Chapter 1

Hysteroscopy: Office and Operative – Myomectomy, Polypectomy, and Adhesiolysis

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1.1 Introduction

Hysteroscopy has become a mainstay within a gynecologic surgeon's practice for endoscopic examination of the uterine cavity due to the benefits of its relatively low-risk methods and accurate diagnostic capabilities. The hysteroscopic approach provides excellent visualization and is minimally invasive in that no incisions are required for therapeutic procedures. New tools are constantly being developed for the office as well as for the operating room, broadening the options available to address a wide variety of intrauterine pathologies.

1.2 Hysteroscopes

The first hysteroscopes that were developed in the late nineteenth century were rigid-rod lens systems. This is still the most commonly used design, but flexible fiber-optic hysteroscopes and digital hysteroscopes are currently available. The flexible hysteroscopes are 3.2–3.5 mm in diameter with a tip that deflects over a range from 90° to 120°, and have the advantage of not requiring preliminary dilation of the cervix or use of anesthesia. They are most commonly used for office hysteroscopy. The disadvantage is that because they are single-channel scopes with 1 mm working channels having a noncontinuous flow, they can only be used for diagnostic purposes and they are more costly, less durable, and cannot be sterilized within an autoclave as is the standard for most rigid hysteroscopes. Digital hysteroscopes such as the Endosee© have recently become available for diagnostic use; they are cordless and utilize single-use cannulas.

Rigid hysteroscopes come with several options for viewing angles: 0°, 12°, 15°, 25°, or 30°. The 12° viewing angle is helpful for surgical procedures because it keeps the working instruments in the field of view at all times. On the other hand, the 30° viewing angle is advantageous because only small rotational movements are needed to visualize the entire cavity, thereby causing less discomfort to the patient. Typically, the single-flow sheath of the rigid hysteroscope has a 2.9 mm diameter and is used in combination with an outer sheath whose diameter ranges from 3.2 to 5.3 mm, creating a continuous flow system as well as permitting the passage of semi-rigid operating instruments such as scissors, graspers, or biopsy forceps. Small 5 French bipolar electrodes can be passed through the working channels of the continuous flow hysteroscopes and can be used for resection of small myomas, polyps, scar tissue, and septa.

For the purpose of definition, a resectoscope is a hysteroscope operating with radiofrequency or mechanical energy and ranging in diameter from 21 to 28 French. The working instruments employed with the resectoscope include loop electrodes, roller balls, and barrels as well as vaporizing electrodes. Resectoscopes may employ monopolar radiofrequency energy where the current flows from the active electrode (i.e., the loop) through the tissue via random diffusion to a remotely located large dispersive electrode. Electrodes in a ball or barrel have a larger surface area than cutting loops and serve well for tissue desiccation and are used to perform endometrial ablations. Monopolar electrodes necessitate the use of nonconductive fluid distention media such as glycine, sorbitol, or mannitol (see "Distending Media" section later in the chapter). Bipolar resectoscopes allow the current to arc only through the tissue, which comes into direct contact with the loop and its return electrode, and require a conductive electrolyte-containing distention medium to be used.

1.3 Morcellators

Hysteroscopic morcellators became available in the United States in 2005 as an option for mechanical resection of intracavitary lesions in which thermal energy is not utilized, and may be used with isotonic electrolyte-rich distention media such as normal saline. The reciprocating blades of the instrument cut while the suction element removes the tissue. Consequently, a morcellator cannot cauterize blood vessels. Due to their side-opening cutting design, the morcellators have limited utility in cases with myomas that have deep involvement into the myometrium. The clear advantage of morcellators is the ease in attaining visibility due to the continuous suction and collection of the resected tissue into a specimen bag [1]. Classic loop resectoscopic surgery can be challenging secondary to the aggregation of tissue chips, formation of gas bubbles, and blood clots obstructing visualization. The time involved in removing chips can be cumbersome when taking into account the multiple removals and reinsertions of the resectoscopic device into the cavity. When using a morcellating device, on the other hand, clearing the cavity can be achieved by activating the device and allowing the suction element to remove the visual field of the debris.

1.4 Distention Media

The options for distending medium include both fluid and gaseous media. Carbon dioxide (CO_2) is the only gaseous media used because it is highly soluble in blood, and currently is only an option for diagnostic procedures because the field of view is obscured when the gas encounters blood. CO_2 gas is readily

soluble in the blood stream and can lead to serious risk of gas embolism, and if the volume of the gas embolism is large, it can result in catastrophic cardiovascular collapse and death.

Low-viscosity fluid is the distention media of choice for current hysteroscopic technologies. High-viscosity media such as Dextran-70 (Hyskon) has fallen out of favor secondary to the low maximum infusion volume of 300 mL, as higher volumes can be associated with adverse outcomes such as pulmonary edema and right-sided heart failure secondary to its impact on expanding the patient's plasma volume. Furthermore, there are concerns of anaphylaxis as well as strict regimens for cleaning instruments when used in high-viscosity fluids, which have further limited the practical use of this media.

The available low-viscosity media vary in electrolyte content as well as in osmolality. The common electrolyte-free media include 1.5% glycine, 5% mannitol, and 3% sorbitol. The electrolyte-free fluids have unique features that vary in their osmolality and have different pathways of metabolism with resultant breakdown by-products. Plasma absorption of electrolyte-free media can lead to hyponatremia and other electrolyte disturbances. The signs of their systemic absorption included nausea, vomiting, and cardiac arrhythmias as well as a range of neurological symptoms such as cerebral edema, seizures, tremors, and even coma or death. On the other hand, 5% mannitol is near isotonic to plasma. However, because it lacks electrolytes, excess absorption can still cause hyponatremia with all the risks noted earlier. As a general rule, the serum sodium will be reduced by 10 mEq/L for every 1 L of electrolyte-free media absorbed. Subsequently, the American Association of Gynecologic Laparoscopists (AAGL) guidelines recommend concluding the procedure that employs hypotonic solutions when the fluid deficit reaches 1,000 mL [2].

On the other hand, electrolyte-rich solutions such as normal saline are isotonic, and thus are safer when they are systemically absorbed as they do not cause an electrolyte imbalance or hyponatremia. AAGL guidelines for operative hysteroscopy using isotonic distention media such as normal saline recommend limiting the fluid deficit to 2,500 mL in order to restrict intravasation of significant volumes of fluid and thereby prevent the onset of dangerous sequelae associated with fluid overload such as right-sided heart failure, hypoxia, difficulty with ventilation, and pulmonary edema [2]. Electrolyte-rich fluids can be used with bipolar radiofrequency surgical instruments but are not an appropriate fluid of choice for monopolar radiofrequency surgical instruments due to the dispersion of current.

