg/m². The patient's recurrent, chronic lung colonization with *Pseudomonas aeruginosa* required cyclic antibiotics and the use of bronchodilators, which had effectively preserved her pulmonary function (Shwachman score: 85).

At the age of 14 years the patient had reached menarche, albeit with slightly delayed development of the secondary sexual characteristics. Menstrual periods had initially been regular, as customary at 30 days intervals and with 4 to 5 days of flow. However, from the age of approximately 25 years, the patient started to suffer from oligomenorrhea and menorrhagia, and such symptoms were accompanied by facial acne and hirsutism.

Endocrine evaluation and ultrasonographic imaging of the ovaries revealed findings consistent with chronic anovulation. Pelvic examination showed that the vulva and vagina were normal, whereas the cervix appeared totally covered by

approximately 15 cm³ of thick mucus coming out from the cervical os. The uterine fundus and adnexa were normal.

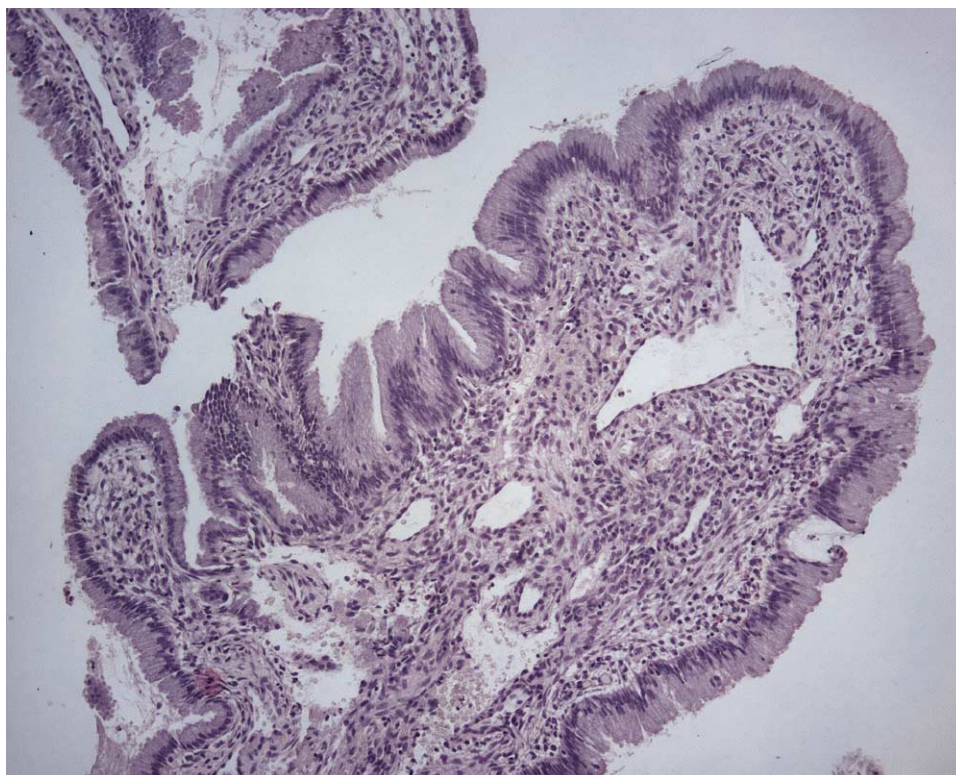
At colposcopic evaluation the ectocervical epithelium appeared erythroplastic, lined by cylindrical epithelium almost totally hidden by the thick mucus layer. The evaluation of the endocervical channel was also hampered by the presence of adherent mucus. As a result, the patient was scheduled for outpatient hysteroscopy.

Once the tenacious, mucous cap occluding the cervical os was removed, hysteroscopy revealed a cervical channel of tortuous, irregular appearance. The endocervical epithelium was totally covered by thickened mucus. Two biopsies were randomly executed in the endocervical canal. Whitish, mucous thickenings were widely diffused throughout the uterine cavity, obstructing tubal ostia and making any complete evaluation of the cavity unfeasible. The vascularization was augmented and irregular, with some large-caliber vessels emerging. The lining of the uterine cavity was repeatedly and randomly biopsied.

