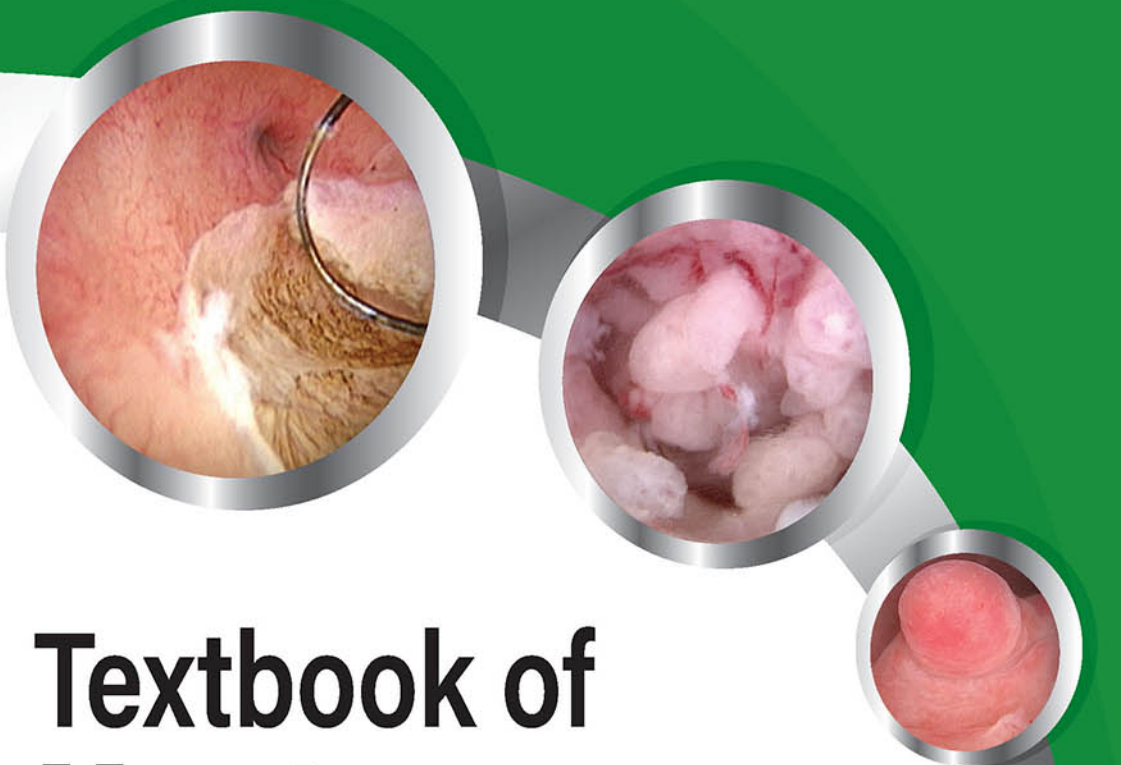
sit our website www.jaypeebrothers.com, for detailed information on obstetrics & gynecology books, visit our website www.jaypeebrothers.com,



Textbook of Hysteroscopy

Editors
Nandita Palshetkar
Hrishikesh D Pai
Rishma Dhillon Pai

Co-Editors
Tanvir Singh
Rohan Palshetkar

2nd Edition

JAYPEE

Contents

Section 1 Basics in Hysteroscopy

1. **Anatomy and Physiology of Uterus, Cervix, and Vagina 3**
   Vineet V Mishra, Smit Bharat Solanki

2. **Instrumentation and Setup of Hysteroscopy and Office Hysteroscopy..... 16**
   Hrishikesh D Pai, Rohan Palshetkar, Ruby Rasaily

3. **Indications and Contraindications of Hysteroscopy 34**
   Arti Luthra

4. **Terminology in Hysteroscopy..... 45**
   Sergio Haimovich, Tanvir Singh

5. **Vaginoscopy..... 51**
   Rohan Palshetkar, Aswath Kumar, Manisha Nandi

Section 2 Electrosurgery Hysteroscopy

6. **Monopolar Energy in Hysteroscopy 63**
   Bhaskar Pal, Mukta Agarwal, Lakshmi

7. **New Bipolar Technology for Hysteroscopy 74**
   Sunita Tandulwadkar, Rashmika Gandhi, Vatsla Vats

8. **Laser in Hysteroscopy 90**
   Anuja Kulkarni, Vishvas Kulkarni

9. **Hysteroscopic Tissue Removal Systems..... 105**
   Mario Franchini, Oronzo Ceci

Section 3 Hysteroscopic View of the Endometrium

10. **Chronic Endometritis/Tuberculosis..... 123**
    Rohan Palshetkar, Nandita Palshetkar

11. **Endometrium: Benign, Premalignant, and Malignant from a Hysteroscopic Perspective..... 129**
    Milind Telang, Maitreyee Parulekar

Section 4 Technique and Different Instrumentation in Uterine/Cervical Pathologies

12. **Operative Office Hysteroscopy** 147
Maite López-Yarto Elejabeitia, Mauricio Agüero, Silvia Agramunt, Julia Castella

13. **Endometrial Biopsy** 166
Tanvir Singh, Shilpa Bandari

14. **Hysteroscopic Polypectomy** 175
Aarti Chitkara, Tanvir Singh

15. **Hysteroscopic Myomectomy** 184
Damodar R Rao, Disha Modi, Asha Rao

16. **Müllerian Anomalies** 197
Bimal John, Shalima Serbin

17. **Isthmocele** 209
Farendra Bhardwaj, Vijay Singh Nahata, Aprajita Pankaj

18. **Hysteroscopic Management of Cesarean Scar Pregnancies** 218
Gnana Sanker Natesan

19. **Hysteroscopy in Adenomyosis** 228
Nozer Sheriar, Riddhi Desai, Zubin Sheriar

20. **Retained Products of Conception** 243
Noam Smorgick

21. **Understanding Intrauterine Adhesions and Hysteroscopy** 251
Sushma Deshmukh

22. **Hysterosalpingography vs. Sonohysterography vs. Hysteroscopy in Evaluation of Uterine Cavity in Infertility** 265
Narendra Malhotra, Neharika Malhotra, Jaideep Malhotra, Manpreet Sharma, Shemi Bansal, Sarita Dixit

23. **Hysteroscopic Tubal Cannulation** 280
Rishma Dhillon Pai, Shivanand Sakhare, Arnav Pai

