Management of Uterine Fibroids

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Abstract

Uterine fibroids are the most common tumors of the female reproductive tract. It is estimated that the incidence of fibroids by age 35 reaches 40% for Caucasian women and 60% for African American women (Baird and Dunson 2003). Most women with fibroids are asymptomatic; however, symptomatic fibroids remain the most common indication for hysterectomy. In 2010, approximately 196,735 hysterectomies were performed for fibroids in the United States (Wright et al., Obstet Gynecol 122(2 Pt 1):233–241, 2013).

The location of fibroids in the uterus will often determine the type and severity of symptoms a woman will experience. The most common presenting symptoms include infertility, heavy menstrual bleeding, bladder pressure, and pelvic pressure. A thorough history and physical examination along with appropriate imaging can help the clinician tailor the treatment options to improve a patient's symptoms. As such, the management of fibroids is highly variable.

Expectant management of fibroids is a reasonable option for women who are asymptomatic or not bothered by their symptoms. Medical management can be used for patients desiring to avoid surgery or in preparation for surgery. The surgical management of symptomatic fibroids is broad and includes endometrial ablation, laparoscopic cryomyolysis, laparoscopic uterine artery occlusion, laparoscopic radiofrequency volumetric thermal ablation (LRVTA), myomectomy (abdominal, laparoscopic, or hysteroscopic), and hysterectomy. Radiology-based management options include uterine artery embolization (UAE) and MRI-guided focused ultrasound. Both the UAE and the MRI-guided focused ultrasound require consultation with radiologists.

Despite treatment options available, it is important for the clinician to recognize that not all fibroids require intervention. Counseling patients that fibroids do not have oncogenic potential may also help reassure them and guide their decision-making. Expectant management of fibroids in a stable woman is often an acceptable choice.

Keywords

Fibroids • GnRH agonist • Levonorgestrel intrauterine device • Mifepristone • Myomectomy • Morcellation • Hysterectomy • Endometrial ablation • Hysteroscopy • Uterine artery occlusion • Laparoscopic radiofrequency volumetric thermal ablation •

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1 Introduction

1.1 Pathology and Epidemiology

Fibroids are benign tumors of the myometrium. They are comprised of smooth muscle and contain large amounts of collagen, fibronectin, elastin, and proteoglycan (Leppert et al. 2006). They are surrounded by a pseudocapsule made of compressed smooth muscle and areolar connective tissue. In certain studies, fibroids have been detected in up to 77% of all uteri removed during hysterectomy (Cramer and Patel 1990).

1.2 Risk Factors

Epidemiological studies have demonstrated certain risk factors for fibroid development. Increasing age is associated with increased probability of developing fibroids. It is estimated that the incidence of fibroids by age 35 reaches 40% for Caucasian women and 60% for African American women. By age 50, the incidence reaches 70% for Caucasian women and 80% for African American women (Baird and Dunson 2003). Race also plays a role in the development of fibroids, as African American women are more likely to be diagnosed with fibroids approximately 5 years earlier than white women (Huyck et al. 2008). The exact mechanism is still unknown, although it could be related to differences in estrogen levels, diet, and environmental exposures (Marshall et al. 1997).

Family history also plays a role in the development of fibroids, as women with a first degree relative with fibroids have a 2.5 times increased risk of developing fibroids themselves (Vikhlyaeva et al. 1995). Overweight women have a 21% increased risk of having fibroids for every 10 kg increase in body weight (Ross et al. 1986).

Certain factors are thought to be protective from the development of fibroids and include late menarche, exercise of 7 h per week, increasing parity, and tobacco use (Baird et al. 2003, 2007; Lumbiganon et al. 1996; Marshall et al. 1998; Michnovicz et al. 1986; Parazzini et al. 1996).

1.3 Oncogenic Potential

Fibroids do not have oncogenic potential. They are monoclonal tumors that arise from myometrial smooth muscle and are genetically different from sarcomas. Genomic hybridization studies comparing sarcomas and fibroids have not found any shared anomalies between the two (Quade et al. 2004). There are certain leiomyoma variants that can demonstrate atypical behavior, but these tumors have a distinct histology and are not thought to originate from benign, typical fibroids. This becomes particularly relevant for women who opt for expectant management of their fibroids, as they should be counseled that their fibroids would not become cancerous if left untreated.