Histological findings revealed metaplastic endocervical epithelium on endometrial fragments (Fig. 1), whereas

FIGURE 1

Section showing tissue fragments of endometrial cavity lined by cervical columnar epithelium. Original magnification, $\times 40$.



Piccolo. Cystic fibrosis and endometrium. *Fertil Steril* 2006.

chronic, acute, and focally erosive cervicitis was found on the cervical specimen.

To improve her cycle irregularities, a combined estroprogestinic formulation containing cyproterone (2 mg) and ethinylestradiol (0.035 mg Diane; Schering, Milan, Italy), to be taken once daily for 21 days per month, was prescribed to the patient. The patient was clinically and hysteroscopically re-evaluated after a 10-month period of therapy.

Hysteroscopy showed a significantly improved appearance of both the cervical channel and the uterine cavity. The cervical channel still appeared tortuous, but the surface was regular. Residual mucous thickenings were noticeable on the posterior uterine wall only, whereas the fundus and the anterior wall were lined with endometrium of normal appearance. Histological examination of endometrial specimens obtained under hysteroscopic view revealed early secretory endometrium and thick stroma, with no residual metaplastic aspects.

The patient discontinued the contraceptive pill in December 2004. Endocrine evaluation and ultrasonographic imaging of the ovaries performed in January 2005 revealed findings consistent with ovulatory cycles. The patient is currently trying to conceive without any pharmacologic aid. A further diagnostic hysteroscopy with target multiple biopsies was performed in March 2005. Such examination confirmed a substantially improved appearance of her endometrium and a complete reversion of the metaplastic alterations that were previously observed.

DISCUSSION

Women with CF are considered less fertile than those not affected by CF (3). The reasons for this observation are still unclear.

Traditionally, the main cause of the reduced fertility rate observed in women with CF has been suggested to be the abnormal expression of the CFTR in the cervical epithelium, leading to the formation of a tenacious, impermeable mucus, which in turn acts as a barrier to sperm motility and penetration (3, 4).

More recently, several lines of evidence have proved that the cause of hypofertility in women with CF is much more complex than what was previously believed, because the CFTR has been shown to be of physiological significance in several reproductive events (10).

Cystic fibrosis transmembrane conductance regulator has been found throughout the female reproductive tract of both animal and human tissues, where it seems to be involved in the secretory activities of the lining epithelia (10, 11).

It has been shown that distribution and expression of CFTR is highly variable, according to the phase of the menstrual cycle (with estrogens enhancing and P down-regulating its expression) (12) and the specific site of the

reproductive tract (oviduct, endometrium, cervix, or vagina). Such hormone-dependent, tissue-specific regulation of CFTR expression provides a physiological basis for the cyclic, regional changes in female reproductive fluid volume and composition, which are consistent with the variable actions played by the fluid at the different levels of the reproductive tract and in the different phases of the menstrual cycle, to permit successful reproductive events in the individual sections of the reproductive tract (10, 13).

This suggests that, in CF, abnormal CFTR expression might lead to biochemical abnormalities in reproductive tract fluid of possible importance to fertility, in addition to any mechanical obstruction to sperm migration from increased viscosity and associated ultrastructural changes of CF cervical mucus.

Multiple ovarian cysts, associated with a polycystic ovary-like hormonal pattern and an increased incidence of anovulation, have also been reported as additional causes of hypofertility in women with CF (5–7). Poor nutritional status due to malabsorption and steatorrhea, impaired insulin sensitivity (due to the progressive replacement of the islet of Langerhans with fibrous and fatty tissue), as well as psychological stress commonly observed in chronically ill patients, have all been considered potential factors responsible for such endocrine abnormalities (6).

