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6

New developments in ambulatory hysteroscopic surgery

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In the last decade, advancements have been made in hysteroscopic techniques, instrumentation and indications. Vaginoscopic hysteroscopy is performed without medication, cervical dilation and use of vaginal speculum or cervical tenaculum. To prevent complications during uterine access, both misoprostol and laminaria are equally effective for cervical priming. The use of normal saline to distend the uterus prevents hyponatraemia, but hypervolaemia may still be a major problem. Irrigant fluid deficit is best monitored by automated devices. Bipolar electrosurgical systems do not require dispersive return electrodes and do not generate stray currents, thus minimizing the risk of electrical burns. Tissue debulking and extraction are facilitated by vaporizing electrodes or morcellators. Hysteroscopic indications have expanded to include diagnosis and treatment of missed abortion, and cervical and interstitial pregnancies. The most important advancement of hysteroscopy has been proximal tubal access for sterilization.

Key words: vaginoscopic hysteroscopy; cervical priming; saline distention; bipolar electrosurgery; fluid monitoring systems; vaporizing electrodes; hysteroscopic morcellator; hysteroscopic fetoscopy; cervical pregnancy; interstitial pregnancy; hysteroscopic sterilization.

The main indications for hysteroscopy include examination of the uterine cavity for menstrual or fertility disorders, direct access for intra-uterine surgery, and proximal tubal access for falloposcopy/tubal cannulation or tubal occlusion for sterilization.

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In order to perform hysteroscopy, the surgeon must have clear indications for the procedure, obtain informed consent, provide adequate analgesia/anaesthesia, access and distend the uterine cavity, and use appropriate instruments to conduct surgery. Adequate training and surgical expertise, including complete knowledge of endoscopic surgical principles and equipment, are of paramount importance. The surgeon must also understand various complications of hysteroscopy to facilitate prevention, recognition and appropriate management when complications occur.

During the last decade, there have been refinements, innovations and advancements in surgical techniques, instrumentation and indications of hysteroscopy. These were designed to minimize patient discomfort and inconvenience, reduce complications, and optimize patient safety and clinical outcomes.

SURGICAL TECHNIQUES

Analgesia/anaesthesia

The use of a rigid hysteroscope for outpatient hysteroscopy has superior optical properties, requires less time for the procedure, and has a higher success rate (100 vs 90%, $P=0.01$) compared with a flexible hysteroscope.[1] However, women experience more discomfort with rigid hysteroscopes.[1] Comparing normal saline with CO_2 as distending media resulted in similar pain during the procedure, less pain immediately after the procedure, greater patient satisfaction and a trend towards lower risk of vasovagal reaction.[2] Diagnostic outpatient hysteroscopy using 4–5-mm diameter hysteroscopes had a 90–95% success rate. The most common complaint responsible for failure was severe pain.[3–5] Several authors reported improved rates of office hysteroscopic feasibility using paracervical block.[3,5]

Pain can be alleviated by a variety of medications and techniques including analgesics, local anaesthetics, conscious sedation and general anaesthesia.

Analgesia

The reduction of pain in the conscious patient can be achieved by a variety of peri-operative medications (Table 1).

Local anaesthesia

The elimination of sensation from the cervix and uterus can be achieved by a variety of gels and sprays. Lignocaine gel applied to the cervix did not reduce pain associated with hysteroscopy[6], while lidocaine aerosol spray in the cervix was effective in reducing pain

Table 1. Suggested peri-operative medications

- Non-steroidal anti-inflammatory drugs
  - Indomethacin 100 mg rectal suppository 1 hours pre-operatively
  - Ketorolac 10 mg IM or 30 mg IV intra-operatively
- Anxiolytics
  - Lorazepam 0.5–1.0 mg sublingual
- Analgesics
  - Pethidine 50 mg PO or IM

Table 2. Suggested cocktail for paracervical block

- 10 mL lidocaine 1% with 1:200 000 epinephrine
- 10 mL bupivacaine 0.2%
- 50 mL (1 ampoule) sodium bicarbonate
- 1 mL (1 ampoule) atropine (0.5 mg)

71 mL total solution. Inject 5–10 mL on each side of cervix.

and discomfort.[7,8] Pain was not alleviated in patients receiving 5 mL of 2% intra-uterine lidocaine for outpatient diagnostic hysteroscopy or endometrial biopsy. In addition, lidocaine did not prevent the occurrence of vasovagal reactions[9] (Table 2).