1.4 Effects on Fertility and Pregnancy

Intramural and subserosal fibroids have not been shown to adversely affect fertility. In a study examining the use of hysteroscopy to assess cavity distortion from intramural and subserosal fibroids, there was no improvement in ongoing pregnancy rates or live birth rates after removal of intramural and subserosal fibroids (Pritts et al. 2009). In this same study, however, women

with submucous fibroids had a 70% decrease in pregnancy and live birth rates, which slightly improved after resection. This data is important to consider when counseling patients who desire fertility and have a fibroid uterus, as improvement in fertility rates remains contingent upon the location of the fibroids.

Currently, there is no high-quality data to confirm the effects of fibroids on pregnancy; however, available data suggests that most women with fibroids will have normal pregnancy outcomes (Segars et al. 2014). Because of the relative paucity of data, it is not recommended that women with incidentally discovered fibroids undergo a myomectomy as part of preconception preparation.

2 Management of Uterine Fibroids

2.1 Clinical Evaluation

The goal of fibroid management and treatment is to improve overall quality of life, as their presence is rarely associated with any life-threatening emergencies. As such, a thorough evaluation of each patient will allow the clinician to provide treatment specific to a woman's symptoms and goals.

2.1.1 Patient History

Evaluation of fibroids begins with evaluation of symptoms, which can often give clues as to the location of the fibroids. The most common presenting symptom for women with fibroids is heavy menstrual bleeding. The degree to which the patient has heavy bleeding is typically related to the location of the fibroids. Submucosal fibroids are the most highly associated with heavy bleeding and are also more likely to cause symptomatic anemia (Puri et al. 2014). The mechanism for this is likely due to fibroid deregulation of certain factors that affect angiogenesis, which in turn leads to the formation of abnormal vasculature that is more likely to cause bleeding (Stewart and Nowak 1996). Fibroids may also cause disrupted uterine contractions and impaired clotting mechanisms. Because the relationship between fibroids and heavy bleeding is variable, however, it is recommended that all women who present with abnormal uterine bleeding receive a full work-up, including screening for coagulopathies and other endocrinopathies. Because fibroids are not often associated with inter- menstrual and postmenopausal bleeding, women with these symptoms should undergo evaluation for underlying malignancies.

The relationship of fibroids to pain has not been clearly established in the literature. In a study evaluating 635 asymptomatic women to determine the presence of fibroids via transvaginal ultrasound, the 96 women who had fibroids were only slightly more likely to complain of cyclic pelvic pain and dyspareunia compared to those without fibroids (Lippman et al. 2003). The women with fibroids were also no more likely to have dysmenorrhea than women without fibroids. Pedunculated fibroids that have torsed on their stalk can cause acute pain, which often requires surgical intervention. Fibroid degeneration is also associated with pelvic pain. Enlarging fibroids may outgrow their blood supply, which leads to cell necrosis and death. This process can often be successfully managed with NSAIDS and expectant management.

Fibroids can be associated with pelvic pressure, bladder symptoms, and bowel complaints. Data looking at the effects of uterine artery embolization (UAE) on bladder symptoms demonstrated a 35% reduction in mean uterine volume with a 86% improvement in urinary frequency and urgency (Pron 2003). A separate study looking at women treated with GnRH agonist for 6 months demonstrated a 55% decrease in uterine volume with an additional decrease in urinary frequency, urgency, and nocturia (Langer et al. 1990). It is unclear from this data, if the symptom improvements were related to the medication or reduction in fibroid size.

As mentioned earlier, patients with submucous fibroids can present with infertility. Thus, women presenting with infertility as a complaint should be evaluated for intracavitary pathology with saline sonohysterogram, MRI, or hysteroscopy as part of their work-up.

There is no evidence to show that "rapid uterine growth," defined by uterine growth of 6-week size in 1 year, correlates with the presence of sarcoma. In one study evaluating the incidence of sarcoma in patients presenting with rapid growth, one of 371 patients were found to have sarcoma (Parker et al. 1994). A reanalysis of the pathologic criteria used for this study found that this one patient had, in fact, an atypical leiomyoma rather than a leiomyosarcoma. Patients presenting with "rapid uterine growth" merit thorough evaluation, but this finding does not imply cancer.