24. **Endometrial Ablation and Transcervical Resection of Endometrium** 293
S Krishnakumar, Shrutika O Makde

Section 5 Safety in Hysteroscopy

25. Complications of Hysteroscopic Surgery 307
Rajesh Modi, Reeti Mehra, Aaina Garg

Section 6 Advances and Training in Hysteroscopy

26. Newer Instrumentation in Hysteroscopy 325
Ameya C Purandare, Pranay Vinod Desai

27. Training in Hysteroscopy 344
Thiago Falbo Guazzelli

28. Ultrasound and Hysteroscopy 351
Luis Alonso Pacheco, Claudia Menchero Sánchez-Migallón, Cristina Sánchez Beltrán

Index 381

CHAPTER 2

Instrumentation and Setup of Hysteroscopy and Office Hysteroscopy

Hrishikesh D Pai, Rohan Palshetkar, Ruby Rasaily

INTRODUCTION

Recent technological advances have revolutionized the field of diagnostic and operative hysteroscopy. Diagnostic and surgical hysteroscopy have become gold standards in the gynecological practice. Numerous pathologies like uterine malformations, intrauterine synechiae, fibroids, and management of abnormal uterine bleeding which were conventionally treated with laparotomy have now become a domain of the hysteroscopic techniques.

Selection of the proper and most appropriate instruments is one of the keystones for the performance of a successful hysteroscopic surgery. The variety of instruments available in the marketplace can get overwhelming, and therefore one must consider only those instruments that fit his or her needs and budget. The two major elements of a hysteroscope are the telescope or lens and the sheath. Two features pertinent to all endoscopes are, first, the angle of view, which ranges from straightforward (0°), fore-oblique (30°), lateral (70°), right angled (90°) to a retrospective view (120°), and second, the field of view, which is the peripheral coverage of the optical system or how much of the object is seen at a given distance from the object. The field of view varies according to the refractory index of the medium used.

As in all endoscopic procedures, it is imperative to have a thorough understanding of the instrumentation and devices in use. This knowledge allows the surgeon to overcome possible malfunctions and make the procedure more effective, less time-consuming, and safe.

The hallmark of a successful hysteroscopist is totally based on the type and quality of instruments one uses to do the procedure. There are numerous companies and vendors in the market. One has to base the choice of equipment based on the following criteria:

- Past and present reputation of the company
- Optical clarity of the scopes
- Durability and performance of allied parts such as sheaths, scissors, and forceps

JAYPEE BROTHERS

- Costs
- Aftersales service
- Upgradability of the instruments

The instrumentation can be divided into the following parts:

- Endoscopes
- Sheaths
- Light cable
- Light source
- Camera
- Recording devices
- Monitors
- Distention systems
- Electrocautery sources
- Electrodes

ENDOSCOPES

Rigid Hysteroscope

There is a range of hysteroscopes starting from the 1.2-mm flexible hysteroscope with a 2.5-mm diagnostic sheath to the standard 4-mm scope with a 5-mm diagnostic sheath. The 1.2-mm scope is a flexible scope which can be easily passed into the uterine cavity without dilatation. However, it is very fragile and generates a small image. Neither does it allow any degree of operative work to be performed. On the other hand, a standard 4 mm Hopkins scope is rigid and gives a very good image. The 4-mm scope is available with varying directions of view: 0°, 12°, and 30°. Normally, a 30° scope is used for diagnosis while a 12° scope is used for resection. However, a 30° scope can also be used for resection. In case of doing operative procedures the 4-mm scope needs to be combined with an operative sheath with a diameter of 7.0–8.5 mm, necessitating anesthesia and cervical dilatation procedures. In order to overcome the above shortcomings, two systems have evolved that can be effectively utilized for diagnostic and operative office hysteroscopy. With these systems, it is possible to perform operative procedures such as polypectomy (<4 cm diameter), adhesiolysis, tubal cannulations, and myomectomies (<2 cm) in an office setting.

Bettocchi Hysteroscope (Karl Storz & Company)

- The standard Bettocchi hysteroscope with Hopkins-based rods lens system is a miniature version of the famous Hamou 2 hysteroscope. The scope has an external diameter of 2.9 mm. It can be used as a panoramic hysteroscope (1×) as well as a micro contact hysteroscope (80×). For diagnostic purpose, it can be used with a single-flow outer sheath of

JAYPEE BROTHERS

3.6 mm or a continuous-flow outer sheath of 4.4 mm. In case of operative office hysteroscopy, it can be combined with a continuous-flow operative sheath of 3.9 mm × 5.9 mm (average diameter of 5 mm). This sheath has an operative channel to accommodate 5 French (Fr) instruments to pass through for operative purpose.

- *Modified Bettocchi:* This is a new version with a 1.9-mm diameter optic along with corresponding decreased diameters of diagnostic and operative sheath.

Versascope System (Johnson & Johnson Gynecare Division)

The Versascope is a flexible telescope made up of a set of 50,000 fused optical fibers, providing a 0° field of vision with an outer panoramic angle view of 75°. The scope has an external diameter of 1.8 mm and a length of 28 cm. The density and optical quality of the image system produce an image, which is similar to the conventional rod lens panoramic hysteroscope. The scope is used with a continuous-flow diagnostic-cum-operative sheath, which has an outer diameter of 3.5 mm and a distal curvature of 10°. A proximal collar is rotatable. This allows manipulation of the scope for full peripheral viewing, without disturbing the instrument position. The operative channel has an expandable instrument channel which can easily accommodate instruments till 7 Fr in diameter. This operative channel also simultaneously functions as an independent outflow port for continuous flow during the procedures.

Unlike Storz, the Versascope has got a disposable sheath. However, in practice the sheath can be reused, after resterilization in Cidex, at least 10–20 times, making the instrument much more cost effective.

Both the scopes come with fiberoptic cables.

Flexible Hysterofibroscopes

Flexible hysterofibroscopes are very fine instruments with diameters of <2 mm. They are extremely costly and very delicate. They can be used for diagnosis as well as fine operative procedures such as embryo transfer. They are not commonly used in practice because of their costs and fragility and also they cannot be autoclaved.

Contact Hysteroscopy

The contact hysteroscope differs in the following aspects:

- It does not require any distending medium.
- It is applicable for diagnostic purposes only and does not require a sheath.
- No fiber optic illumination system is needed, since the instrument traps and collects directed as well as ambient light.