The advantages of paracervical analgesia in hysteroscopic surgery remain in doubt.[5,10,11] Unlike the uterine wall, the endometrium and endometrial polyps are insensitive to pain. Dilatation of the cervix is usually painful. A recent review of available evidence concluded it is reasonable to use non-steroidal anti-inflammatory drugs 1 hours before the procedure, if not otherwise contra-indicated, and topical analgesia before the insertion of the hysteroscope.[12]

Conscious sedation

During conscious sedation, there is minimal reduction in the level of consciousness while patients retain their own airway and respond to physical and verbal stimuli. Suggestions for conscious sedation are listed in Table 3.

Caution should be exercised when pre-medicating patients because medication given by various routes peak at different times. Anxiolytics and narcotics can potentiate each other's contribution to respiratory and cardiac dysfunction. Therefore, blood pressure and heart rate monitoring, as well as pulse oximetry, are recommended when using conscious sedation.

It is generally accepted that hysteroscopy is less painful than hysterosalpingography (HSG). As a result, many surgeons are presently performing a variety of hysteroscopic procedures without any analgesia or anaesthesia.

Vaginoscopic hysteroscopy

This 'no-touch' procedure was pioneered by Bettocchi and Salvaggi in 1995.[13] It is performed without medication, cervical dilatation and use of vaginal speculum or cervical tenaculum. The only instrumentation required is a 5-mm-diameter, continuous flow hysteroscope that allows semi-rigid 5-F instruments through its channel. These instruments can be used to grasp, cut, biopsy, vaporize or coagulate.[14,15]

Table 3. Suggested medications for conscious sedation

- Fentanyl citrate 1 μg/kg IV
- Atropine 0.5–0.6 mg IV
- Midazolam 4 mg IV
- Anti-emetic
  - Dimenhydrinate 50 mg IV
  - Prochlorperazine 10 mg IM or IV infusion

The hysteroscope is introduced into the vagina and advanced through the cervical canal into the uterine cavity. Initially, the labia minora may have to be held together to facilitate distention of the vagina during the vaginoscopy part. The uterine distention is maintained by an electronic suction/irrigation pump, using saline at a pressure of approximately 30 mmHg. Failure rates of vaginoscopic procedures have ranged from 0[13,14] to 2.4%.[16] The technique has been adopted by many surgeons to perform a variety of intra-uterine surgical procedures.[2]

Uterine access

During uterine access, the patient must be in a horizontal position to minimize the risk of air or gas embolism.[17] The position, size and shape of the uterus is assessed by bimanual examination if cervical dilatation is required. After the cervix is dilated, the hysteroscope is inserted under direct visualization. Complications encountered during uterine access include vasovagal reaction, cervical tears, creation of false passages, and partial or complete uterine perforations.

Vasovagal syndrome

Vasovagal syndrome was reported in 15 of 2079 (0.72%) women undergoing outpatient hysteroscopy without analgesia.[18] Severe pain was often associated with vasovagal reactions. The risk was higher with the use of a rigid hysteroscope (1.85%) and CO_2 as the distending media (2.34%), regardless of the indication for hysteroscopy.[18] Other studies have reported rates of vasovagal syndrome during office hysteroscopy ranging from 1.0[4] to 1.7%[3], and one study reported a rate as high as 30%.[10] Topical anaesthesia and smaller hysteroscopes (3.5 mm) decreased the risk of vasovagal syndrome.[19,20]

Uterine perforation

A prospective multicentre study involving 13 600 hysteroscopic procedures reported perforation rates during diagnostic and operative hysteroscopy of 0.13 and 0.76%, respectively.[21] In another study, the overall perforation rate was 1.61% with a range of 0.80% for endometrial resections and 7.94% for adhesiolysis.[22] The authors also reported a uterine perforation rate of 1.2% from six published series involving 8743 hysteroscopic procedures.[18] A survey of physicians learning and performing endometrial resection reported that 52% of uterine perforations occurred during the first five cases and 33% occurred during the first case.[23]