2.1.2 Physical Examination

Physical examination of patients with fibroids can often reveal size and location of fibroids and is essential when considering treatment options and planning a surgical approach.

Even for women with a BMI >30 cm/kg, a bimanual exam to assess uterine size has been shown to correlate well with the actual pathologic size and weight of the uterus (Cantuaria et al. 1998). Most clinically significant subserosal and intramural fibroids will be detected as bulky and irregularly shaped on physical examination (ACOG 2000).

As part of the evaluation, the clinician should assess the location of the top of the fundus. This will help determine the type of skin incision that is used for laparotomy or whether placement of an umbilical port would be feasible during laparoscopy. It is also important to determine how broad the uterus palpates in relationship to the pelvic sidewall. If the fibroid uterus feels very broad and difficult to be elevated off the sidewall, laparoscopic surgery may be more technically difficult.

2.1.3 Imaging

Imaging should be included as part of the evaluation of uterine fibroids. The most commonly used imaging modalities for fibroids are transvaginal ultrasound, saline-sonohysterography (SSH), and magnetic resonance imaging (MRI). In one study evaluating the preoperative use of transvaginal ultrasound, SSH, hysteroscopy, and MRI in patients who were scheduled to undergo hysterectomy for symptomatic fibroids, MRI was 100% sensitive and 91% specific at detecting submucosal fibroids (Dueholm et al. 2001). Transvaginal ultrasound had 83% sensitivity and 90% specificity, SSH had 90% sensitivity and 89% specificity, and hysteroscopy had 82% sensitivity and 87% specificity. MRI provides the additional benefit of identifying adenomyosis and adenomyomas (Dueholm et al. 2002a, b). Focal areas that appear not well delineated and that have high or low intensity signals within the myometrium are very characteristic of adenomyosis.

Of the above imaging modalities available for evaluation of fibroids, ultrasound continues to be the least expensive and most accessible. Fibroids on ultrasound appear as regularly shaped, hypoechoic masses. For uteri <375 cc with 4 or less fibroids, it is considered a very accurate imaging modality (Dueholm et al. 2002a).

When available, MRI provides greater accuracy for characterization of fibroids and is an essential tool for preoperative planning. The MRI is useful in assessing location of the fibroids in relation to the bladder, bowel, and pelvic sidewall. It can help differentiate between a submucosal versus intramural fibroid and can help assess the relationship of the fibroids to the endometrium – this can determine the best surgical approach. Intraoperatively, the surgeon can use the findings on the MRI to ensure that he or she has not left behind fibroids that may have otherwise gone undetected.

As a final tool, the MRI is also important in helping to better characterize a fibroid as benign or malignant. Sarcomas on MRI may show increased vascularity and increased enhancement with Gadolinium. This can be distinguished from degenerating fibroids, which have decreased perfusion and enhancement. The results of the gadolinium-enhanced dynamic MRI, combined with results of LDH and LDH-3 isoenzyme, have been used to very accurately diagnose sarcoma in patients with uterine masses (Goto et al. 2002). In that study, the combined use of LDH and MRI revealed 100% specificity, 100% positive predictive value, and 100% negative predictive value for assessing the presence of sarcoma. However, other studies have found lower predictive values.

2.2 Expectant Management

Fibroids are not precancerous tumors and are rarely a surgical emergency. The treatment of fibroids is geared toward improving quality of life, and as such there is a strong role for expectant management.

Women who opt for expectant management should be aware of what to anticipate in terms of growth and symptoms if their fibroids are left untreated.

In one prospective study looking at 72 reproductive-aged women, serial MRI results revealed a median growth rate of the fibroids of about 9% over a 6 month interval (Peddada et al. 2008). Not all the fibroids grew at the same rate, even when examining multiple fibroids in the same patient. In that same study, the rate of fibroid growth after age 35 decreased with time in Caucasian women. Importantly, the rate of growth did not slow down for African American women.

Some data suggests that in older, premenopausal women, fibroids can spontaneously regress if left untreated. Estimating a rate of regression for an individual patient is difficult, however, as it appears to be most contingent upon patient age and race. Although not well documented, some evidence shows that fibroids regress following menopause (Ross et al. 1986).