For patients with compromised cardiovascular systems or who are elderly, the AAGL recommendation is to limit the maximum fluid deficit to 750 mL, regardless of the composition of the distention medium.

1.5 Office Hysteroscopy

The most common use of diagnostic office hysteroscopy is to evaluate both pre- and postmenopausal patients who complain of abnormal uterine bleeding (AUB) for intracavitary pathology. Additionally, systematic evaluation of the uterine cavity can be helpful in diagnosing unsuspected abnormalities in infertility patients [3,4]. The advantage for the physician is an expedited pathway to diagnosing and treating the etiology of the AUB and/or infertility via a safe procedure with few complications. For the patient, resumption of daily activities begins immediately and the risks of undergoing anesthesia are avoided.

Patients should be selected appropriately for office hysteroscopic procedures. Select those who are ASA Class I or II, whose procedures are not complicated, and can be completed successfully within a brief period of time. Avoid patients who have poor pain tolerance or unrealistic expectations of in-office procedures. Further considerations regarding cardiac and pulmonary medical history should be taken into account if moderate or deep sedation is involved.

1.5.1 Indications for Office Hysteroscopy

- Abnormal uterine bleeding (polypectomy, myomectomy)
- Infertility evaluation
- Intrauterine synechiae evaluation and treatment
- Retained products of conception evaluation and treatment
- Uterine malformation evaluation and treatment
- Retrieval of intrauterine device (IUD) or foreign bodies
- Evaluation of defects from hysterotomy at the time of cesarean section (isthmocele)
- Placement of permanent contraceptive implants

Scenarios of complications that can be encountered when performing office procedures include vasovagal reactions, local anesthetic toxicity, uterine perforation, hemorrhage, allergic reaction, and respiratory arrest secondary to excessive sedation.

Vaginoscopy is a technique employed in order to enter the vaginal, cervical, and uterine cavity without use of a speculum or a tenaculum. A common reason for failing to complete an office hysteroscopic procedure is pain. The stimulus of pain is generated from the cervix and the vagina often by use of the tenaculum, the speculum, as well as manipulation of the instrument within the endocervical canal. The pain sensation is conducted by autonomic fibers up to the S2 to S4 spinal ganglia via the pudendal and pelvic splanchnic nerves. Pain from intraperitoneal structures that occurs during the instillation of fluid into the uterine body is conducted by autonomic fibers via the hypogastric nerves to the T12 to L2 spinal ganglia. A 2010 meta-analysis of nine randomized controlled trials (RCTs) involving 1,296 patients compared the effectiveness and safety of different types of pharmacological interventions for pain relief and concluded that the use of local anesthesia during outpatient diagnostic hysteroscopy significantly reduces the mean pain score in comparison to placebo both during the procedure as well as 30 minutes after the procedure. On the other hand, no significant reduction of pain was found with the use of nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids when compared to placebo at both those time points.

1.6 Choice of Analgesia

The choice of anesthesia is surgeon dependent. The options range from NSAIDs to combinations of intravenous (IV) or

general anesthesia with or without adjunct administration of local anesthesia. Surgeons may choose to avoid a paracervical block secondary to the discomfort caused by performing the block itself, which is not insignificant. Moreover, potential complications from local anesthesia can occur when patients are given an overdose of the analgesia, have an allergic reaction, or when the analgesia is inadvertently injected intravascularly. Manifestations of systemic injection include dizziness, tremor, oral paresthesias, blurry vision, and seizure. More serious sequelae include bradycardia secondary to myocardial depression, as well as respiratory depression and apneic episodes. To reduce the risks associated with systemic injection, the addition of epinephrine (1:100,000) can be used to enhance local vasoconstriction and thereby minimize the absorption of the analgesic.

If vaginoscopy is not performed, a total infiltration of 20 mL of a local anesthetic (such as 1% lidocaine buffered with 2 mL sodium bicarbonate) can be used as a paracervical block. The block consists of the following technique: 2 mL injected superficially into the anterior lip of the cervix at the 12 o'clock position prior to placement of a tenaculum, and the remaining 18 mL injected at the 4 o'clock and 8 o'clock positions along the cervicovaginal junction (9 mL at each site). Maximum dosing should not exceed 4.5 mg/kg of 1% lidocaine without epinephrine, or 7 mg/kg of 1% lidocaine with epinephrine.

1.7 Cervical Ripening Agents

Cervical dilation is the first step at the commencement of an operative hysteroscopic procedure to gain access to the uterine cavity. Some surgeons may elect to pretreat with cervical ripening agents in an effort to gain easier passage through the endocervical canal. Nearly 50% of hysteroscopic complications are related to difficulty of entry into the cervix. Thus cervical ripening can reduce complications associated with difficult entry such as creation of a false passage, cervical lacerations, and uterine perforation.

A commonly used cervical ripening agent is synthetic E1 prostaglandin (PGE1) known as misoprostol. Its administration in 200–400 mcg tablets taken orally or vaginally 12–24 hours before surgery for cervical ripening is considered an off-label, investigational use in the United States despite the existence of high-quality evidence from RCTs that suggest it improves cervical dilation as well as decreases the risk of traumatic entry in premenopausal patients [5]. In postmenopausal women, there is evidence to suggest that pretreatment with 25 μg of vaginal estradiol for 2 weeks in combination with 400 μg of vaginal misoprostol 12 hours prior to the procedure can help facilitate cervical dilation in hysteroscopic procedures [6,7]. Side effects of misoprostol include fevers, chills, vomiting, diarrhea, vaginal bleeding, and uterine cramping. Other options include a natural prostaglandin E2 (PGE2) known as dinoprostone, or hygroscopic dilators that are placed within the endocervical canal. Hygroscopic dilators gradually dilate the endocervical canal radially via osmosis-induced expansion over a period of hours and may be a good option for women with contraindications to prostaglandin use; however, the limited available evidence is mixed regarding the efficacy of this method [5]. Given that laminaria require time to hydrate and dilate, this method requires an office visit the day prior to surgery or at least 6 hours pre-operatively for intracervical placement.

Injection of a dilute solution of vasopressin (0.05–0.2 U/mL of normal saline) can also promote cervical dilation as well as improve hemostasis by inducing contraction of the myometrium, thereby decreasing the fluid absorption. Associated toxicity can include arrhythmias. This technique consists of a total of 8–10 mL of dilute vasopressin, with 4–5 mL injected intracervically at 3 o'clock and at 9 o'clock positions. See "Vasopressin Administration" section under Hysteroscopic Myomectomy for further details.