Cervical priming

To help prevent complications during uterine access, the surgeon may consider intracervical injection of vasopressin, xylocaine with epinephrine, or pre-operative cervical priming. The use of oral misoprostol, 400 μg, given 12 hours prior to diagnostic hysterscopy[24] and 400 μg, given 12 and 24 hours prior to operative hysteroscopy[25], was shown to be beneficial over placebo in the ease of cervical dilatation. This benefit was seen in both pre-menopausal[24,25] and post-menopausal women[25], and in those pre-treated with gonadotrophin-releasing hormone (GnRH)-a.[25] Vaginal misoprostol, 200 μg, given 9–10 hours prior to hysteroscopy in pre-menopausal women, facilitated the procedure and resulted in fewer complications compared with placebo.[26,27]

In a randomized comparison, both misoprostol and laminaria were shown to be equally effective in inducing proper cervical priming prior to operative hysteroscopy.[28]

Uterine distention

The uterine cavity can be distended by CO_2 gas or liquid solution. Advantages of liquid distention include better patient tolerance[2], visibility[29] and clearing out of blood, blood clots and debris. The mean intra-uterine pressure required to separate the uterine walls is 40 mmHg (range 25–50 mmHg)[30], and spill from normal fallopian tubes occurs at 70 mmHg.[31] Therefore, an effective intra-uterine pressure for hysteroscopic surgery should be between 25 and 70 mmHg. Factors known to correlate with intravasation of fluid include intra-uterine pressure greater than mean arterial pressure, depth of tissue destruction, intra-uterine surface area, duration of the procedure and tissue vascularity.[32,33]

There were no cases of fluid overload (greater than 1000 mL) during diagnostic hysteroscopies, and there was a 0.2% (4/2515) incidence during operative procedures.[21] The incidence of fluid overload has been reported to occur in up to 11% of cases[34] with an average of 3.4%.[21] Factors that significantly reduce fluid intravasation include pre-operative treatment with GnRH-a[35–37], intracervical vasopressors[38–40], use of outflow suction[41], and low intra-uterine distention pressure.[32,33] Excessive, rapid and unpredictable absorption of irrigant solutions may lead to acute hyponatraemia, congestive heart failure and pulmonary and/or brain oedema which may result in coma, blindness and even death.

Commonly used non-conductive fluids during monopolar electrosurgery include the amino acid glycine (1.5 and 3%) and sugar solutions (sorbitol 3%, mannitol 5%). The 5% mannitol is considered to be a safer solution because it is isotonic (280 mOsm/L) and, if absorbed, induces its own diuresis.[42] However, it remains to be proven that mannitol-induced isotonic hyponatraemia is safer than hypotonic hyponatraemia induced by 1.5% glycine or 3% sorbitol. In one study using rabbits, less brain oedema occurred during acute isotonic than hypotonic hyponatraemia. However, the mortality rates remained the same at approximately 30%.[43]

Physiologically, the most appropriate irrigant solution should be isotonic and isonatraemic, such as normal saline or Ringer's lactate solutions. The use of various resectoscopic electrosurgical systems in normal saline has been reviewed, including the ERA sleeve (Conceptus Inc., San Carlos, CA, USA), the OPERA Star (FemRx Inc., Sunnyvale, CA, USA) and the VersaPoint (Gynecare Inc., Somerville, NJ, USA) .[44] The use of physiological solutions during hysteroscopic surgery does not preclude excessive fluid absorption, thus the surgeon should not be lulled into a false sense of security. Saline is absorbed at the same rate and conditions as other fluids, and one death following excessive absorption of normal saline has been documented.[45]

Fluid monitoring

It is imperative that fluid absorption be monitored diligently throughout the surgery, either manually or using automated volumetric and weighing methods. Manually, fluid deficit should be assessed every 1000 mL of irrigant fluid used or at least every 5–10 minutes.[46] Automated fluid monitoring systems allow for adjustments of the flow rate and distention uterine pressure by varying the infusion and outflow pressures. In addition, some devices deliver the fluid in

a pulsatile fashion causing myoclonic uterine contractions that may 'massage' intramural myomas into the uterine cavity. By using this technique, we have been able to resect intramural myomas up to 8 cm in diameter hysteroscopically. The automated devices digitally monitor and display inflow and outflow volumes, and alarm at a deficit of 500 mL. The procedure should be completed quickly at a fluid deficit of 750–1000 mL, and be terminated at a deficit greater than 1500 mL or $Na^+ < 125$ mEquiv./L.[46] Post-operative hyponatraemia correlated significantly with 1.5% glycine deficit ($R^2 = 0.83$, $P < 0.001$); a decrease of approximately 1 mEquiv./L of Na+ per 100 mL of fluid deficit.[47] If normal saline is used, the corresponding volumes are 1500 and 2500 mL, respectively.[46]