As mentioned, "rapid uterine growth," is not suggestive of uterine cancer. Patients with sarcoma are usually older, and often present with abdominal and pelvic pain, vaginal bleeding, and worrisome imaging. In one analysis of the SEER database between 1989 and 1998, the average age of women diagnosed with sarcoma was about 63 years old. The average age of women undergoing myomectomy was 36 years old (Brooks et al. 2004; Parker et al. 1994). While there are currently no accurate screening tools for uterine sarcoma, a complete history, accompanied by appropriate labs and imaging, can help guide the clinician's suspicion for cancer and counsel the patient accordingly.

Women for whom expectant management would not be appropriate are those with symptomatic anemia due to excessive abnormal uterine bleeding, women who develop obstructive hydronephrosis due to ureteral compression, and women who develop venous compression with subsequent clot formation from fibroids.

2.3 Medical Management

2.3.1 NSAIDS

Currently, there is no data to suggest that NSAIDs decrease the amount of blood loss caused by fibroids. NSAIDs have also not been shown to affect fibroid size or pressure symptoms. While they may be helpful in the management of dysmenorrhea, NSAID therapy is not an appropriate treatment for women who present with abnormal uterine bleeding or pelvic pain secondary to fibroids. NSAID therapy is very effective in the management of women with pain from fibroid degeneration.

2.3.2 GnRH Therapy

Of the medical treatments available to women, GnRH agonists have been shown to be the most effective, short-term option. GnRH agonists function by causing an initial upregulation of gonadotropins, followed by a downregulation, inducing a temporary state of menopause. It is administered as an intramuscular injection and is available in two doses: 3.75 mg IM every month or 11.25 mg IM every 3 months. Data has shown that 6 months of treatment with GnRH agonists can improve heavy bleeding, reduce fibroid size by approximately 30%, and decrease overall uterine volume by 35% (Schlaff et al. 1989). This reduction in size is most appreciated in the first 3 months of treatment, and a majority of women will have improvement in their bleeding profile by 6 months (Friedman et al. 1991).

The most common side effects of GnRH therapy include hot flushes, vaginal dryness, and frontal headaches. Other less common symptoms include loss of libido, arthralgias, myalgias, insomnia, emotional lability, edema, and depression. Treatment for longer than 6 months may be associated with loss of bone density. Addition of progestin therapy such as norethindrone may help improve symptoms without affecting the induced amenorrhea or fibroid shrinkage. While a majority

of women will choose to remain on therapy for a short treatment course despite these symptoms, patients should be counseled on what to expect prior to initiation of treatment (Leather et al. 1993).

Peri-menopausal or late reproductive aged women may be most likely to benefit from this therapy. Initiation of GnRH agonist treatment can be used by providers to medically induce an earlier menopause in these patients until natural menopause occurs. Younger, reproductive-aged women who are further away from menopause are likely to re-develop their symptoms after discontinuation of treatment, often demonstrating rebound bleeding and fibroid growth. It is therefore not considered an effective long-term option for these patients. However, this therapy may be considered for either group of patients prior to surgical treatment to reduce fibroid size.

2.3.3 Levonorgestrel Intrauterine Device

Observational studies have shown that the levonorgestrel intrauterine device appears to be effective in management of abnormal uterine bleeding secondary to uterine fibroids. In one study, nearly 85% of women with abnormal uterine bleeding secondary to fibroids developed a normal bleeding pattern after 3 months of treatment, and by 12 months approximately 40% of women had amenorrhea (Grigorieva et al. 2003). Currently, the levonorgestrel intrauterine device is approved for the management of heavy menstrual bleeding.

Appropriate candidates for this treatment are thought to be women with fibroids <5 cm diameter and those with fibroids that are less than 50% intracavitary (Soysal and Soysal 2005). The presence of intracavitary fibroids is considered a relative contraindication to placement of the device. Women with large, bulky fibroids that distort the endometrial cavity should be counseled that they may have a higher rate of expulsion due to distortion of the endometrial cavity.

2.3.4 Mifepristone

Other progestin treatment that has been evaluated includes progesterone antagonists. In one study, use of mifepristone was associated with an almost 50% reduction in uterine size after 6 months (Steinauer et al. 2004). However, because mifepristone causes a state of unopposed estrogen, it can be associated with development of endometrial hyperplasia. In one systematic review of the effects of mifepristone on uterine fibroids, the rate of simple endometrial hyperplasia diagnosed by biopsy was 28%. There were no cases of atypical hyperplasia. It is currently not considered standard medical treatment for management of symptomatic fibroids.