Furthermore, involvement of cytokines or a disturbed hypothalamic–pituitary–ovarian axis cannot be excluded as causes for reduced fertility in women with CF. Indeed, CFTR messenger RNA expression has been recently found in the region of rat hypothalamus containing high concentrations of GnRH and estrogen-rich neurons, which are likely to be involved in sexual maturation and reproduction (14).

We believe this is the first report in the English literature indicating such a particular histological endometrial abnormality in a CF patient as a potential cause of the patient's hypofertility, together with other well-known factors of infertility, including thick cervical mucus and polycystic ovaries.

Our patient benefited from the blockage of ovarian steroidogenesis induced by a 10-month cycle with an estroprogestinic formulation. During the control visit we noticed a significant improvement in her clinical symptomatology (acne, hirsutism, and menstrual irregularities) and the hysteroscopic appearance of her endometrium. In addition, we noticed a complete histological reversion of the metaplastic alterations previously observed.

The present report introduces a new etiopathogenetic hypothesis in the understanding of the mechanisms involved in determining hypofertility and infertility in young female CF patients. The study suggests a novel histological alteration possibly affecting fertility in CF women. The viscosity, as well as the electrolyte composition of the endometrial mucus secreted by the metaplastic endocervical glands, might alter the physiological uterine environment required for the re-

gional reproductive processes, such as sperm transport and capacitation, as well as embryo transport, development, and implantation.

Because this histological alteration was accompanied by other well-recognized factors of infertility in our patient, it is difficult to evaluate the real impact of this endometrial change on her hypofertility and infertility.

Finally, the positive response to the estroprogestinic treatment observed in our patient poses new questions regarding the relationship between ovarian hormones and CFTR regulation, either in normal or in CF patients, offering interesting future perspectives for a hormonal therapy in the treatment of subfertility in women with CF.

We are now evaluating the real incidence and impact of this histological abnormality in hypofertile and infertile young female CF patients.

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Case report

Hysteroscopic Removal of Gauze Packing Inadvertently Sutured to the Uterine Cavity: Report of 2 Cases

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ABSTRACT We report on 2 cases of successful hysteroscopic removal of uterovaginal packing, inserted during cesarean sections after uterine hemorrhage resistant to medical therapy. The packing, in both cases, could not be removed vaginally with sponge forceps as it had adhered to the uterine cavity. A hysteroscopic approach enabled identification and cutting with 5F scissors of the stitches fixing the packing to the uterine walls, allowing straightforward removal in an outpatient setting and avoiding a repeated laparotomy. Some useful techniques to handle such a situation are described. *Journal of Minimally Invasive Gynecology* (2008) ■, ■–■ © 2008 AAGL. All rights reserved.

Keywords: Cesarean section; Hemorrhage; Hysteroscopy; Scissors; Stitches; Uterovaginal packing

Management options for postpartum hemorrhage (PPH) include oxytocics, prostaglandins, genital tract exploration, ligation or angiographic embolization of uterine/internal iliac arteries, and hysterectomy.

After excluding uterine rupture, genital tract lacerations, and retained placental tissue, efforts are directed toward contracting the uterus by bimanual compression and oxytocics. If these are not successful either, surgical techniques are recommended. At this stage, alternative options to control bleeding would be tamponade balloons, such as Foley [21], Bakri balloon [23], and Sengstaken-Blakemore tube [22,23], or uterovaginal packing, which is easy and quick to perform even by the novice [1,2]. The uterovaginal packing may be inserted in women who have delivered either abdominally or vaginally, the success of the procedure being strictly related to the technique used [3]. Indeed, a high level of success in bleeding control was reported by using the unrolled packing material and evenly distributing it in all areas of the uterine cavity

through repeated insertion efforts [3]. After uterine packing is completed, vaginal packing is usually also carried out.

The 2 main complications of uterovaginal packing are infections of the packing [4,5] and difficulties encountered during removal, often caused by awkward surgical maneuvers [1,6,7]. Uterovaginal packing is usually removed 12 to 24 hours after positioning, with sponge forceps, by gently drawing the visible end toward the perineum with downward and forward movement and care must be taken withdrawing knotted strips [8]. If removal is painful, sometimes uterovaginal packing must be removed in a surgical setting, under anesthetic, or both [9]. In addition, sometimes it is impossible to remove the packing vaginally especially after cesarean section, because the packing may remain entrapped within the stitches of the suture. Whenever this occurs, a new laparotomy is usually performed to safely remove the packing.