INSTRUMENTS TO OPERATE

Intra-uterine surgery can be performed by various instruments including scissors, fibre lasers (Nd:YAG, Ho:YAG) and electrodes. The use of monopolar electrodes requires non-conducting distending solutions and a dispersive return electrode. Electrical currents in the monopolar mode induce stray currents through defective electrode insulation or by capacitance, which may result in electrical burns to the genital tract and/or adjacent organs.[48–51] A major innovation in hysteroscopic surgery used to minimize the risk of electrical burns has been the introduction of bipolar electrosurgery.

The VersaPoint™ system

Intra-uterine surgery using a new versatile co-axial bipolar electrode (VersaPoint, Gynecare Inc., Somerville, NJ, USA) in normal saline solution was introduced in 1997.[45,52] The electrosurgical system consists of a high-frequency dedicated electrosurgical generator and co-axial bipolar electrodes designed to cut, desiccate (coagulate) and vaporize tissue. The 1.6-mm-diameter (5-F), 36-cm-long, flexible bipolar electrode can be used through any operating hysteroscope. There are three electrode tips available: a spring to vaporize, a 'twizzle' to cut, and a ball to coagulate tissue. These electrodes can only function in a normal saline environment (Table 4).

The VersaPoint system has been used with the administration of conscious sedation, with or without paracervical block[45,52], with the use of general anaesthesia[53,54] and without any anaesthesia[14] to treat a variety of intra-uterine lesions.

Table 4. Advantages of the VersaPoint system

- Requires minimum cervical dilatation (≤ 5 mm)
- Requires minimum or no analgesia/anaesthesia
- Can operate in a small confined cavity
- Uses normal (0.9%) saline solution, avoiding hyponatraemia
- Uses bipolar current and low voltage, minimizing risks of burns
- Vaporizes tissue, eliminating the necessity for tissue removal

TISSUE DEBULKING AND EXTRACTION

Vaporizing electrodes

Hysteroscopic polypectomy and myomectomy is frequently indicated in women with bleeding, fertility and pregnancy disorders. Myomas, polyps and endometrial shavings can be removed through the cervix by graspers, curettes or loop electrodes after they have been reduced to small 'chips'. As a rule, when chips accumulate they tend to obscure the view and make placement of the electrode more difficult and dangerous. Cutting into tissue may result in excessive bleeding requiring coagulation, and excessive intravasation of fluid may lead to fluid overload. To optimize the view and minimize the risk associated with the chips, electrodes that vaporize or coagulate tissue and seal bleeding vessels have been introduced.

The VaporTrode™ electrode

The VaporTrode electrode (Circon-ACMI, Stanford, CT, USA) consists of a 3-mm-wide roller cylinder with three grooves to provide eight edges through which the radiofrequency current is concentrated at the edges to vaporize cells in contact. The power required to vaporize tissue is 150–300 W of pure cut current delivered by any electrosurgical generator in the monopolar mode.[55] Following the introduction of the VaporTrode electrode, a dispersive pad electrode burn to the underlying skin was encountered during vaporization of a myoma.[56] It is recommended that during hysteroscopic procedures, power output should be kept below 200 W. Myomas and polyps should not be vaporized completely but should be morcellated and extracted with graspers for histological examination.

The VersaPoint resectoscopic electrode

At the beginning of 2000, the VersaPoint co-axial electrode was modified for resectoscopic surgery. This system utilizes a dedicated 27-F continuous flow resectoscope and two electrodes designed to deliver a range of controlled, predictable tissue effects. In the vaporizing mode, the generator controls the creation of a vapour pocket or steam bubble, which upon contact with tissue, causes instantaneous vaporization of cellular water content resulting in tissue vaporization. The energy follows the path of least resistance through the saline distention media, and returns to the generator through a parallel electrode. It does not require a dispersive return pad electrode. The vaporizing electrode is 4 mm wide and 4 mm in diameter, while the corresponding cutting loop electrode has a diameter of 2.5 mm. Strict fluid intake and output monitoring is required during hysteroscopy although normal saline is used.