2.3.5 Ulipristal Acetate

Ulipristal acetate is a progesterone receptor modulator. Unlike mifepristone, it does not induce a state of unopposed estrogen and as such has little effect on serum estradiol levels.

European studies assessing the effects of preoperative ulipristal acetate treatment on women with heavy bleeding and uterine size less than or equal to 16 weeks demonstrated a significant reduction in bleeding after 3 months (Donnez et al. 2012). A 12–21% reduction of uterine size was also noted. No hyperplasia was found in patients treated with the ulipristal.

Ulipristal acetate is not currently available in the United States at the same doses used in the above studies and as such is not used for the preoperative treatment of fibroids and bleeding.

2.4 Surgical Management

The surgical management of fibroid symptoms is broad and includes myomectomy, laparoscopic radiofrequency volumetric thermal ablation (LRVTA), laparoscopic uterine artery occlusion, endometrial ablation, and hysterectomy. Preoperative history and examination, imaging, surgeon skill, and patient preferences will determine which option is best for each patient.

Appropriate preoperative planning is an essential component for intraoperative preparedness. For patients presenting with severe anemia secondary to heavy vaginal bleeding, preoperative correction of anemia is recommended. Depending upon the patient's level of acuity, iron supplementation can be given either orally or as an intravenous infusion. An intravenous infusion of iron

1000 mg is often sufficient to treat preoperative anemia and replete iron stores without causing overload. Hemoglobin levels start to rise in 2–3 weeks, and the deficit is usually halved after 1 month of treatment. Levels should return to normal within 6–8 weeks after treatment.

Recombinant erythropoietin can also be administered preoperatively for patients who present with significant anemia. Data from cardiac, orthopedic, and neurologic surgery has shown that administration of recombinant erythropoietin for 3 weeks prior to surgery can significantly increase hemoglobin rates and decrease the subsequent need for transfusion (Wurnig et al. 2001).

As mentioned in the Medical Management section of this chapter, GnRH agonists can also be used to improve preoperative hemoglobin and to decrease fibroid and uterine size. Data assessing the preoperative treatment of patients with iron and GnRH agonists demonstrated a significant improvement in hemoglobin levels after 3 months compared to women receiving only iron with a placebo (Stovall et al. 1995). Further data suggests that preoperative treatment with a GnRH agonist for 3–4 months prior to abdominal myomectomy can significantly reduce the amount of intraoperative blood loss (Lethaby et al. 2002).

2.4.1 Myomectomy

Surgical options for removal of fibroids within the uterus include abdominal, laparoscopic or robotic, and hysteroscopic myomectomies. Myomectomy is an appropriate option for women who desire uterine preservation and should be offered to patients who desire surgical management of their fibroids. One study comparing intraoperative risks of myomectomy versus hysterectomy found that while myomectomy was associated with longer operative times (200 vs. 175 min), there was a higher estimated blood loss in the hysterectomy group (484 vs. 227 mL) (Sawin et al. 2000). Performing a myomectomy largely avoids dissection of bladder and retroperitoneal structures and as such is considered a safe alternative to hysterectomy.

Medical techniques to decrease intraoperative blood loss may help the surgeon safely remove even very large fibroids. In one randomized controlled trial, misoprostol administered 2 h prior to surgery was shown to significantly decrease intraoperative blood loss (Kaligiannidis 2011). Use of perioperative tranexamic acid has also shown to reduce intraoperative blood loss by up to 40% (Shaaban et al. 2015). Intraoperative use of vasopressin, an anti-diuretic hormone, via injection into the fibroid pseudocapsule can also be used to decrease intraoperative blood loss during myomectomy (Frederick et al. 1994). Mechanical constriction of the uterine arteries, ovarian vessels, and utero-ovarian ligaments via tourniquets and clamps may also decrease the amount of blood loss during the myomectomy.

Another method used to decrease need for heterologous blood transfusion is employment of a cell- saver device. By suctioning blood from the operative field and storing the blood with heparin and saline in a canister, this blood can be returned to the patient if they require intraoperative transfusion. Returning the patient's own blood reduces the risk of transfusion reaction and infection (Yamada et al. 1997).