The contact hysteroscope is composed of three major parts. The first part is a solid core of optical mineral glass supported and surrounded by

JAYPEE BROTHERS

an interior mirrored and exterior steel sheath. The outer diameter of the most popular model is 6 mm, and the core measures 350 mm in length (with magnifier). The second component is a cylindrical light trap onto which an external light source (e.g., the examination room light) is directed. A magnifying eyepiece with focusing mechanism enlarges the image threefold. This endoscope provides discrimination to 20 mm. It is a portable instrument with a simple but ingenious optical system and is ideal for office and outpatient hysteroscopy.[1]

The modern contact hysteroscope is a highly refined, precise instrument compared with its primitive ancestor and provides the endoscopist with the simplest and most portable system available. The quality of the image obtained with the contact optical system is excellent and can discriminate between two points that are just 20 mm away. The basis for contact hysteroscopy is completely different from that of panoramic hysteroscopy since the endoscope lies within the tissue itself, whereas in panoramic hysteroscopy, the tissue is viewed from a distance. Also, accurate interpretation depends on an intact vascular supply to allow proper color differentiation. Since the uterine cavity is not distended, the endometrium is viewed in its natural state, which is with the anterior and posterior endometrial walls in apposition. In a manner analogous to colposcopy, patterns seen by the hysteroscope are then interpreted.[2]

Panoramic Telescopes

Telescope is the most important component of the endoscopic system. The optical features of the telescope include lenses, prisms, glass windows, and fiber optics.[3] Three different optical systems are used: The bead-lens system, the rod-lens system, and the graded index system. Bead lenses are made of glass no thicker than their diameter, whereas in the rod-lens system designed by Hopkins,[4] the lenses' thickness is larger than the actual diameter, with very small spaces in between. This provides a larger viewing angle and a brighter image, which is transmitted by an array of long cylinders of superior optical-quality glass. The third optical system is the graded index (GRIN) system, in which the entire system includes a slender rod of glass with a progressively increasing refractory index from the axis to the periphery. This latter system is used with very slender optical systems. A new system using fiber-optic imaging technology has been introduced that permits better use of light, thus permitting a decrease in the size of telescopes without impairing resolution. The higher the refractory index, the smaller the field of view.[5]

With the use of fiber optic, potent lights can be transmitted through an appropriate light source to the endoscope without producing excessive heat or breakage of distal bulbs. The many thousands of small glass fibers (10 μm) with a high refractory index core and low index cladding deliver brighter light

JAYPEE BROTHERS

efficiently with minimal loss. All this have resulted in high-quality, small-diameter telescopes capable of producing high-quality images with wide fields of view.

SHEATHS

Before entering a hollow organ like the uterus, the telescope must be fitted to a sheath through which a distending medium can be infused to provide necessary distention for panoramic viewing.[6] The typical sheath measures 5 mm in diameter to accommodate the 4 mm telescope. As mentioned above, the sheath's diameter is based on the type of scope used. The new small-diameter continuous-flow hysteroscopes with a 5-Fr operative channel have been introduced and manufactured by most instrument companies, such as Storz, Olympus, ACMI, Wolf, and so on.

Quality and construction should be evaluated periodically to ensure safety of the procedure. The input and output stopcocks, locking mechanism of the sheath, etc., should be checked regularly.

Most modern continuous-flow systems have isolated inflow and outflow channels and provide excellent washing of the uterine cavity. The gold standard for a 21st-century operative hysteroscopic sheath is a continuously flushing mechanism. This system uses an inner sheath to deliver fresh fluid into the uterine cavity and an outer perforated drain sheath to evacuate cloudy or discolored fluid from the cavity.

- *Versascope sheath:* This is a disposable sheath having a continuous-flow inflow and outflow channel. This 3.5-mm sheath can be used for both diagnostic and operative procedures. This enables it to have a good distention and good vision. It also has an operating channel through which one can pass 2-mm diameter instruments such as Versapoint electrodes (twizzle, spring, ball) or forceps.
- *Sheath for 2.9-mm Bettocchi scope:*
  - Single-flow 3.6-mm diagnostic sheath
  - Continuous-flow 3.6-mm inner sheath along with 4.4-mm outer sheath for diagnostic hysteroscopy
  - Single-flow 4.3-mm operating sheath which has got a channel for introducing 2-mm operating instruments
  - Continuous-flow 4.3-mm inner sheath along with 5-mm outer sheath for diagnostic as well as all operative procedures. This combination is the best to have.
  - Recently, there is a new smaller diameter resectoscope with inner and outer channels along with smaller diameter electrodes (loop, ball, cylinder, and knife) which can be used with the Bettocchi.
- *Sheaths for the 4-mm standard hysteroscope:*
  - Single-flow sheath for diagnosis
  - Continuous flow with inner and outer sheath for diagnosis

JAYPEE BROTHERS

- Continuous-flow inner and outer sheath for operative purpose along with operative channel
- Standard 26-mm resectoscope with inner sheath, outer sheath, working element, and electrodes for using unipolar current
- Standard 26-mm resectoscope (Gynecare Johnson) with inner sheath, outer sheath, working element and bipolar electrodes to be used with Versapoint bipolar current. It is important to note that this sheath has to be used with standard 2.9 mm or 4 mm Hopkins rigid hysteroscope. It cannot be combined with the Versascope.

Miniaturized mechanical operating instruments: Miniaturization of mechanical instruments to the 5 Fr dimension has made it possible to perform operative procedures during office hysteroscopy. They are introduced into the working channel of the operating hysteroscope and make it possible to perform biopsies, polypectomies, the retrieval of "lost" intrauterine devices (IUDs), the lysis of small adhesions, and septa. The mechanical 5 Fr instruments most commonly used are the toothed grasping forceps (also called the alligator forceps), the pointed and the blunt scissors, and the tenaculum grasping forceps (Hesseling forceps).[7-9]

LIGHT CABLES

- Special fused fiber light cable is to be used with Versascope. This cable can be attached to any type of light source with special adaptors. It is important to note that one has to exclusively use this cable in combination with Versascope. If one uses the standard fiber-optic cable, by mistake, there is a possibility of damage to the Versascope.
- Standard fiber-optic cable is to be used with Hopkins endoscopes and cold light source or xenon light source. The cable is normally 5 mm in diameter and 180 cm in length.