Hysteroscopic morcellation

Resection and removal of entire intra-uterine lesions, including the endometrium, is more advantageous than vaporization. Endomyometrial resection provides a complete sample for histological analysis, revealing malignancy in up to 3% of cases missed at pre-operative endometrial biopsy.[57]

The SL resectoscope

A new physiological morcellating resectoscope, the OPERA Star (FemRx Inc, Sunnyvale, CA, USA), was first described in 1998.[58] The resectoscope allowed operative hysteroscopy to be performed with normal saline, thus reducing the risk of dilutional hyponatraemia. The SL system requires a conventional monopolar electrosurgical generator, and the electrical current returns to the generator through the resectoscope morcellator housing located in the insulated sheath of the resectoscope. It does not require a dispersive electrode. The SL resectoscope requires 100 W of pure cutting power.

The hysteroscopic morcellator

A hysteroscopic intra-uterine morcellator is currently undergoing clinical evaluation.[59] The morcellator is similar to an arthroscopic surgery blade; 35 cm in length and inserted into a straight working channel of a 9-mm hysteroscope. The inner tube rotates within the outer tube, driven mechanically by an electrically powered motor, controlled by a foot pedal that initiates the rotation and direction of the inner tube. Both tubes have a window opening at the end with cutting edges. The tissue intended for morcellation is sucked into the window opening and cut and shaved by the rotation of the inner tube. The major advantages of this system are the use of saline solution and ease of tissue removal by suction (-200 mmHg). A potential disadvantage is its inability to coagulate bleeding vessels encountered during surgery.

INDICATIONS

Hysteroscopy for menstrual disorders

Hysteroscopic evaluation and directed biopsy has been considered to be the 'gold standard' in the diagnosis of intra-uterine anomalies. It is especially important when imaging and office endometrial biopsy is unavailable, inadequate or inconclusive. Reports on the diagnostic accuracy of hysteroscopy indicate sensitivity and specificity ranges of 0.84–0.97 and 0.88–0.93, respectively.[60,61] An additional advantage of hysteroscopy compared with saline infusion sonography (SIS) for the management of abnormal uterine bleeding is treatment provided at the same time.

Hysteroscopy for fertility disorders

A prospective randomized study concluded that office hysteroscopy, SIS and HSG were statistically equivalent regarding evaluation of the uterine cavity in infertile women.[62] However, in view of the low complication rates, minimal time requirement, and negligible effect on the post-operative course associated with hysteroscopy, it should become a routine procedure in all infertile women undergoing diagnostic laparoscopy.[63] A significant percentage of women have intracavitary lesions that may impair the success of fertility and treatment.[15,64,65]

Uterine septum

Hysteroscopy with concomitant laparoscopy is considered to be the gold standard for diagnosis and treatment of the septate uterus.[15,66,67] Incidental finding of a septate

uterus is not an indication for surgical intervention in the absence of infertility or adverse obstetrical performance.[67] The septum can be divided by hysteroscopic scissors, electrosurgery (monopolar or bipolar) or laser fibres under local, general or no anaesthesia at all.[67] A residual septum of less than 1 cm does not appear to have an adverse effect on reproductive outcomes.[68] Bettocchi et al performed 154 hysteroscopic evaluations of septated uteri using the vaginoscopic approach without anaesthesia or analgesia.[66] Using scissors, the septum was cut through a 5-F channel. The septum was completely removed in the office in 109 (70.8%) women, while laparoscopic evaluation was required in 45 women. The mean surgical time was 6+2 minutes and none of the patients experienced discomfort, pain or excessive bleeding. At 3 months, all women had a normal hysterosalpingogram. The use of adjunctive treatment with an intra-uterine device (IUD)[69] or systemic oestrogens in the immediate post-operative period has been shown to be of no benefit.[70]

A review of 16 publications on reproductive outcome of pre- and post-hysteroscopic metroplasty reported a pre-treatment miscarriage rate of 80%, a pre-term delivery rate of 9% and a live birth rate of just 3%. Following hysteroscopic metroplasty, the corresponding rates were 14, 6, and 80%.[67]