It is rarely necessary to soften the cervix for office hysteroscopy due to the narrow diameter of the hysteroscopic equipment. The surgeon must beware that oversoftening of the cervix will make it difficult to maintain uterine distention during the hysteroscopic procedure.

1.8 Hysteroscopic Lysis of Adhesions

Intrauterine adhesions, interchangeable with the term Asherman's syndrome, typically present secondary to trauma of the basalis layer of the endometrium. This most often occurs after a uterine curettage for management of postpartum hemorrhage or incomplete spontaneous abortion. However, they can also develop after common procedures such as hysteroscopic myomectomy. Granulation tissue forms secondary to the trauma and creates tissue bridges between the walls of the uterine cavity, resulting in occlusive adhesions.

1.8.1 Indications for Procedure

Patients may present with secondary amenorrhea and severe dysmenorrhea with hematometria if cervical adhesions are dense and cause menstrual outflow obstruction. Oligomenorrhea or diminished menstrual flow with irregular spotting is also a common presenting complaint. With adhesions of the cavity diminishing the viable endometrial surface, patients may also frequently present with infertility or recurrent miscarriages.

1.8.2 Diagnosis and Treatment Guidelines

Hysteroscopy is the gold standard for the diagnosis and treatment of adhesions as it is very effective in restoring normal menstruation and improving fertility and reproductive outcomes [8]. If hysteroscopy is not available for diagnosis, hysterosalpingography and hysterosonography are considered reasonable alternatives. There is no role for medical management alone or blind D&C for these patients.

It is important to obtain a transvaginal ultrasound in order to evaluate the endocervical canal and endometrial lining of the uterine cavity. If there is no lining visible, it is suggestive of obliteration of the cavity, and the surgeon should consider intraoperative transabdominal ultrasound guidance as this can be particularly useful to prevent inadvertent uterine perforation when attempting lysis of adhesions because there are no anatomic landmarks.

Box 1.1 ASRM Classification of Intrauterine Adhesions

Extent of cavity involved	<1/3	1/3 to 2/3	>2/3
	1	2	4
Type of adhesions	Filmy	Filmy and dense	Dense
	1	2	4
Menstrual pattern	Normal	Hypomenorrhea	Amenorrhea
	0	2	4
Stage I	(Mild)	1 to 4	
Stage II	(Moderate)	5 to 8	
Stage III	(Severe)	9 to 12	

There are a variety of classification systems proposed for intrauterine adhesions. A commonly used system in the United States is provided by the American Society for Reproductive Medicine (ASRM), which defines the severity of intrauterine adhesive disease based on the extent of cavity involvement (<1/3, 1/3 to 2/3, >2/3); the type of adhesion seen (filmy, filmy and dense, dense), as well as the menstrual pattern (normal, hypomenorrhea, amenorrhea). Points are assigned to each finding and the patient is staged from 1 to 3 corresponding to mild, moderate, or severe, based on the total score (Box 1.1) [9].

If the adhesions are minimal to moderate (occupying <2/3 of the cavity) and the patient does not have cervical stenosis, then office hysteroscopic adhesiolysis can be considered and this procedure offers the advantage of avoiding IV sedation for anesthesia.

1.8.3 Pain Management

In the outpatient setting, we do not routinely pre-medicate our patients with NSAIDs. However, patients can elect to take 600 mcg of ibuprofen before or after the procedure, however they prefer. We do not use local anesthetic blocks for this procedure as taking down scar tissue should not cause pain unless the adhesiolysis has extended into the wrong plane, such as into the myometrium. During outpatient office adhesiolysis, the patient's vocalization of discomfort can provide the surgeon with important clinical cues that otherwise are not available when the patient is under IV sedation.

1.8.4 Pre-Procedure Planning

Patients whose procedures you anticipate will take <15 minutes are candidates for outpatient adhesiolysis. For extensive adhesiolysis, we offer patients IV sedation under monitored anesthesia care in the operating room. We do not pre-treat our patients with prostaglandins, as the small 5 mm caliber rigid hysteroscope can be advanced into the uterus without the necessity of cervical dilation. No prophylactic antibiotics are indicated for this type of procedure. The optimum timing for hysteroscopic procedures is during the early proliferative stage (menstrual day 4–11), as this is when the endometrial lining is the thinnest.

1.8.5 Surgical Approach

Treatment consists of sharp hysteroscopic adhesiolysis using the 5 mm rigid hysteroscope with 12° viewing angle and blunt-tipped scissors, with the primary objective to restore the normal volume of the cavity as well as the communication between the cavity, cervical canal, and fallopian tubes. Blunt dissection can lyse filmy adhesions easily using only the tip of the hysteroscope or with blunt use of the scissors. Our practice avoids use of electrosurgical instruments for adhesiolysis as the approach itself further damages the endometrium and thereby predisposes the patient to recurrent adhesive disease. In addition, since the procedure has an inherently higher risk of perforation, using electrosurgery for the procedure has the potential to cause thermal injury to surrounding organs. The choice of distention medium for our practice is isotonic electrolyte-rich fluids such as normal saline.

1.8.6 Surgical Technique

"Insert Video – Office Hysteroscopy: Lysis of adhesions Here"

1. Place patient in the dorsal lithotomy position.
2. Perform pelvic exam to determine the position and size of the uterus.
3. Sterile prep the patient.
4. Using the vaginoscopic technique, the hysteroscope is introduced into the vagina and distend the vaginal vault with normal saline. Slowly raise your hand to lower the tip of the scope into the posterior fornix, directly visualizing the upper third of the vagina as you pull back to locate and visualize the external os. Guide the scope into the endocervical canal and drop your hand toward the ground to keep the internal os centralized at the 12 o'clock position in order to avoid digging the scope into the posterior wall of the endocervical canal. Do not advance the scope with force if you are met with resistance as this can result in formation of a false passage. Successful entry into the cavity is achieved by placing one hand on the light cord and the other on the camera while rotating the entire scope back and forth between 4 o'clock and 8 o'clock positions and advancing gently along the axis of the cervical canal.
5. Once the uterine cavity is entered, obtain a panoramic view to assess the extent of adhesive disease and locate any lesions if present (Figure 1.1). Take a systematic

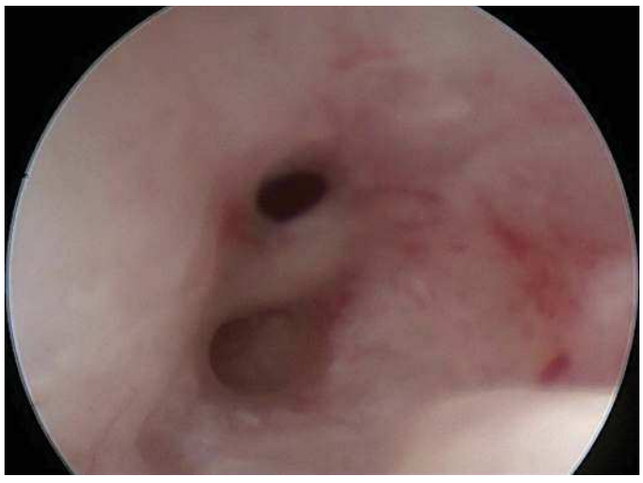

Figure 1.1 Hysteroscopic view of fundal adhesions.