We report on 2 successful outpatient hysteroscopic removals of uterovaginal packing, inserted during cesarean sections and entrapped within uterine stitches.

Case 1

A 38-year-old woman, primigravida, underwent an elective cesarean section performed for breech presentation. During surgery, a severe primary hemorrhage led the operator to opt for uterine packing after several failed attempts to contract the uterus by bimanual compression and administration

The authors have no commercial, proprietary, or financial interest in the products or companies described in this article.

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Submitted August 1, 2008. Accepted for publication September 19, 2008.
Available at www.sciencedirect.com and www.jmig.org

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doi:10.1016/j.jmig.2008.09.615

of oxytocics and prostaglandins. Packing was placed from the fundus through the cervix up to the vagina and provided good control of the hemorrhage. The hysterotomy incision was then sutured with polyglactin 1. The patient underwent antibiotic therapy and was scheduled for vaginal removal of the packing 24 hours later. The gynecologist was not able to remove the packing as it seemed to adhere to the uterine walls. Before performing a repeated laparotomy, the gynecologist contacted the hysteroscopic department for advice, as it was suspected that the packing was entrapped in the hysterotomy suture. Hysteroscopy was performed in an office setting using the vaginoscopic approach without speculum or tenaculum, without analgesia or anesthesia. The procedure was performed using the 4-mm continuous-flow operative office hysteroscope with a 2.9-mm rod lens (Bettocchi office hysteroscope size 4, Karl Storz, Tuttlingen, Germany).

Distention of the uterine cavity was achieved using normal saline solution and intrauterine pressure was automatically controlled by an electronic irrigation and suction device (Endomat, Karl Storz). Intrauterine pressure was initially set at 45 mm Hg, this being the balance of irrigation flow approximately 200 mL/min and a vacuum of 0.2 bars. Then it was increased to improve endoscopic view. The vaginal extremity of the packing was kept in tension manually by the operator to mobilize the packing within the uterine cavity and to allow identification of the stitches holding the gauze to the uterine wall. Endoscopically it was possible to determine that the packing was anteriorly entrapped in the hysterotomy suture. Two stitches in particular were identified and easily cut by means of 5F sharp scissors (Fig. 1). Subsequent removal of the packing from the uterine cavity was straightforward.

Case 2

A 37-year-old woman, primigravida, underwent an elective cesarean section performed for central placenta previa. During surgery, a primary hemorrhage, intractable despite

administration of oxytocics and prostaglandins, led the operator to opt for tight uterovaginal packing, placed through the hysterotomy incision and then through the whole uterus and cervix up to the vagina, using 3 U of povidone-iodine-soaked gauze, which successfully controlled uterine bleeding. Then the hysterotomy incision was sutured with polyglactin 1 and further hemostatic sutures were also provided in correspondence with the right uterine artery. The patient underwent antibiotic therapy and was scheduled for vaginal removal of the packing 24 hours later. The packing seemed to adhere to the uterine walls and, as a result, the gynecologist was not able to remove it. Before performing a new laparotomy, the gynecologist contacted the hysteroscopic department seeking advice, as it was suspected that the packing was entrapped in the uterine sutures. Hysteroscopy was performed in an office setting using the same instrumentation and setting as in the first case. The operator first decided to cut the packing in half with a Versapoint Twizzle Electrode (Gynecare) to improve endoscopic vision of the uterine cavity. After that, the endoscopic view showed that the packing was entrapped in the hemostatic suture of the right uterine artery. Taking into account the potential for intractable bleeding that could result after cutting the hemostatic stitch, the operator decided to cut the packing with 5F sharp scissors leaving a small piece (<1 cm) in situ, thus avoiding loosening of the suture. After 30 days a repeated office hysteroscopy was performed, the stitch was easily cut with 5F scissors, and the residual gauze was safely removed from the uterine cavity.