Regardless of the route of myomectomy, patients should be counseled on the risk of development of new fibroids after surgery. It is estimated that if a woman only has one fibroid present at the time of surgery, her risk of requiring a repeat surgery for a new appearance of fibroids is approximately 11% (Malone et al. 1969). If a woman has multiple fibroids at the time of her surgery, her risk of requiring a repeat surgery for a new appearance is approximately 26%. This data is important to review with patients, as they may opt for definitive management via hysterectomy instead of myomectomy if they are concerned about the possibility of repeat surgery.

Abdominal Myomectomy

Appropriate candidates for an abdominal myomectomy can include patients with numerous very large fibroids, patients in whom the fibroids are palpated to be heavily resting on the pelvic sidewall, and patients who desire fertility with fibroids that are largely abutting the endometrium.

The uterine incisions made during a myomectomy can be either vertical or horizontal, as neither direction has been found to decrease the

amount of blood loss during the procedure. Planning of the location of the incisions is important, as unanticipated extension of incisions into the cornua could lead to distortion of anatomy.

Post-operative recovery time following laparotomy is longer than with minimally invasive surgery. Patients should plan to spend 2–3 nights in the hospital. Pain control can be accomplished through intravenous narcotics, oral narcotics, NSAIDs, and continuous infusion of bupivacaine at the incision site via an elastomeric pump. Early ambulation, early introduction of regular diet, and decreased amount of time with a urine catheter can help the patient have a normal recovery and reduce complications such as deep venous thrombosis and urinary tract infections.

Laparoscopic and Robotic Myomectomy

Patients with numerous, large fibroids may also be candidates for laparoscopic myomectomy. The size and location of the fibroids, the patient's fertility goals, and the surgeon's level of skill with laparoscopic suturing should determine whether the fibroids can be safely removed laparoscopically. Patients desiring fertility with fibroids abutting the endometrium can also have a laparoscopic myomectomy; however, decreased haptic feedback during laparoscopy may increase the possibility of endometrial damage.

Removal of fibroids from the abdominal cavity in a laparoscopic myomectomy requires morcellation of the specimen. Morcellation can be accomplished via manual morcellation at one of the trocar sites, extension of a laparoscopic incision and manual morcellation via this incision, and power morcellation. Power morcellation involves the use of a specialized, circular blade that cuts the specimen into small pieces for removal via a small laparoscopic incision. All of these methods can employ the use of an endoscopic bag, into which smaller pieces of the fibroid may fall.

The use of laparoscopic power morcellation has recently been brought to question by the United States Food and Drug Administration (FDA). Based upon a case report of a poor outcome for a patient who underwent laparoscopic power morcellation of an undiagnosed sarcoma, the FDA initiated an investigation of the incidence of sarcoma in women undergoing this procedure. A limited literature review conducted by the FDA revealed that for every 458 women having surgery for presumed fibroids, one will have an unsuspected leiomyosarcoma (FDA Safety Communication). Subsequent studies have revealed much lower estimates, showing that the prevalence of leiomyosarcoma among women undergoing surgery was 1 in 1960 (Pritts et al. 2015). A study conducted to evaluate the effects of the FDA warning on surgical practice and patient outcomes demonstrated a significant decrease in laparoscopic hysterectomy with subsequent increase in vaginal and abdominal hysterectomy in the first 8 months after the FDA warning, with subsequent increase in surgical complication rates (Harris et al. 2016). Clinicians should complete a thorough preoperative evaluation of all women who may undergo laparoscopic fibroid removal, and the patient should specifically be consented for the use of power morcellation.

Hysteroscopic Myomectomy

Patients with suspected intracavitary or submucous fibroids should be evaluated for hysteroscopic myomectomy. Success and safety of the procedure is determined by assessing the type of submucous fibroid, using Federation of Gynecology and Obstetrics (FIGO) classification system. Class 0 fibroids are defined as being entirely in the endometrial cavity. Class I fibroids extend less than 50% into the myometrium. Class II fibroids extend greater than 50% into the myometrium (Munro et al. 2011). Patients with Type 0 and Type I submucosal fibroids can be appropriate candidates for hysteroscopic resection.