LIGHT SOURCE

The type of light source has a major impact on image quality. A high-quality light source such as a xenon source gives the best results. There are various light sources which one can use for illumination. The metal-halide light sources produce a bluish coloration to the delivered light. Although a 175 W light source is satisfactory for most hysteroscopic procedures, a miniature telescope could require a brighter (300 W) source. This 300 W source is also recommended for video-control hysteroscopy as well as for photography. The light is transmitted through a fiber-optic or fluid light cable 2.5–4.8 mm in diameter and 180–300 cm long. Light cables for standard hysteroscopy are 2.5–3.5 mm in diameter and 180 cm in length.

- *Halogen:* This 150–250 W cold light source is sufficient for vision. However, it tends to give a reddish tinge to the image.

JAYPEE BROTHERS

- *Xenon:* A 175 W xenon light source provides an outstanding illumination and enables a good depth of field. Although the light is extremely hot at its source, most of the heat gets dissipated along the length of the fiber-optic cable. Despite this, a significant amount of heat can be generated at the distal tip. This can cause thermal injury to the patient or burn paper drapes or clothing with prolonged contact. Hence, one should keep the intensity of the light as less as possible.

ENDOSCOPIC CAMERA AND MONITOR

It is important that the operators learn how to work in a comfortable and ergonomically sound position while watching the video-hysteroscopic image on the monitor. In office hysteroscopy, the image size is quite small. Hence, it is preferable to use cameras with zoom system to select the appropriate size of the picture. A single-chip endoscopic camera is sufficient for diagnostic and minor operative work. A three-chip camera will not be of additional help, unless it has additional filters to eliminate the pixelization and digitalization of the image. Newer high-definition cameras provide extremely sharp and realistic images that facilitate video endoscopy and reduce operator fatigue.

The technical criteria of a good camera are as follows:

1. *Good resolution:* Based on the number of lines or pixels
2. Minimum sensitivity (lux)
3. High quality of video output/images
4. *High signal-to-noise ratio:* This means that the change in video signal occurring in an extreme situation (e.g., bleeding) causes minimal loss of light intensity
5. Method of sterilization

RECORDING DEVICES

Analog and digital peripheral equipment for recording, transferring, and storage of image data such as video recorders, video printers, and digital documentation units with the ability to burn CDs and DVDs are commercially available. Tele Pack is a video monitoring system, especially designed for hysteroscopy in an outpatient department (OPD) setting. This combines image display functions with a camera unit, illumination, and documentation in one compact and convenient system.

MONITORS

One can use high-resolution Sony monitors or digitalized flat-screen computer monitors for good clarity. One can also use the newer generation flat-screen televisions to cut costs.

JAYPEE BROTHERS

DISTENTION SYSTEMS

Virtually, all hysteroscopic procedures require adequate distention of the uterine cavity. When a hysteroresectoscope is used for intrauterine electrosurgery, additional safety measures are required. Although liquid media are most commonly used, gaseous media may also be used for diagnostic hysteroscopy.

Fluid Distention Systems

There are various distention systems that can be used. These are as follows:

- *Gravity:* About 90–100 cm height of the bag is sufficient to achieve a pressure of about 70 mm Hg. Irrigation is achieved by connecting the tubing of the outflow to a connection basin. Connecting the outlet to a suction pump is not usually preferred.
- *Pressure cuff:* Inflating the cuff around the bag is a very useful method to attain adequate pressure. However, the pressure drops as the bag is gradually emptied. Irrigation is achieved in the same way as the gravity fall system.

Electronic Suction and Irrigation Pump

These include:

- Hysteromat
- Endomat
- Total inflow-outflow system

Automatically controlled suction and irrigation are very important to maintain a clear field of view in hysteroscopic surgery and also for constant dilatation of the uterine cavity. There are newer versions available that allow automatic monitoring and control of the preset volume difference between irrigation liquid inflow and outflow and the change in this parameter per minute. Generally, a flow rate of about 200 mm Hg, outflow pressure of 75 mm Hg, and suction pressure of 0.25 bar are usually used. The HAMOU Endomat can be used in both hysteroscopy and laparoscopy by simply changing the irrigation set.

Of these, the Endomat is the ideal system, especially for office hysteroscopy purposes, as it correctly maintains intrauterine pressure to around 70 mm Hg, thus preventing peritoneal reflux and resultant discomfort. However, the Endomat is very costly and a simple pressure cuff in conjunction with low-intensity outflow suction can do the trick.

Gas Distention Systems

One can use a CO_2 hysteroflator. Care should be taken not to use laparoscopic pneumoinsufflator for distending the uterine cavity as this can lead to death on table.[10]

JAYPEE BROTHERS

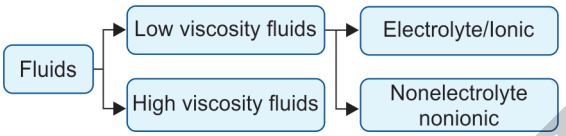
Normally, the uterine walls are in apposition and it requires distention of the true uterine cavity for the purpose of detection of any intrauterine pathology by a hysteroscope. Hence, various distention media are available for the purpose of creating a cavity by overcoming the myometrial resistance. It also creates sufficient pressures, which prevents bleeding that occurs during operative hysteroscopy.

Types of Media

The different types of media available are as follows:

a. Gas CO_2 gas

b.



Carbon Dioxide Gas

Carbon dioxide (CO_2) gas using an insufflation pump with an automatic pressure control was introduced to hysteroscopy by *Lindemann* in 1972. It is highly diffusible and soluble, allowing continuous elimination of small quantities of intravasated gas by the lungs so the risk of air embolism is negligible. It requires electronic machines, which measures the intrauterine gas pressure and also the gas delivery flow rate.

Most hysteroscopic examination can be performed at a flow rate of approximately 30–40 mL/min with an intrauterine pressure at approximately 60–70 mm Hg. These two parameters are inversely proportional to each other and thus compensate each other to maintain proper balance.

Advantages

- Provides clean medium and detailed assessment of endometrial pathology
- Permits excellent visualization, as there is no interposition of a substance to cause refraction
- Provides adequately maintained distention of the uterine cavity

Disadvantages

- When mixed with blood, it may produce bubbling which is cumbersome and may obscure view. It may rarely lead to gas embolism and death.
- Specific machines are necessitated for electronic calibration of CO_2 flow rate and pressure.
- Laser use is cumbersome, as the smoke and fumes cannot be easily evacuated without deflating the uterine cavity.

However, it remains the best distention media for diagnostic hysteroscopy with smaller diameter hysteroscopes.