Techniques

To improve the endoscopic view and facilitate the identification of those stitches to be cut, some special techniques can be used.

Increasing Intrauterine Pressure

The cervical leakage of fluid distention medium as a result of the packing extruding throughout the cervix did not allow satisfactory distention with the values of flow (200 mL/min), suction (0.2 bar), and pressure (120 mm Hg) commonly used in office setting to avoid patient discomfort. Thus, the intrauterine pressure was increased by closing suction and increasing flow and pressure of irrigation up to 250 mL/min and 150 mm Hg, respectively.

Handling of Vaginal Extremity of Gauze Packing

In the first case, the vaginal extremity of the packing was kept in tension manually and pulled to 1 side by the operator and the hysteroscope advanced progressively in the space between the opposite uterine wall and the packing itself. The operation was then repeated on the opposite side. This action allowed the mobilization of the packing within the uterine cavity and the exact identification of the stitches fixing the gauze to the anterior uterine wall.

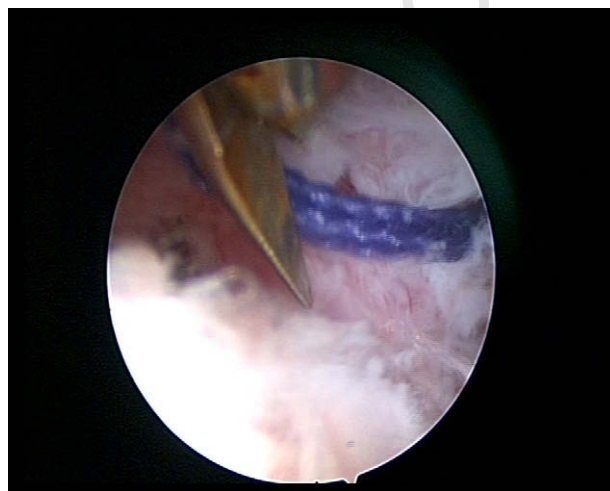


Fig. 1. Sharp 5F scissors cutting 1 of 2 stitches fixing packing to uterine wall.

Cutting of the Gauze Packing

In the second case the operator decided to halve the packing to improve the intrauterine view. Taking into account the hard consistency of the packing, a 5F bipolar electrode was preferred instead of sharp scissors. Subsequently, the endoscopic view showed the packing entrapped in the hemostatic suture of the right uterine artery.

Color Searching

After entering the uterine cavity, in both cases, the endoscopic view showed that the predominant color was white, as the gauze packing occupied the whole cavity, simulating an enormous submucous myoma. Therefore, the operator needs to be quick and have precise control of movements to identify the blue of the stitches within the white.

Discussion

Acute PPH is nowadays the main cause of maternal death in developing countries, whereas in developed countries it is the third most common reason, after embolism and hypertensive emergency [10]. Current hemorrhage management, on the premise that prevention assessed by continued observation is the gold standard in managing this complex obstetric emergency [11–14], shows different possibilities such as medical, paramedical, parasurgical, and surgical procedures. When a pharmacologic approach and bimanual compression cannot stop the bleeding, uterovaginal packing may represent a valid alternative before opting for surgical techniques. Furthermore, uterovaginal packing may be used to gain time to stabilize the patient while arranging for a surgical procedure. In some of these situations, packing alone proved successful, thereby obviating the need for surgery [7].

Uterovaginal packing for PPH was often used before the 1960s. Its use subsequently declined because of fear of infection and concealed hemorrhage [6]. Today, newer and safer options are available and were in use since the 1990s, especially in the United States [15]. Placement of a uterine balloon tamponade (Foley [16], Bakri balloon [17], or Sengstaken-Blakemore tube [18,19]), which may be inserted either after cesarean section or vaginal delivery, is an option with interesting advantages, thus often preferred to gauze packing. Indeed, placement of a uterine balloon can act as a diagnostic test to screen those women who need hysterectomy. In addition, it minimizes the risk of occult bleeding and the removal of a balloon is not a painful procedure [20].