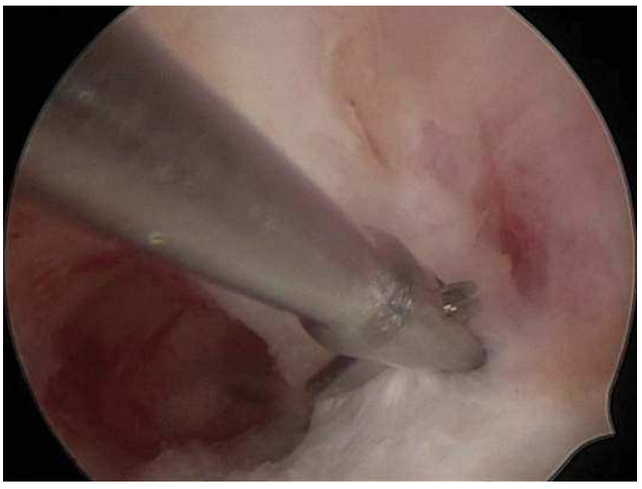

Figure 1.2 Lysis of intrauterine adhesions with scissors.

approach and note if either ostium is visible. Classify the severity of adhesive disease by the degree of uterine cavity involvement as described earlier. With more significant adhesive disease, anatomic landmarks are no longer recognizable and make spatial positioning difficult. In those cases, intraoperative transabdominal ultrasound guidance can be helpful.

6. Advance the blunt-tipped scissors, using both the sharp dissection to take down synechiae as well as blunt dissection by spreading the tips of the scissors (Figure 1.2). If you encounter bleeding, this is a cue that you are no longer dissecting scar tissue and have encountered the myometrium. Continue adhesiolysis until the normal cavity is restored (Figure 1.3). In cases with obliterated cornua, it may be difficult to visualize the tubal ostia after adhesiolysis secondary to the small size of the ostia.
7. While extracting the hysteroscope, evaluate the endocervical canal.

Figure 1.3 Restoration of the uterine cavity.

1.8.7 Postoperative Management

There is no consensus on postoperative management of patients with Asherman's syndrome. Estrogen supplementation is given postoperatively to stimulate endometrial growth; however, there is no standard dosing length or regimen [10]. Following the procedure, we recommend a 25-day course of 4 mg of oral estradiol (2 mg tablet by mouth twice daily) along with 5 days of medroxyprogesterone acetate (10 mg tablet by mouth once daily on days 21–25 of the cycle) for withdrawal. We perform a second-look office hysteroscopy within 2 weeks of the initial procedure in order to bluntly break the newly forming synechiae before they become dense [11]. The patients then return for another hysteroscopy 4 weeks later to assess the cavity, and additional sharp lysis of adhesions can be performed if needed.

Additional methods to reduce the recurrence of adhesions include intrauterine balloons or catheters and intrauterine devices. Options include insertion of a size 8 French pediatric Foley catheter with a 5 mL balloon placed into the uterine cavity for 3–10 days, or placement of a Malecot catheter for up to 10 days. Prophylactic antibiotics (Doxycycline 100 mg tablet by mouth twice daily × 10 days) should be considered when inserting a foreign body into the uterus. Insertion of an inert IUD for a period of several weeks is another option to keep the uterine walls apart following adhesiolysis. However, it should be noted that none of the above methods have been shown to be effective as the studies were few in number and underpowered [12,13].

1.8.8 Outcomes

Prognosis largely depends on the stage of adhesive disease. Recurrence rate of intrauterine adhesions can be as high as one in three women with minimal to moderate adhesions, whereas two in three women with severe adhesive disease may experience recurrence. Follow-up reassessment after two to three menstrual cycles is recommended if the patient has not achieved pregnancy or has not re-established a normal bleeding pattern.

1.9 Hysteroscopic Polypectomy

Endometrial polyps are exophytic overgrowths of hyperplastic endometrial glands and stroma that are soft in consistency and present in a multitude of shapes, sizes, and numbers. Increasing age, obesity, hypertension, and diabetes are all well-known risk factors for the development of endometrial polyps. Tamoxifen use is associated with malignant transformation as well as with large (>2 cm) and multiple polyps [14].

1.9.1 Indications for Procedure

Polyps represent one of the most common etiologies of abnormal uterine bleeding in both premenopausal and postmenopausal women, but it can also be asymptomatic. Focal malignancy can occur in 1–2% of the patients [15]. However, the vast majority of polyps are benign. Endometrial polyps are also thought to adversely impact fertility, as they are space-occupying lesions that could interfere with embryo implantation [16]. In patients with unexplained infertility, current evidence supports resection of endometrial polyps and has been shown to improve assisted reproduction conception rates [17]. The natural course of endometrial polyps is largely unknown and small polyps may resolve spontaneously in 25% of the cases. However, the definitive treatment is surgical resection and is widely practiced [18]. Data regarding the relationship between hormonal therapy and endometrial polyps are contradictory; thus medical management of polyps has a limited role and is not supported by evidence.

1.9.2 Diagnosis and Treatment Guidelines

Saline infusion sonogram can be very useful for diagnosis and determining the location and shape of the lesion in comparison to transvaginal ultrasound alone. Endometrial biopsy is a basic part of the workup for abnormal uterine bleeding; however, there is low sensitivity for diagnosis of polyps when compared with direct visualization and guided resection via the hysteroscopic approach.

Typically, hysteroscopic polypectomy can be performed in the office and offers the advantage of avoiding additional IV sedation for anesthesia.

1.9.3 Pain Management

In the outpatient setting, premedication is not universally necessary. However, patients can elect to take 600 mcg of oral ibuprofen 20 minutes before the procedure.