JAYPEE BROTHERS

Low Viscosity Fluids

Low viscosity fluids are mainly used during operative hysteroscopy as they permit uterine cavity lavage of the blood clots and tissue debris formed during the operation.[11] A less favorable property of the low-molecular-weight media is that they mix very well with blood, so the uterine cavity must be continuously perfused with the fluid to maintain distention. The basic parameters to be controlled in using low-molecular-weight media are flow rate, which must be high enough to ensure rapid irrigation of the cavity, and outflow pressure, which ensures adequate uterine cavity distention. High pressures can lead to significant intravasation and further complications. Both electrolyte-free solutions (glycine, sorbitol/mannitol) and saline or physiological solutions are generally available in 1.5 or 3 L bags and are delivered to the resectoscope by a special high-flow irrigation pump. Tuohy-Borst adapters are excellent for this purpose.

Electrolytes/Ionic Distention Media

The most commonly used ionic media are:

- Normal saline (0.9% NaCl, i.e., sodium chloride)
- 5% and 10% dextrose
- 4% and 6% dextran solutions
- 50% saline (0.45% NaCl)
- Ringer's lactate solution

Advantages:

- The presence of electrolytes makes the operation somewhat safer by preventing hyponatremia should excessive amount of fluid be used and absorbed.
- Inexpensive and readily available
- Normal saline is iso-osmolal (at 280 mOsm/L) and metabolically inert.
- Solution for use with bipolar electrosurgery

Disadvantages:

- Volumes overload from excessive intravasation (>2.5 L) of media. This can cause left heart failure and pulmonary edema (noncardiogenic origin).
- Available in 1 L plastic bags and requires pumps
- Hence, the quantity of fluid used should be carefully monitored.
- Contraindicated for monopolar electrosurgery

Nonelectrolytes/Nonionic Distention Media

Available solutions are:

- 3% sorbitol (sugar solution, metabolizes into fructose and glucose)
- 1.5% glycine (mixture of amino acids, metabolizes into ammonia, urea, and oxalate)

JAYPEE BROTHERS

- 5% mannitol (sugar solution, osmotic diuretic, and minimal metabolism)
- Combination of sorbitol 2.8% and mannitol 0.5%
- Most of these fluids are available in 3-L plastic containers.

Advantages:

- Inexpensive and readily available
- When attached to large bore tubing, and elevated to approximately 80 cm, enough pressure is obtained to distend the uterine cavity by gravity and does not require any tourniquets or pumps
- It is a media of choice for monopolar resectoscope surgery, because there are no electrolytes to disperse the current and impede the electrosurgical effect.

Disadvantages:

- Both sorbitol and glycine solution are hypo-osmolal and are readily metabolized by specific pathways. The remaining surplus of free water in the intravascular tree can be manifest as the transurethral resection (TUR) syndrome. This is manifested as dilutional hyponatremia and hypervolemia.
- Associated with multisystem morbidities including cerebral edema, cardiac and skeletal muscle dysfunction from alteration of nerve impulses and membrane potentials
- Mannitol is relatively iso-osmolal and is minimally metabolized (6–10%). This reduces the risk of fluid overload and hyponatremia.

High Viscosity Fluids

The most commonly used high viscosity fluid is Hyskon-a 32% high-molecular-weight dextran solution (70,000 Da). It is instilled using a 50-mL syringe, and 100 mL are generally enough to distend the cavity.

Advantages

- Being highly viscous, small quantities are required for examination.
- Provides excellent visualization due to its high refractory index and as it does not mix with blood

Disadvantages

- Expensive
- Tends to "caramelize" on instruments, which must be disassembled and thoroughly cleaned in warm water after each use. It may "freeze" the stopcocks of the instruments, making them inoperable.
- Morbidities caused:
  - Pulmonary edema (noncardiogenic origin)
  - Coagulopathies

JAYPEE BROTHERS

  - Electrolytes imbalance
  - Anaphylactic reaction
- Mechanical pump is necessary to deliver these fluids.

Useful Tips while Using Distention Media

- *To improve visualization:*
  - Overdilate the cervix to facilitate the overflow.
  - Use of continuous flow sheath, promoting lavage of blood clots and debris
  - Direct aspiration with a disposable outflow catheter
- *Uterine inflow depends upon:*
  - Length, diameter, and patency of inflow tubing
  - Viscosity of distention medium
- *Uterine outflow depends upon:*
  - Transtubal passage into the peritoneal cavity
  - Intravasation into the vascular tree
  - Leakage of the media through cervix
  - Continuous flow sheath interface
- *Intrauterine pressure depends on:*
  - Pressure of infusion device
  - Rate of inflow of media
  - Rate of outflow of media
- *Intrauterine pressure can be increased by:*
  - Raising the height of media bag
  - Lowering the patient's table
  - Closing the outflow part
  - By application of tenaculum on either side of an overdilated leaky cervix
  - Increasing the pressure of infusion device
- *Intrauterine pressure can be decreased by:*
  - Overdilating the cervix and making it leaky
  - Use of intermittent or constant suction to the outflow sheath

  There is a minimal drop in pressure due to transtubal passage and intravasation into the vascular tree.

  A sudden profound drop in intrauterine pressure should make one think of either obstruction of the inflow channels or uterine perforation.
- *Intravasation:* Mean arterial pressure (MAP) is the intrinsic resistance of superficial layers to significant fluid absorption. Thus, maintaining intrauterine pressures below MAP can prevent significant intravasation.[12] Since the pressure of the uterine veins is typically <20 mm Hg, some absorption of fluid occurs inevitably, while surgical entry into the deeper intramyometrial veins abolishes the protective effects of the MAP and can lead to unpredictable and dangerous intravasation.

JAYPEE BROTHERS

The other contributory factors are:
- Length of surgery
- Partial perforation
  - False passage
  - Cervical tears/injury
- Surgery that leads to entry into myometrium opening larger vascular channels—myoma resection/division

To prevent intravasation:
- Limit bag height of distention media bag to 1 m above the patient's table
- Use of electronic machine, which can calibrate the flow rate and intrauterine pressures
- Monitor input/output and calculate the deficit.

If 500–1,000 mL (less if the patient is medically compromised) is believed to be absorbed, the following should be undertaken:
1. The procedure should be suspended until fluid status is ascertained.
2. A Foley catheter should be placed, if not already in place.
3. Consideration should be given to rapid conclusion of the operative procedure as appropriate, as once fluid absorption is started, it progresses rapidly.