Nevertheless, uterovaginal packing is useful in controlling hemorrhage from uterine atony and placental site bleeding caused by placenta previa or placenta accreta [7]. Indeed, uterine atony unresponsive to oxytocics is the most common indication for its use [2]. Its foremost advantage is that it is very simple and quick to perform and requires no special equipment. Indeed, technical notes in packing positioning advise tight uniform packing to be carried out in all areas of the uterine cavity, to be continued up to vagina to the introitus to

maintain a tamponade effect on the uterine sinuses and prevent concealed hemorrhage [3]. In spite of this, fear of the concealment of continued bleeding and infection together have led to uterovaginal packing falling into disfavor, although good packing techniques with prophylactic antibiotic therapy can minimize this complication [3–5]. Another complication of uterovaginal packing is represented by difficulties associated with its removal, which often requires a new laparotomy [1,6,7]. This event mainly occurs after positioning of packing during a cesarean section. Indeed, a surgeon who is dealing with a major hemorrhage might focus only on bleeding control, committing the mistake of entrapping the packing in the hemostatic stitches.

Until the 1990s, gynecologists were used to performing office hysteroscopy only for diagnostic purposes while patients, scheduled to have lesions removed or treated, were always transferred to the operating department. Recent technical developments pertaining to design and manufacture of hysteroscopes and change of the distention medium from carbon dioxide to normal saline have significantly increased patient compliance, thus making it possible to perform even operative procedures in outpatient setting without cervical dilatation or anesthesia. Currently, surgeons skilled in hysteroscopy may not only perform targeted biopsies but also treat a number of benign intrauterine pathological conditions including polyps, submucous myomas, synechiae, and septa [21].

Throughout recent years, it was shown that even unusual pathological conditions that traditionally represented a great challenge for the gynecologist can be safely and effectively treated by outpatient operative hysteroscopy [22].

In this article we report 2 cases of successful hysteroscopic removal of uterovaginal packing, inserted during cesarean section, which could not be removed vaginally with sponge forceps as it was entrapped in 1 or more stitches. Without recent technical and technological advancements in hysteroscopy, these 2 cases would have required a more traditional surgical approach with incredibly higher morbidity.

In the first case, the hysteroscopic approach allowed identification of the packing entrapped in the hysterotomy incision, whereas in the second case it identified the packing stuck in a hemostatic stitch in correspondence with the right uterine artery, which was carried out to stop a huge hemorrhage in this area during cesarean section.

In both cases the main intent of the operator was to prevent the sutures, which were either hysterotomic or hemostatic, from loosening; in particular in the second case it was even decided not to cut the stitch fixing the gauze, but to wait for physiologic hemostasis, before cutting the stitch during a second office hysteroscopy.

Nonetheless, such an approach, which in theory is safe and easy, can, at times, be difficult even for qualified and skilled operators. Indeed, visibility within the uterine cavity is considerably reduced in the case of the significantly higher volume of uterus in early puerperium, the presence of a foreign body simulating an enormous submucous myoma, and

the cervical leakage of fluid distention medium as a result of the packing extruding throughout the cervix.

Nevertheless, in both cases the hysteroscopic approach and the described tips allowed overcoming the aforementioned difficulties and cutting of the stitches that held the packing to the uterine walls, thus allowing its easy removal in an outpatient setting.

Conclusions

Thanks to recent technological advancement, difficult uterovaginal packing removal, which has traditionally represented a great challenge for the gynecologist, can now effectively be considered a viable option that can be safely carried out during outpatient hysteroscopy.

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CONCLUSIONS

Healthcare providers are facing increasing demands for improvement in quality of life for patients. Improvements in service provision for women are being ensured by the introduction of minimally invasive technologies into all spheres of gynaecologic practice.