1.9.4 Pre-Procedure Planning

It is not necessary to pre-treat patients with prostaglandins, as the small 5 mm caliber rigid hysteroscope can be advanced into the uterus without necessity of cervical dilation. No antibiotics are indicated for this type of procedure. Optimum timing for hysteroscopic procedures is during the early proliferative stage (menstrual day 4–11), as the endometrial lining is the thinnest during this time.

1.9.5 Surgical Approach

Hysteroscopic visualization of the polyp using the 5 mm rigid hysteroscope with a 12° viewing angle is the preferred modality, as blind curettage may miss the polyp and provide inadequate treatment. The polyp(s) are excised with hysteroscopic scissors and removed from the cavity with hysteroscopic grasping forceps or tenaculums under direct vision.

If multiple polyps are present, an electrosurgical loop may be more effective to achieve resection of the lesions. For infertility patients, we recommend sparse use of electrosurgery so as not to damage the underlying endometrium. In our practice, we use the resectoscope loop to bluntly lift the base of the polyp away from the underlying myometrium and activate the loop only when directly on polyp tissue. The distention medium with use of the bipolar resectoscope is isotonic electrolyte-containing fluids such as normal saline.

1.9.6 Surgical Technique

"Insert Video – Office Hysteroscopy: Polypectomy Here"

1. Place patient in the dorsal lithotomy position.
2. Perform pelvic exam to determine the position and size of the uterus.
3. Sterile prep the patient.
4. Introduce the hysteroscope vaginoscopically as described earlier.
5. Once you have entered the uterine cavity, obtain a panoramic view as polyps can be located anywhere along the endometrial cavity and can be varied in dimension and shape.
6. Advance the blunt-tipped scissors to use sharp dissection to dissect 90% of the base of the polyp off of the underlying endometrium (Figure 1.4). Introduce the hysteroscopic graspers or 5 French tenaculum to then grab the polyp and twist in a circular motion to avulse the remaining connected fibers (Figure 1.5). Directly visualize the specimen in your graspers in front of your

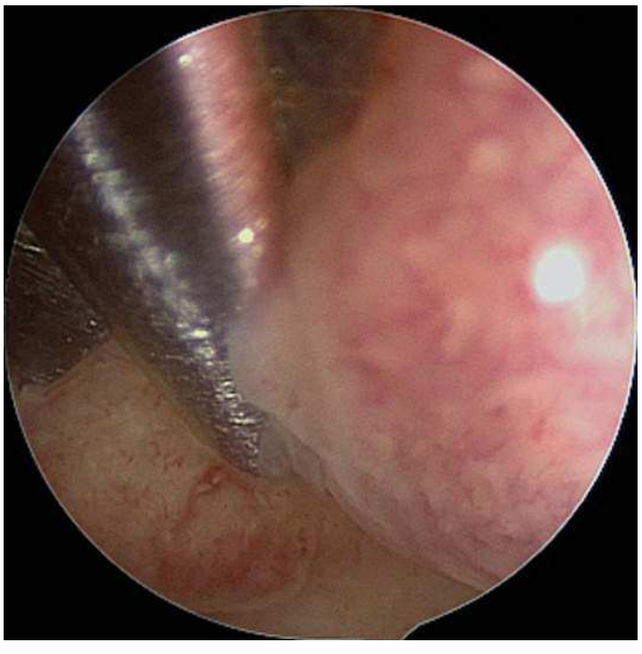

Figure 1.4 Polyp stalk is incised with scissors.

Figure 1.5 Remainder of the polyp stalk is grasped with polyp forceps and avulsed.

hysteroscopic lens as you extract the tissue. This method avoids losing the specimen in the cavity, as it is important to send it to pathology for review. Note that when utilizing a hysteroscopic morcellator device, polypectomy is then best approached from the distal end, advancing the tip of the device toward the endometrial wall as the polyp is being resected. However, unless the polyp is extremely large, this is not a cost-effective use of this device.

7. Reintroduce the hysteroscope to confirm complete removal of the polyp.

1.9.7 Outcomes

Recurrence rates vary between 2.5% and 13%, and widely depend on the length of follow-up and nature of polyp [19,20]. Among subfertile patients, the subsequent pregnancy rates can vary between 60% and 70% [21].

1.10 Hysteroscopic Myomectomy

Uterine fibroids are monoclonal tumors that derive from the myometrial layer of the uterus, and have a varied presentation depending largely on their size, number, and location. Submucous fibroids disrupt the vasculature of the endometrial lining and inhibit the uterine contractile capacity, and thus can present with heavy flow, irregular menstrual bleeding, and iron-deficiency anemia as well as issues related to recurrent pregnancy loss or infertility. Among women with abnormal uterine bleeding, a systematic review reported that 23% will have submucous leiomyomas identified as one of the contributing etiologies [22]. There are three main techniques for myomectomy: (i) monopolar and bipolar electrosurgical loops, (ii) mechanical morcellation, and (iii) vaporization, which is performed with a large surface area bipolar electrode.

1.10.1 Indications for Procedure

Fibroids are the most common benign pelvic tumors in women, and indications for transcervical resection of symptomatic submucous myomas present when they negatively impact quality of life secondary to abnormal uterine bleeding among women who desire to maintain their uterus. There is an extensive body of evidence for the deleterious effect on implantation that a submucous myoma exerts, leading to significantly decreased pregnancy rates [23]. Uterine leiomyoma are common and malignancy is very rare. For resectoscopic surgery, the incidence of malignancy has been reported to be as low as 0.13% [24].

1.10.2 Diagnosis and Treatment Guidelines

It is important to evaluate the location, size, and extent of depth into the myometrium for each fibroid either via saline infusion sonography (SIS), or a combination of diagnostic hysteroscopy with transvaginal ultrasound. SIS may not be effective when uterine distention is encumbered by enlarged fibroids (e.g., ≥14-week-sized uterus on pelvic examination). Magnetic resonance imaging (MRI) provides accurate location and size of the fibroids; however, it is expensive and not routinely indicated.

1.10.3 Pain Management

Local anesthetic blocks for this procedure such as 2% chloroprocaine without epinephrine can be utilized, but the anesthetic relief when combined with IV sedation or general anesthesia has not been well studied [25,26]. Either 15 or 30 mg of IV Ketorolac helps to mitigate postoperative cramping if the patient can tolerate NSAIDs.