If >1,500 mL is absorbed or serum sodium is <125 mmol/L, the procedure should be terminated as rapidly as reasonable. Patients with a serum sodium level below 120 mmol/L should be considered for treatment in a critical setting, especially if a hypotonic distending medium was used. The best strategy to treat symptomatic hyponatremia is:
- Early detection and rapid initiation of treatment
- Early diuresis with frusemide
- Monitoring input/output and electrolytes
- Restrict fluid intake.
- Supplement oxygen.
- Correct sodium levels (if sodium <120 mmol/L → critical care).

Thus, the surgeon must be vigilant to recognize and quantify the volume deficit of distention media and act promptly.

ENERGY SOURCES

- *Mechanical energy:* These are in the form of 2-mm semirigid sharp as well as blunt scissors, biopsy forceps, and the Myoma screw. These instruments can be passed through the operating channel to obtain biopsy specimens, transecting base of small polyps, and excising uterine septa and synechiae.
- *Monopolar:* This has been the traditional energy used for operative hysteroscopy. However, one cannot use this energy in the office hysteroscopy as the fully conscious patient will not tolerate it and will complain of pain.[13]

JAYPEE BROTHERS

- Bipolar standard electrode[14,15]
- *Bipolar Versapoint:* This bipolar cautery, marketed by Gynecare Division, has many advantages:[16]
  - It can be used with saline, thus eliminating the side effects of using glycine.
  - The electrodes can easily pass through the operative channel of office hysteroscopy.
  - Instant vaporization and desiccation can eliminate resection chips.
  - Decrease in the amount of blood loss
  - The pain is minimal if you restrict the surgery to the endometrial level.
- *Laser:* Laser beams are collimated, or parallel, which creates a minimal amount of divergence as the light is transmitted from its source, the laser energy is coherent (i.e., all of the waves are in phase), and the laser light is monochromatic (i.e., a single color).

When laser light strikes an object including cellular tissue, it may be reflected, transmitted, scattered, absorbed, or a combination of these. To exert a biologic action, the beam must be absorbed. The principal effects on tissue of the lasers used in gynecology are thermal (i.e., light energy is converted to heat). In many aspects, the thermal action of lasers and electrosurgical devices is identical. Cutting of tissue occurs when temperatures of 100°C are reached rapidly (i.e., vaporization or explosive evaporation).

Fiber-optic lasers and electrosurgery can be used with the hysteroscope. Fiber-optic lasers are best suited for hysteroscopic surgery, not only because these lasers can be transmitted through the fiber inserted into the operating channel, but also because these lasers are not blocked by fluids and can be easily directed to any area of the uterine cavity. The neodymium:yttrium–aluminum–garnet (Nd:YAG) laser is most commonly used, particularly for endometrial ablation, because it destroys tissue protein by coagulation with its frontal, back, and lateral scattering. The depth of penetration of 4–5 mm makes it suitable for endometrial ablation. This laser is in the infrared portion of the spectrum, with a 1064-nm wavelength, and is specifically absorbed by tissue protein.[17]

Recent advances in surgical technology and innovative techniques have revolutionized surgical gynecology, including transcervical hysteroscopic procedures. Surgical lasers (Nd:YAG, argon, diode, and CO_2 lasers) have been promoted to remove a variety of gynecological pathologies.[18]

For hysteroscopic surgery, the diode laser represents the most versatile and feasible innovation, with simultaneous cut and coagulate action, providing improved hemostasis compared with the CO_2 laser. The newest diode laser devices exhibit increased power and a dual wavelength, to work precisely with reduced thermal dispersion and minimal damage to the surrounding tissues. Updated evidence reports that several hysteroscopic

JAYPEE BROTHERS

procedures, including endometrial polypectomies, myomectomies, and metroplasties, can be successfully performed with a diode laser.[18]

Risks: For the patient, the principal risk is occult damage to pelvic contents if the beam penetrates through the uterine wall. Although the safety record of hysteroscopic laser surgery has been good, prospective laser surgeons should attend preceptorship programs by surgeons experienced in hysteroscopic laser techniques.[19,20]

MORCELLATION

The TRUCLEAR™ (Smith and Nephew, Andover MA, USA) technique is based on an instrument that consists of a set of two metal hollow rigid tubes that fit into each other. The inner tube rotates within the outer tube, is driven mechanically by an electrically powered control unit, and is controlled by a foot pedal that activates the 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 morcellator is inserted. Both tubes have a window-opening at the end with cutting edges. By means of a vacuum source connected to the inner tube, the tissue is sucked into the window-opening, cut and "shaved" as the inner tube is rotated. The system uses no electrocoagulation, and there is no lateral thermal or electrical energy spread. Hemostasis occurs by spontaneous myometrial contraction. The removed tissue is discharged through the device, is collected in a tissue trap, and is available for pathology analysis. The 4.0-mm morcellator is introduced in the uterine cavity through a straightforward working channel of a continuous flow 8–9-mm rigid hysteroscope. After dilatation of the internal orifice of the uterine cervix, atraumatic insertion is accomplished with the use of an obturator in the outer sheath of the hysteroscope. Saline solution is used for distention and irrigation.

A new development in hysteroscopic morcellation is the recent availability of a smaller outer diameter TRUCLEAR™ system, with a 2.9-mm cutting blade and a 5.0-mm hysteroscope for office or ambulatory use with no or local anesthesia. Polyps, small myomas, and retained products of pregnancy can be removed in that way. A new morcellator system MyoSure® was recently introduced by Hologic (Bedford MA, USA). A recent patent infringement US jury verdict could jeopardize its future availability. Another company that recently introduced an alternative device is Storz (Tuttlingen, Germany).

ELECTRODES

- *Monopolar electrodes:* This 2-mm electrode uses monopolar energy and has to be used in combination with nonionic media such as glycine.
- *Bipolar electrode:* This 2-mm electrode uses bipolar energy and has to be used in combination with either nonionic media such as glycine or ionic media such as saline.

JAYPEE BROTHERS

- *Bipolar Versapoint electrodes:* These 2-mm electrodes use bipolar energy and have to be used in combination with Versapoint bipolar generator. These are of three types:
  1. Twizzle electrode
  2. Ball electrode
  3. Spring electrode

These are used in combination with ionic distention media such as saline.