Office hysteroscopy is an extremely exciting and rapidly advancing field of gynaecologic practice and there is a general consensus that it is the current gold standard for the evaluation of the uterine cavity and subsequent detection of intrauterine pathology. It is a safe, with a low incidence of serious complications, and simple procedure and, if it might always be carried out successfully in an outpatient setting, will definitely be a most attractive practice. Indeed outpatient hysteroscopy has already shown good correlation of findings compared with inpatient hysteroscopy, presenting distinct advantages such as reduced anaesthetic risks, enhanced time-cost effectiveness and patient's preference, as a result of the rapid alleviation of anxiety, faster recovery and less time away from work and home.

Treating the majority of uterine, cervical and vaginal pathologies in outpatient regimen is a revolutionary, vanguard concept. Up to 90s, gynaecologists performed hysteroscopy in the office setting only for diagnostic purposes while the patients were scheduled to have the lesions removed or treated always within the operating room theatre by means of resectoscope.

At the beginning of 90s, the development of rigid, semi-rigid and flexible smaller diameter scopes with working channels, through which mechanical instruments can be introduced and continuous flow systems has made it possible to treat the majority of uterine, cervical and vaginal pathologies in outpatient regimen without cervical dilatation and consequently without anaesthesia or analgesia. This new philosophy ("see and treat hysteroscopy") reduces the distinction between a diagnostic and an operative procedure, shifting the focus in healthcare away from inpatient diagnosis and treatment. In other words, the "see and treat" hysteroscopy introduces the concept of a single procedure in which the operative part is perfectly integrated in the diagnostic work-up.

Mechanical operative instruments (scissors, biopsy cup, grasping, corkscrew) have long been the only way to apply the "*see and treat*" procedure in an outpatient setting. However, although grasping forceps and scissors were excellent for treating adhesions, anatomic impediments and endometrial polyps smaller than or the same size as the IUO,

bigger endometrial polyps or thick lesions (i.e myomas) were difficult to be treated successfully without cervical dilatation.

Finally, a revolution occurred in 1997 with the introduction by Gynecare, Ethicon of a versatile electrosurgical bipolar system dedicated to hysteroscopy called Versapoint which represents a key point in the history of office operative hysteroscopy. As a matter of fact, thanks to the use of 5 Fr bipolar electrodes the number of pathologies treated by office operative hysteroscopy has increased tremendously, reserving the use of resectoscope and operating room to a very limited number of cases.

Bettocchi *et al.*, (2002) first evaluated the benefits of this new 5 Fr bipolar electrosurgical equipment in the treatment of large benign intrauterine pathologies, demonstrating that the combination of a new generation small diameter hysteroscope and the Versapoint system enables the gynaecologist to treat in an office setting also myomas or polyps bigger than the IUO, with an excellent patient tolerance during the entire procedure.

Today, thanks to further technological advancement and increased operator experience, some other uterine, cervical and vaginal pathologies or conditions which have traditionally represented a great challenge for gynaecologist can be treated safely and effectively by outpatient operative hysteroscopy. This represents the “*new frontiers of office operative hysteroscopy*” which should further increase and promote the acceptability and spreading of such philosophy.

What's about the future? Maybe in the future we could use endoscopes providing 3D view or another possibility is to realize video- endoscopes for hysteroscopy thanks to “chip on tip” technology. This innovative technology allows to place the CCD at the distal tip of the instrument; besides, camera-on-tip technology provides rod-lens and fibers-free optical systems.

Recently, in order to make work more efficient with an ergonomical design, prof Bettocchi designed an integrated S. E. T. H. S. (Storz Enhanced Technology Hysteroscopic System) hysteroscope. This innovative system offers revolutionary benefits in terms of handling, quality and resistance compared to the traditional hysteroscopes. The ergonomics of the S. E. T. H. S is due to its mono-bloc system, quick to assembly and to disassembly, in which all connections in- and outflow tubes are positioned in the lower part of the device.

In conclusion, since novel instruments and techniques continue to emerge, the prospects for improvement seem unlimited. Thus it may be hypothesized that in the near

future, “see and treat” hysteroscopy would be proposed as the gold standard for the investigation and treatment of most benign gynaecological pathology.

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