1.10.4 Pre-Procedure Planning

Routine pre-operative evaluation should include pregnancy testing for reproductive-age women as well as a serum hematocrit as these patients are frequently anemic. Anticipated blood loss for these procedures does not typically exceed 100 mL. In our practice, we do not pre-treat our patients with prostaglandins or GnRH agonists. No antibiotics are indicated for this type of procedure. Optimum timing for hysteroscopic procedures is during the early proliferative stage (menstrual day 4–11), as this is when the endometrial lining is the thinnest.

1.10.5 Surgical Approach

When considering the options for transcervical approach, classification of the submucous leiomyoma into three subtypes can be useful for guidance and counseling of the patient [27]. Fédération Internationale de Gynécologie et d'Obstétrique (FIGO) put forth one of the most commonly used classification system for the extent of myometrial involvement, describing Type 0 lesions as completely within the endometrial cavity, Type I lesions as those that extend <50% into the myometrium, Type II lesions as those in which ≥50% are within the myometrium, and Type III lesions are 100% intramural and abut the endometrium but do not distort the endometrial cavity [28] (Figure 1.6). The goal of submucous myomectomy is to remove

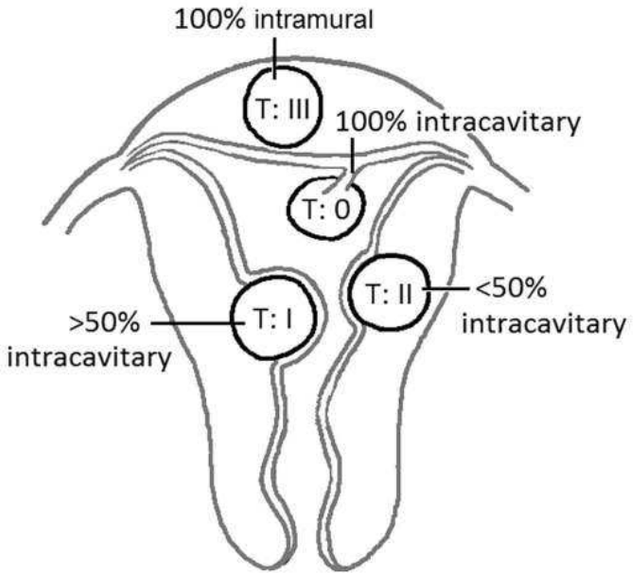

Figure 1.6 FIGO classification of myomas. (Modified from Munro MG, Critchley HO, Broder MS, Fraser IS. The FIGO Classification System ("PALM-COEIN") for causes of abnormal uterine bleeding in non-gravid women in the reproductive years, including guidelines for clinical investigation. *Int J Gynaecol Obstet*. 2011;113:3–13.)

100% of the fibroid. Complete hysteroscopic resection yields high patient satisfaction between 85% and 95%, and patients can avoid hysterectomy with few recurrences of symptoms [29]. Removal of 100% of a Type I or II myoma can be safely achieved as long as one stays within the pseudocapsule and does not cut myometrium because a fibroid (not adenomyoma) will displace myometrium and not invade it. Even myomas that extend close to the uterine serosa can be safely removed using this technique as the myometrium thickens as the myoma is resected [30].

Patients with Type III myomas should only have hysteroscopic resection by very experienced hysteroscopic surgeons. Similarly, transcervical resection of low lying is challenging in that the cervical canal often obstructs the outflow channels of the resectoscope, making visualization very difficult.

When fibroids are on opposing uterine cavity walls (either the anterior, posterior, or lateral walls of the uterus), consideration should be given to performing surgery in two stages, as intrauterine adhesions can form between the two surgical sites if opposing myomas are resected at the same surgery.

In our practice, we most often select a size 24 French bipolar resectoscope (7.5 mm diameter) with a 12° viewing angle for resection of leiomyomas. For patients who are postmenopausal and/or have a small myoma, we may select a size 22 French bipolar resectoscope (7.3 mm diameter). Patients should be counseled that a second procedure may be necessary to completely excise lesions for those with multiple fibroids, large fibroids (>3 cm), and/or those whose fibroids penetrate deeply into the myometrium. Multistage procedures are generally performed at least 6 weeks after the initial procedure.

Hysteroscopic myomectomy carries a greater risk of excess fluid absorption because breeches in the integrity of the myometrium allows fluid intravasation into the venous bed secondary to the higher hydrostatic pressures (>50 mmHg) compared to venous intravascular pressures (10–12 mmHg). It is important to follow the current fluid absorption guidelines published in 2013 by the AAGL. The key to minimizing fluid overload is to keep the intrauterine pressure at the lowest level that allows for adequate visualization. If it is feasible to keep the intracavitary pressure lower than the patient's mean arterial pressure (MAP), then the risk of significant fluid intravasation is drastically reduced. See the earlier section on "Distending Media" for further details regarding fluid management.

1.10.6 Additional Methods to Decrease Fluid Absorption

Active engagement with the anesthesiologist is important for resectoscopic cases. They should be notified that myomectomies are associated with risk of higher volumes of fluid intravasation, and that the IVF should be running at a slow infusion rate that only keeps the vein open.

1.10.7 Pre-treatment with GnRH Agonists

GnRH agonists may be administered for 2–3 months prior to hysteroscopic myomectomy to correct significant anemia as well as to reduce the size of very large myomas to facilitate surgery. In addition, GnRH agonists may decrease myometrial vascularity to help limit fluid intravasation. However, premenopausal women are more susceptible than postmenopausal women to hyponatremic hypotonic encephalopathy secondary to estrogen's inhibition of the Na^+/K^+-ATPase pump, and thus are more likely to die or have permanent brain damage [31].

1.10.8 Intracervical Vasopressin Administration

Intracervical injection of 8 mL of a dilute solution of vasopressin (0.05 U/mL of normal saline) has been shown to decrease fluid absorption during resectoscopic surgery via its primary mechanism of inducing vasoconstriction [32]. The dilute injection can be repeated at 20-minute intervals. Avoid intravascular injection, as systemic absorption can result in vagal-mediated bradycardia as well as coronary artery vasospasm provoking cardiac arrest. In situations of cardiac arrest, chest compressions should be initiated along with 1 mg epinephrine, 0.5 mg of atropine as well as 100% oxygen. Do not exceed the maximum dosage of approximately 5 U of Vasopressin.

1.10.9 Surgical Technique

"Insert Video –Hysteroscopic Myomectomy Here":

1. Place the patient in the dorsal lithotomy position.
2. Perform pelvic exam to determine the position and size of the uterus.
3. Sterile prep the patient.
4. Insert an open-sided speculum into the vaginal vault. Grasp the anterior lip of the cervix with a single-toothed tenaculum and place tension on the tenaculum in order to straighten the axis of the uterus into a midline position.