- Unipolar resectoscope electrodes used in combination with working element. These are of four types: Loop, rollerball, cylinder, and Colvin's knife. These have to be used in combination with monopolar cautery and glycine.
- Bipolar Versapoint resectoscope electrodes used in combination with working element. These are of two types: Loop and 0o electrodes. These have to be used in combination with Versapoint bipolar cautery and saline.

Resectoscopes

The gynecological resectoscope is specially designed for the resection and retrieval of abnormal intrauterine tissue as well as endometrial ablation and septal dissection. The resectoscope may be used with 0°, 9–12°, 30°, or even 120° telescopes. It consists of a classic 4-mm telescope—preferably with a 120° viewing angle to keep the electrode within the field of view—combined with a cutting loop actuated by a passive spring mechanism and two concentric sheaths for continuous irrigation and aspiration of the distention medium. A clear unobstructed panoramic view of the lesion and the surrounding normal endometrium is essential to avoid accidental perforation.[21]

A variety of other electrodes like microknives can be used with the working element of the resectoscope. Two main types of resectoscopes are used which differ in their outer diameter (22 Fr and 26 Fr) and the type of current used (unipolar or bipolar). The 26 Fr resectoscope is usually used unless the uterine cavity is small when it would be better to use the smaller resectoscope. A new instrument—the Opera Star system—is being tested for resectoscopy that provides capabilities of resection and/or coagulation of intrauterine lesions as well as simultaneous morcellation of resected tissue with continuous aspiration. No clinical acceptance and approval have occurred as of yet, nonetheless.

Sterilization

The current standard for sterilization of endoscopes is gas sterilization with ethylene oxide. Some newer telescopes may be steam autoclaved on an emergency basis without damaging the lenses; however, this cannot be a routine.[22]

JAYPEE BROTHERS

Low-temperature sterile processing systems such as the Steris System 1 offer rapid and safe sterilization of instruments using peroxyacetic acid (PAA). The new-generation disinfectants are the Cidex OPA [0.55% ortho-phthalaldehyde (OPA)] solutions that have practically replaced the glutaraldehyde, making the process of sterilization more rapid, a 12-minute soak time at 20°C or a 5-minute soak time at the minimum of 25°C in an automatic endoscope reprocessor (AER). Furthermore, it enhances safety and reduces instrument damage. This solution is bactericidal, including spores, fungicidal, tuberculocidal, and virucidal. It however requires three 1-minute rinses to remove residual Cidex OPA solution before use.

CONCLUSION

To date, the technology and sophistication of endoscopic simulation remains in its infancy. The operations and schematics are rather simplistic; nevertheless, they permit a novice to experience manipulation of devices in an interactive manner.[23] Unfortunately, the key skills of maintaining distention and a clear visual field are not part of the simulation.[24,25]

The advancement of hysteroscopy, both diagnostic and operative, has significantly contributed to better management of gynecological surgeries related to the uterus. Proper instrumentation is essential in achieving a complication-free optimal outcome. The newer smaller diameter hysteroscopes coupled with advanced bipolar Versapoint technology, usage of saline as a distention media, and outpatient minimal anesthesia procedures have revolutionized present-day hysteroscopy.

REFERENCES

1. Baggish MS. Contact Hysteroscopy: A new technique to explore the uterine cavity. Obstet Gynecol. 1979;54:350.
2. Amin RF. Hysteroscopy for gynecologic diagnosis. Clin Obstet Gynecol. 1983;26:253.
3. Gardner FM. Optical physics with emphasis on endoscopes. In: Baggish MS, (Ed). Clinical Obstetrics and Gynecology. Philadelphia: Harper and Row; 1983;26:213.
4. Hopkins HH. Optical principles of the endoscope. In: Berci B (Ed). Endoscopy. New York: Appleton-Century-Crofts; 1973.
5. Strong J. Concepts of Classical Optics. San Francisco: WH Freeman; 1958.
6. Heller J. Revising instrument processing practices. AORN J. 2001;74:716-21.
7. Vitale SG, Bruni S, Chiofalo B, Riemma G, Lasmar RB. Updates in office hysteroscopy: a practical decalogue to perform a correct procedure. Updates Surg. 2020;72(4):967-76.
8. Nappi C, Di Spiezio Sardo A. State-of-the-Art Hysteroscopic Approaches to Pathologies of the Genital Tract. Tuttlingen: Endo-Press; 2014.
9. van Herendael BJ, Valle R, Bettocchi S. Ambulatory Hysteroscopy: Diagnosis and Treatment. Oxford: Bladon Medical Publishing; 2004.

JAYPEE BROTHERS

10. Lindemann JH. The use of CO_2 in the uterine cavity for hysteroscopy. Int J Fertil. 1972;17(4):221.
11. Corson SL. Hysteroscopic fluid management. J Am Assoc Gynecol Laparos. 1997;4(3):375-9.
12. Hamou J, Fryman R, McLucas B, Garry R. A uterine distension system to prevent fluid intravasation during hysteroscopic surgery. Gynaecol Endosc. 1996;5:131-6.
13. Voyles CR, Tucker RD. Education and engineering solutions for potential problems with laparoscopic monopolar electrosurgery. Am J Surg. 1992;164:57.
14. Watteiz A, Khandwala S, Bruhat M-A. Electrosurgery in Operative Endoscopy. New York: Cambridge Blackwell Science; 1995.
15. Baggish MS, Tucker RD. Tissue action of bipolar scissors compared with monopolar devices. Fertil Steril. 1995;63:422.
16. Loffer FT. Preliminary experience with the Versapoint bipolar resectoscope using a vaporizing electrode in a saline distending medium. J Am Assoc Gynecol Laparosc. 2000;7(4):498-502.
17. Valle R, Glob. libr. women's med., Hysteroscopy, Contact. Hysteroscopy, and Microhysteroscopy. (ISSN: 1756-2228) 2008; DOI 10.3843/GLOWM.10087. Last Reviewed 2008.
18. Vitale SG, Mikuš M, De Angelis MC, Carugno J, Riemma G, Franušić L, et al. Diode laser use in hysteroscopic surgery: current status and future perspectives. Minim Invasive Ther Allied Technol. 2023.pp.1-10. doi; 10.1080/13645706.2023.2247483. Epub ahead of print. PMID: 37584381.
19. Baggish MS. Basic and Advanced Laser Surgery in Gynecology. Norwalk: Appleton-Century-Crofts; 1985.
20. Baggish MS. Endoscopic Laser Surgery in Clinical Practice of Gynecology. New York: Elsevier; 1990.
21. Valle RF. Mechanical instruments for operative hysteroscopy. In: Van Harendael BJ, Valle RF, Bettocchi S (Eds). Ambulatory Hysteroscopy. Diagnosis and Treatment. Oxford: Bladon Medical Publishing; 2004. pp. 135-9.
22. Morrison DM. Disinfection, sterilization, and maintenance of instruments: USA. In: van Herendael BJ, Valle R, Bettocchi S (Eds). Ambulatory Hysteroscopy: Diagnosis and Treatment. Oxford: Bladon Medical Publishing; 2004. pp. 166-9.
23. ACOG Committee Opinion. Credentialing guidelines for new operative procedures. No. 142. Int J Gynaecol Obstet. 1994;47:313.
24. Letterie GS. How virtual reality may enhance training in obstetrics and gynecology. Am J Obstet Gynecol. 2002;187:S37-40.
25. Muller-Wittig WK, Bisler A, Bockholt U, Los Arcos JL, Oppelt P, Stähler J, et al. LAHYSTO-TRAIN development and evaluation of a complex training system for hysteroscopy. Stud Health Technol Inform. 2001;81:336-40.