Intra-uterine adhesions

Intra-uterine adhesions may occur after trauma to the basalis layer of the endometrium by vigorous diagnostic or post-partum curettage, endomyometritis, multiple myomectomies, endometrial ablation and pelvic radiation. The occurrence of such adhesions may result in decrease or absence of menstruation, infertility and pregnancy disorders such as recurrent pregnancy loss, placenta accreta and intra-uterine growth restriction. The risk of uterine perforation during operative hysteroscopy for adhesiolysis has been reported as 7.5%.[22] Hysteroscopic adhesiolysis requires the use of small diameter hysteroscopes. The procedure can be performed using scissors, laser fibres or the VersaPoint electrode.[45,53,54,71]

One study compared a Foley balloon for 10 days with an IUD (Lippes loop) for three cycles to prevent recurrent adhesions following adhesiolysis. All patients were given antibiotic prophylaxis, with oestrogen as well as progestins. During the next 4 years, in the Foley catheter group, 81.4% had restoration of normal menstruation compared with 62.7% in the IUD group ($P<0.05$). Persistent amenorrhoea/oligomenorrhoea was reported in 18.6% of cases compared with 37.3% ($P<0.03$), while the conception rates were 33.9 and 22.5%, respectively. The study concluded that the Foley catheter was a safer and more effective adjunctive method following treatment of intra-uterine adhesions compared with the IUD.[72] Benefits from adjunctive oestrogen alone or in combination with progestins remain controversial. In a prospective, randomized, controlled study of 92 women undergoing hysteroscopic adhesiolysis, the use of auto-cross-linked hyaluronic acid gel significantly decreased the reformation of adhesions after 3 months of follow-up compared with a control group.[73]

Hysteroscopic fetoscopy

Investigations following unexplained fetal demise in early pregnancy include imaging as well as tissue and biochemical examination post-evacuation. Frequently, the cause of fetal death remains elusive and becomes a major source of frustration and guilt for parents and healthcare providers. A preliminary study of eight consecutive,

non-selected, missed abortions described hysteroscopic fetoscopy as an additional investigational tool just prior to evacuation. The gestation varied from 9 to 19 weeks and amnioscopy/fetoscopy was achieved using a 26-F continuous flow resectoscope and a loop electrode to access the amniotic sac. Anatomical fetal deformities, surface skin lesions and cord accidents were identified in all cases. Pre-operative imaging and histochemical evaluation of tissue failed to describe any of the observed anatomical abnormalities observed through hysteroscopy.[74]

Cervical pregnancy

Resectoscopic evacuation of a 6-week cervical pregnancy was reported in 1996.[75] Resection/coagulation was preceded by vasopressin solution injected into paracervical tissue and suture ligation of the cervical branch of the left uterine artery. Beta-human chorionic gonadotrophin (β-hCG) decreased from 3192 IU/L to 0 after 14 days. Hysteroscopic electrocoagulation with a rollerball electrode of a heterotopic cervical pregnancy after intracytoplasmic sperm injection has also been reported. The intrauterine pregnancy progressed uneventfully to term.[76] We have also successfully treated a 10.5-week viable cervical pregnancy (β-hCG 105 000 IU/L). The cervical pregnancy was evacuated using a 26-F continuous flow resectoscope and a loop electrode after transfemoral bilateral uterine artery occlusion.

Interstitial pregnancy

Interstitial (cornual) pregnancy is rare, comprising 2–4% of ectopic pregnancies. It carries a maternal mortality rate of 2–2.5%.[77] Treatment modalities range from conservative medical management to more invasive surgical techniques.

Hysteroscopic management of an interstitial ectopic gestation was reported in 1989.[78] Using hysteroscopic forceps, a 6-week gestation was removed from the right cornua under concomitant laparoscopic guidance. Several case reports demonstrated the usefulness of hysteroscopy in the diagnosis of suspected interstitial ectopic pregnancies. Hysteroscopic removal of a residual interstitial ectopic sac following systemic methotrexate treatment and hysteroscopic injection of methotrexate into an interstitial pregnancy has also been reported. Most hysteroscopies were done under laparoscopic guidance with patients that were haemodynamically stable. Surgical expertise and the desire to preserve fertility were common factors in these case reports.