There is no established fibroid size cut off for performing hysteroscopic myomectomy. However, patients are more likely to have successful removal of the entire fibroid in one procedure if the fibroid is less than 3 cm (Hart et al. 1999). Larger fibroids can be removed via hysteroscopy; however, the patient should be counseled that it could require two procedures if rising fluid deficits do not allow enough time for complete removal.

Vasopressin can also be used during a hysteroscopic myomectomy to decrease blood loss. For a hysteroscopic myomectomy, the vasopressin is injected into the cervical stroma, which can cause significant reduction in intraoperative blood loss (Wong et al. 2014). Care should be taken to avoid intravascular injection as this has been reported to cause hypertension, bradycardia, and morbidity.

Risks of hysteroscopy include excessive intravascular absorption of distension media, which can cause electrolyte imbalances, pulmonary edema, cerebral edema, cardiac failure, and even death. It is generally recommended to terminate a hysteroscopic procedure once the fluid deficit reaches 1500 mL of a nonelectrolyte distention media or 2000 mL of an electrolyte-positive distension media (Loffer et al. 2000). For this reason, it can be more difficult to remove larger fibroids >4 cm in one procedure, as this is often associated with longer operative time, more intravascular absorption of fluid through the exposed myometrial bed, and subsequent higher risk of excessive fluid deficit.

2.4.2 Laparoscopic Radiofrequency Volumetric Thermal Ablation (LRVTA)

More recent technology for the minimally invasive management of fibroids includes the use of laparoscopic radiofrequency volumetric thermal ablation (LRVTA). In this procedure, a laparoscopic ultrasound transducer is introduced into the abdomen via a trocar to map out the location of fibroids. A radiofrequency hand piece containing a seven-needle electrode is also introduced and using the ultrasound transducer to locate the exact position of the fibroids, the hand-piece deploys the electrodes into the fibroid to deliver a continuous, alternating current (Chudnoff et al. 2013). LRVTA candidates include women who are pre-menopausal, with 6 or fewer fibroids, none of which exceeds 7 cm, who have heavy menstrual bleeding, who have completed child bearing, and who do not have an active coagulopathy. In addition, patients should be counseled that the results are not immediate – as such, good candidates also include women who are amenable to waiting months to years to see results. Inappropriate candidates include women with adenomyosis as seen on MRI, women with pedunculated or submucosal fibroids, and women with a history of gynecologic cancers or who may have cervical dysplasia.

Data looking at changes in bleeding pattern as well as fibroid size in 135 women who underwent the procedure have demonstrated an improvement in menstrual blood loss and a decrease in fibroid size by approximately 45% as measured on MRI (Berman et al. 2014). This group included only women with fibroids no greater than 7 cm. When re-evaluated in 3 years, the same cohort of women still experienced improvement in quality of life, while 11% required a repeat intervention.

Women who elect to undergo this procedure can expect to go home on the same day of surgery. Risks of the procedure include postoperative pelvic abscess, bowel injury, post procedure vaginal bleeding, and pain (Chudnoff et al. 2013).

2.4.3 Laparoscopic Cryomyolysis

Laparoscopic cryomyolysis is a less frequently used technique of also reducing fibroid size and subsequent symptoms. The technique was originally developed in 1996 and has subsequently been modified. It involved laparoscopic introduction of a cryoprobe into a fibroid to freeze the tissue.

Different studies have been inconsistent in demonstrating fibroid shrinkage and symptom improvement. More recent data analyzing 20 women who underwent the procedure without receiving preoperative GnRH agonist shows an average fibroid shrinkage of 62% at 12 months after surgery (Zupi et al. 2005). The majority of patients in this study reported being strongly satisfied with the improvement in their symptoms.

Appropriate candidates for this procedure are women over 40 years old, with fibroids between 4 and 8 cm in diameter, who do not desire future fertility. Patients who are undergoing this procedure should be counseled that it may cause an increased risk of pelvic adhesive disease. In one study, 53% of women undergoing laparoscopy for other reasons following their cryomyolsis were found to have dense pelvic adhesions (Donnez et al. 2000).