5. Gently dilate the cervical canal up to the diameter that is equivalent to the hysteroscopic sheath in order to prevent inadvertent uterine perforation, cervical laceration, or creation of a false passage. Overdilating the cervix may make it difficult to maintain adequate distention.
6. Introduce the resectoscope into the endocervical canal with your dominant hand, and utilize the other hand to straighten the cervix with traction on the single-tooth tenaculum with your index finger placing countertension on the cervix as you advance into the cavity in order to prevent tearing of the cervix by the tenaculum. Drop your hand toward the ground to keep the internal os centered at the 12 o'clock position in order to avoid digging the scope into the posterior wall of the endocervical canal. Do not advance the scope with force if you are met with resistance as this can result in formation of a false passage. Successful entry into the cavity is achieved by placing one hand on the light cord and the other on the camera while rotating the entire scope back and forth between 4 o'clock and 8 o'clock positions and advancing gently along the axis of the cervical canal.
7. Once you have entered the uterine cavity, obtain a panoramic view and locate the lesions present. Take a systematic approach and note if bilateral ostia are visible.
8. Controlled variation of the intracavitary pressure is an important step throughout the procedure. Initially, briefly decreasing the pressure will allow for better identification of the lesions as higher pressure may obscure them by compressing them into the myometrium. Further along in the procedure, making special note of the intracavitary pressure in relationship to the patient's MAP will be important. The goal is to keep the distention of the cavity adequate enough for resection with as minimal pressure required so as to diminish the amount of fluid intravasation.
9. Readjust your hands so that you are now holding the camera head steady with your non-dominant hand, and with your dominant hand hold the working element of the resectoscope with your thumb and third finger in the handles of the scope.
10. Place your foot comfortably next to the pedal that actives the electrode of the loop. Begin by opening the handles to extend the loop of the resectoscope out into the uterine cavity, and place the loop squarely behind the fibroid. Be aware of the space behind the fibroid and the proximity of the surrounding uterine walls to avoid inadvertent injury to the normal endometrium. Slowly bring the loop slightly toward the lens by closing the handles without applying current. This enables you to have countertension placed on the lesion and ensures you are in the correct position prior to initiating energy for resection. Next, activate the cutting current and continue closing the handles to bring the loop towards the lens in a linear motion until you have reached the edge of the fibroid (Figure 1.7). You should visualize the fibroid as dense, white fibers that are distinct from the appearance of the surrounding pink myometrium. Shave evenly and systematically along the fibroid in a unidirectional fashion (e.g., from left to right), with care to avoid tunneling in one place.

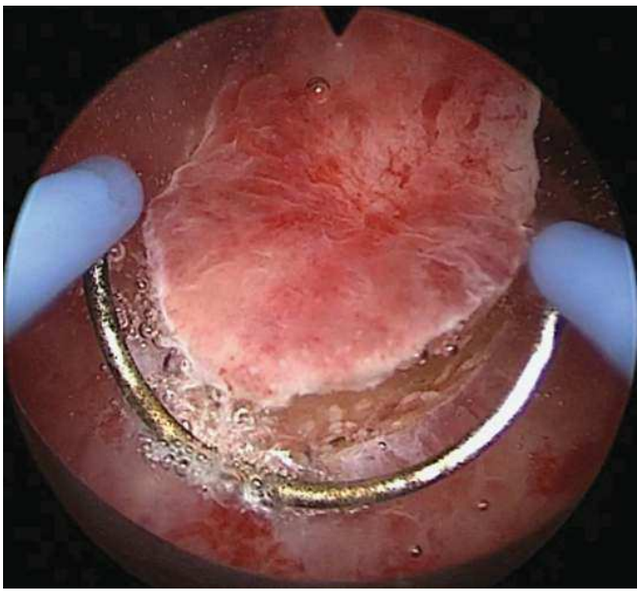

Figure 1.7 The endometrium over the myoma is resected to reveal the myoma.

11. The pseudocapsule provides an excellent guide to the boundaries of the myoma. Using your inactive loop, extend it to gently tease out the edges of the cleavage plane of the pseudocapsule to release its fibers connecting it to the surrounding myometrium (Figure 1.8). Note the depth of the previous resections you have made with each swipe of the loop. Deeper resections can be attained by dropping your hand slightly toward the ground while bringing the loop toward the lens, keeping in mind that the consequence of going too deep is perforation (Figure 1.9). Also note that when encountering fibroids that are large, it may require that you move in a synchronized fashion in which you bring the entire scope toward you while simultaneously closing the handles of the working element to bring the loop toward the lens. In effect, you are able to successfully shave more surface area of the fibroid than when moving only the loop in isolation. Never resect with a motion that pushes forward with the loop activated, as this can result in perforation with significant damage to surrounding organs secondary to application of thermal energy.
12. During your resection, transected myometrial vessels will bleed into the cavity. If you are using a bipolar resectoscope, you can choose to selectively arrest the bleeding by approximating the edge of your loop to the bleeder and briefly activating the coagulation current (Figure 1.10).
13. You will encounter chips and air bubbles that compromise adequate visualization. When you encounter a bubble in front of your view, turn your entire scope 180°sideways quickly to see if this dislodges it. If you encounter a larger buildup of bubbles, turn off your inflow, rotate your entire

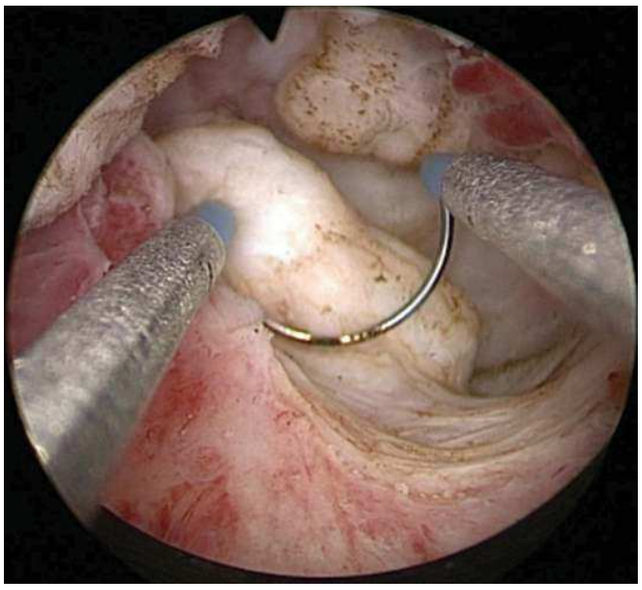

Figure 1.8 The pseudocapsule is identified by pushing up on the edge of the myoma with the resectoscope loop without applying current.