PROXIMAL TUBAL ACCESS

Falloposcopy/tubal cannulation

Flexible falloposcopes, 120–130 cm in length and 0.3–0.5 mm in diameter, may be introduced into the fallopian tubes via hysteroscopy.[79] Although falloposcopy may provide more accurate data about endotubal disease and be of therapeutic value cannulating the fallopian tubes, several studies have found that technical problems may limit its usefulness in routine clinical practice.[80,81]

Hysteroscopic tubal sterilization

Hysteroscopic methods of tubal occlusion were explored in the 1970s. They included the use of formed-in-place silicone plugs[82–84], hydrogelic devices[85], laser fibres[86] or radiofrequency electrodes[87] to coagulate the tubal ostia. Office hysteroscopic sterilization was accomplished in approximately 90% of women and no significant complications were noted.

The ESSURE system

A permanent, irreversible sterilization device, Essure™ (Conceptus Inc., San Carlos, CA, USA) is a dynamically expanding micro-insert coil that is placed in the proximal section of the fallopian tube using a hysteroscopic approach. By 3 months, fibrosis completely occludes the fallopian tube.[88]

In a cohort study of 227 women, micro-inserts were successfully placed in both fallopian tubes in 88% of women. After 6015 women-months of exposure to intercourse, no pregnancies were recorded.[89] In another study, bilateral placement of the micro-inserts was achieved in 464 of 507 (92%) women, and no pregnancies were reported after 9620 women-months of exposure to intercourse.[90] These reports concluded that hysteroscopic interval tubal sterilization with micro-inserts is well tolerated and results in rapid recovery, high patient satisfaction and effective permanent contraception.[90] Long-term results (1–3 years) of the Essure sterilization device demonstrated a high rate of effectiveness and wearing comfort.[91] A total of 664 of 745 (90%) women achieved bilateral placement, and 643 of 664 (97%) were able to rely on Essure for permanent birth control. As of 26 November 2003, there were no pregnancies reported in women with the Essure device.[91] Further improvement of the Essure system was obtained utilizing a new coil catheter delivery system. Bilateral placement of the micro-inserts occurred in 98% of women (100 of 102).[92]

A comparative cost-analysis of Essure sterilization in the operating room versus laparoscopic tubal fulguration in the USA demonstrated a 10% reduction in costs with the Essure device.[93] Concomitant Essure tubal sterilization and global endometrial ablation by various systems has been reported.[88,94–96] Furthermore, the Essure micro-insert has been used as an alternative to salpingectomy or laparoscopic tubal occlusion in a morbidly obese woman (body mass index 50 kg/m^2) with hydrosalpinges prior to in vitro fertilization.[97]

The Adiana system

The Adiana catheter system is another hysteroscopic tubal sterilization procedure currently undergoing evaluation. During the procedure, low-power (<1 W) bipolar energy is delivered to the superficial endosalpinx and a porous matrix is left in the lumen. Tubal occlusion by fibrosis is completed within 3 months. An advantage of this system is the need to cannulate only 1 cm of the intramural fallopian tube. A 5-mm hysteroscope is used in an office setting. The bilateral first-attempt access rate for this procedure was 94.5% (241/255 women), and over 50% of patients were treated using local anaesthesia without sedation. The mean total hysteroscopy time was 14 minutes. In 1000 women-months of exposure to intercourse, there have been no pregnancies and no significant complications related to the procedure or the device.[98]

SUMMARY

Hysteroscopy has evolved from the art of examining the uterus in the 1970s to a variety of intra-uterine surgeries. In the last decade, advancements have occurred in hysteroscopic techniques and instrumentation, allowing simple and complex surgical procedures through a minimally invasive approach. Vaginoscopic hysteroscopy has eliminated the need for analgesia or anaesthesia, and can be performed in an outpatient office or clinic with minimum patient discomfort and inconvenience.

The use of normal saline distention media in conjunction with automated fluid monitoring systems provides additional safety features and reduces the risk associated with fluid intravasation.

Bipolar electrosurgery requires normal saline as the distention media and there is no need for a dispersive electrode. In addition, the absence of stray currents minimizes the risk of electrical burns to the patient.

The most important advancement of hysteroscopy is proximal tubal access for tubal sterilization. This allows tubal occlusion through minimal access surgery in an outpatient setting, with minimal discomfort and inconvenience to women.

Research agenda

- means to decrease and monitor irrigant fluid intravasation
- introduce active electrode monitoring during resectoscopic surgery
- introduce coblation bipolar electrosurgery
- explore role of fetoscopy
- explore reversible tubal occlusion

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