JAYPEE BROTHERS

for detailed information on obstetrics & gynecology books, visit our website www.jaypeebrothers.com, for detailed information on obstetrics &

Textbook of Hysteroscopy

Salient features

- A thorough hysteroscopy book on diagnostic and therapeutic role in clinical gynecology
- Covers both abnormal uterine bleeding and infertility
- Easy-to-understand, adding value in clinical practice
- Chapters are from practices around the world, allowing the reader to expand the indications and possibilities in hysteroscopy
- Gives a step-by-step description of surgical techniques and practical points in hysteroscopic procedures
- Strongly recommended for all gynecologists in training, early career, and in clinical practice.



Nandita Palshetkar MD FCPS FICOG FRCOG (UK) is a Professor Emeritus, Department of Obstetrics and Gynecology, DY Patil School of Medicine, Navi Mumbai, Maharashtra, India. Currently serving as the President of the Indian Society for Assisted Reproduction. She has held various leadership roles, including President of the Federation of Obstetric and Gynaecological Societies of India (2019), Mumbai Obstetric and Gynaecological Society (2016), Indian Association of Gynaecological Endoscopists (2017), Maharashtra Chapter of ISAR (2016), Association of Maharashtra Obstetric and Gynaecological Societies (2020), and FOGSI representative to FIGO. As the Founder and Medical Director of Bloom IVF, overseeing 10 centers across India, she has significantly contributed to reproductive health. With over 70 orations, numerous talks, and extensive publications, she has received 18 national and international awards, including the Bharat Gaurav Award at the House of Commons in the UK. Most recently, she was honored with the Fellowship of the Royal College of Obstetricians and Gynaecologists for her outstanding work in advancing women' health.



Hrishikesh D Pai MD FRCOG (UK-HON) FCPS FICOG MSc (USA) is the President of FOGSI (2022–2023). He is the Founder and Medical Director of Bloom IVF Group, Lilavati Hospital IVF Center, Mumbai, Maharashtra, India and Administrator of FOGSI Manyata Initiative. He is a Professor, Department of Reproductive Medicine, DY Patil University, Navi Mumbai. He is the Director of Corporate Affairs, International Federation of Fertility Societies and adjunct Assistant Professor at Eastern Virginia Medical School, USA. He is a Postgraduate Teacher in Gynecology at DNB Examination, India and a Visiting Professor in Department of Obstetrics and Gynecology, Manipal University, India. He has been conferred with the Fellowship of the Royal College of Obstetricians and Gynaecologists. He is the Past President of ISAR, IAGE, and MOGS.



Rishma Dhillon Pai MD DNB FCPS DGO FICOG is a Gynecologist and Infertility Specialist at Jaslok, Lilavati, and Hinduja Health Care Hospitals in Mumbai, Maharashtra, India; the Director of the Everywoman Cliniq and Pearl Center Hospital, Mumbai, which was the first to break new ground in the field of family planning. She has been the President of FOGSI (2017), Mumbai Obstetrics and Gynaecological Society (2021), Indian Association of Gynaecological Endoscopists (2018) and Indian Society for Assisted Reproduction (2018). She was the Organizing Secretary of AICOG 2013. She is the Treasurer of International Federation of Fertility Societies. She has delivered several orations and talks at national and international conferences and has several publications to her name in national and international journals.



Tanvir Singh MS (Obstetrics and Gynecology) is a Consultant at Tanvir Hospital, Hyderabad, Telangana, India. She specializes in minimally invasive gynecology, with a focus on diagnostic and operative office hysteroscopy. She has setup an Ambulatory/Office Hysteroscopy Unit and Urogynecology Unit. She has done her Diploma in Gynec Endoscopy from Centre International de Chirurgie Endoscopique (CICE), France (2012). She has done her Fellowship from Kidney Disease and Research Institute, Ahmedabad, Gujarat. She has done her Program Level 1 Certification which is supported by ESGE, ESGO, SERGS, and ESHRE. She has completed her FOGSI Certification in Endoscopy and Basic Ultrasound and done her IOTA Certification from Europe. She has received the AAGL IAGE Young Skill and Excellence Award in 2023, FOGSI Future Award in 2019.



Rohan Palshetkar MS FRM BDRME ADRME is an Obstetrician, Gynecologist, and ART Consultant with a focus on high-risk obstetrics. He serves as Professor at DY Patil School of Medicine and Bloom IVF and Head of Unit, Bloom IVF, Mumbai, Maharashtra, India. He holds key positions, including 2nd Joint Secretary of the Association of Maharashtra Obstetrics and Gynaecological Societies and Managing Committee Member of Maharashtra Chapter of ISAR and Mumbai Obstetric and Gynaecological Society. He chairs the FOGSI Young Talent Promotion Committee (2024–2027) and has delivered the FOGSI YUVA Oration and the YUVA ISAR Oration. Recognized for his contributions, he has received awards such as the Asia Oceania Federation of Obstetrics and Gynaecology Young Gynaecologist Award and the FOGSI Corion, Shanti Yadav, Kumud Tamaskar, and Praveen Mehta Awards for his research papers. He has several publications in national and international journals.

Printed in India

Available at all medical bookstores
or buy online at www.jaypeebrothers.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
OBSTETRICS & GYNECOLOGY

ISBN 978-93-5696-483-9