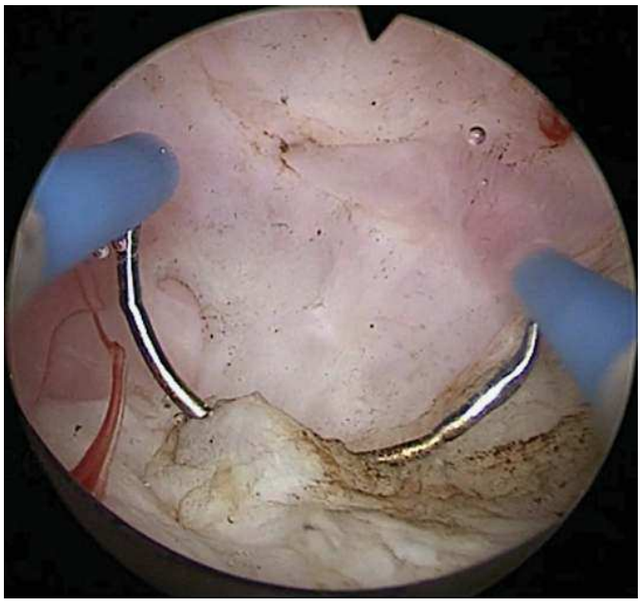

Figure 1.9 The myoma is resected with cutting current.

scope 180°, and fully open your outflow in order to extract the bubbles. Chips should be removed by grasping them firmly in your loop as you close your hand and slowly extract the instrument. Be certain to directly visualize the chips in your loop as you extract the instrument to avoid losing the specimens in the cavity, as it is important to send chips to pathology for review. Many choose to keep the inflow running while extracting chips for sake of efficiency. If a chip is stuck onto your loop, bring your loop into the center of the cavity, ensure clear space

Figure 1.10 Bleeding vessels are sealed with coagulating current.

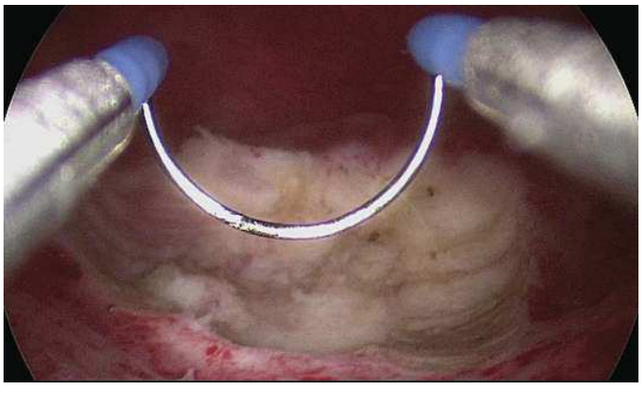

Figure 1.11 The myoma has been completely resected to normal myometrium.

surrounding, and activate the electrode of the loop to dislodge the chip.

14. When reinserting the scope after resection has begun, the cavity is often full of blood clots and visualization is hampered. Advancing the scope to the fundus allows for quick identification of this landmark as well as clearing of your view. Whenever the resectoscope is advanced through the cervix, the outflow should be on so as not to "piston" air into venous sinuses thus reducing the risk of air embolization.
15. You can consider the fibroid completely resected when only myometrial tissue is seen at the base of the surgical site (Figure 1.11).
16. While extracting the hysteroscope, evaluate the endocervical canal.

1.10.10 Postoperative Management

Long-term studies indicate that transcervical resection of myomas has a high rate of success, i.e., >94% [29]. Rates of requiring a second surgery are related to the overall size of the fibroid, depth of myometrial invasion, as well as location and number of fibroids. In addition, comorbid conditions such as adenomyosis can result in persistent abnormal uterine bleeding that may result in subsequent hysterectomy for definitive treatment.

1.11 Complications of Operative Hysteroscopy

- Uterine perforation
- Fluid overload
- Heavy bleeding
- Infection
- Intrauterine adhesions

1.11.1 Uterine Perforation

The incidence of uterine perforation is 0.014% for hysteroscopic procedures. Known risk factors for uterine perforation due to traumatic entry are menopause, cervical stenosis, retroversion, and nulliparity. Signs and symptoms of uterine perforation include sudden increase in fluid deficit and loss of adequate intracavitary distention. It can result in bleeding and potentially significant injury to surrounding organs. Management of perforations is dependent on the location of the perforation and whether or not any energy (including mechanical shavers) was used. If thermal or mechanical injury of surrounding viscera is a possibility, a diagnostic laparoscopy is mandated. If the perforation is fundal and blunt as occurs during initial dilation of the cervix, then observation with discontinuation of the case is recommended. Lateral injuries incite concern for possible formation of broad ligament hematoma from vascular injury. If the perforation is anterior, hematuria may result and use of cystoscopy can aid in a thorough evaluation of the bladder.

1.11.2 Fluid Overload

The incidence of fluid overload is between 1.6% and 2.5%. Excess fluid absorption is one of the most common complications associated with hysteroscopic procedures. Careful observation of fluid deficit as well as thoughtful consideration of the distention media used is important for patient safety. Use of an electronic fluid management system is encouraged. See "Distention Media" section earlier for further details.

1.11.3 Heavy Bleeding

In the majority of cases, myometrial contraction is sufficient to arrest the bleeding postoperatively and heavy bleeding is uncommon after hysteroscopic surgery. Should it occur, prompt recognition and active management is essential. Intracervical injection of a prostaglandin F2α analog known as Carboprost or Hemabate can result in uterine contraction with subsequent decrease in uterine bleeding. If heavy bleeding persists, placement of a Foley catheter into the uterine cavity and inflating the balloon with 30 cc of saline can be used to effectively function as a tamponade. The balloon can be deflated and the Foley removed after the bleeding has subsided for 4 hours. In instances where bleeding persists despite the above interventions, consider consultation with interventional radiology for uterine artery embolization.

1.11.4 Infection

The incidence of infection is 0.01–1.6% of hysteroscopic cases. There is currently no established role for prophylactic antibiotic administration at this time.

1.11.5 Intrauterine Adhesions

When lesions on opposing sides of the uterine cavity (either the anterior, posterior, or lateral walls of the uterus) are resected simultaneously, adhesion formation has been noted in the postoperative period. Examining the cavity with office hysteroscopy 6 weeks after surgery in such instances can be useful both for diagnosis as well as treatment by bluntly lysing the adhesions with the tip of the hysteroscope.

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