2.4.4 Uterine Artery Occlusion

Apart from uterine artery embolization, which will be discussed later on in this chapter, surgical occlusion of the uterine arteries has also been described via laparoscopic approach. This approach is not commonly performed, and there is paucity of robust data to describe standard technique, demonstrate effectiveness of treatment, and establish patient safety.

In laparoscopic uterine artery occlusion, the retroperitoneum is entered, and the uterine artery is dissected and isolated. It is then either clamped or coagulated. Case series publications demonstrate short operating times (30.8 min average) and a low complication rate (7.3%) (Holub et al. 2004). In these series, women followed at 12 months after their procedures demonstrated a 57.8% reduction in fibroid size.

2.4.5 Endometrial Ablation

Ablation of the endometrial cavity, with or without concurrent resection of submucosal fibroids, may also be used as a surgical management option for women with fibroids. There are currently five devices approved by the Food and Drug Administration to be used for endometrial ablation. These include devices that use a thermal balloon in the endometrial cavity, devices that circulate very hot fluid inside the cavity, radiofrequency electrosurgery, cryotherapy, and microwave energy. In one study looking at the amount of bleeding reported after hysteroscopic endometrial ablation, 94% of women who had undergone an ablation with or without resection of fibroids reported improvement in their bleeding patterns at the end of 2 years (Indman 1993).

Appropriate candidates for endometrial ablation include women who can tolerate hysteroscopy in general, women with heavy menstrual bleeding or abnormal uterine bleeding thought to be secondary to fibroids, women who do not have submucous fibroids, women who do not have any suspected endometrial cancers, and those who do not desire future fertility.

The rate of injury with endometrial ablation is low and varies depending upon which device is used. These injuries include genital tract burns, bowel injury, uterine perforation, infection, uterine and cervical scarring, hemorrhage, ureteral thermal damage, and ureterovaginal fistulas (Gurtcheff and Sharp 2003).

2.4.6 Hysterectomy

Hysterectomy is the definitive management for women with fibroids, and as such fibroids represent the most common indication for hysterectomy. It is estimated that fibroids account for 30% of hysterectomies in white women and 50% of hysterectomies in black women (Management of Uterine Fibroids 2001). The procedure can be performed abdominally, laparoscopically or robotically, or vaginally depending upon patient symptoms, the surgical history, the size of the uterus, and patient preference.

Women who have completed child bearing, who desire definitive treatment, and who no longer desire to keep their uterus are good candidates for a hysterectomy. However, women who are undergoing a hysterectomy should be counseled regarding the potential risks, including changes in hormone profile, as a hysterectomy has been associated with an increased risk of premature ovarian insufficiency as well as earlier onset of menopause (Moorman 2011).

2.5 Radiologic Management

2.5.1 Uterine Artery Embolization (UAE)

Uterine artery embolization (UAE) provides a minimally invasive method of reducing fibroid size and symptoms while avoiding surgery. Patients should be evaluated both by an interventional radiologist as well as a gynecologist to assess candidacy for the procedure. Those who are good candidates for UAE are women with multiple fibroids but do not desire hysterectomy, women who are done with childbearing, women who do not have adenomyosis, women who are not taking GnRH agonists, and women who have not had previous ligation of the internal iliac artery.

During this procedure, interventional radiologists guide a catheter through the femoral artery and inject either gelatin sponges, polyvinyl

alcohol particles, or tris-acryl gelatin microspheres into the uterine artery and its branches. The decreased tissue perfusion over time causes fibroids to shrink, with subsequent improvement in symptoms.

Women undergoing a UAE should be observed in the hospital for the first evening after their procedure, as it can be associated with severe pain. Most women require NSAIDs for the first 1–2 weeks following the procedure.

Data has shown that over the course of 3 months, a mean fibroid size reduction of about 33% can be expected. In addition, almost 83% of women will have improvement in their heavy menstrual bleeding, while 77% should also have improvement in dysmenorrhea (Pron 2003). This procedure is also associated with a short recovery and hospital stay. Women who undergo UAE have a 9% risk of need for repeat UAE or surgical intervention for fibroids (Edwards et al. 2007).

Because there are limited data observing the relationship between UAE and future fertility, it is not recommended for women who desire fertility. The relationship between UAE and subsequent ovarian function is also unclear. Data looking at ovarian perfusion via Doppler ultrasound following a UAE suggests that 35% of women had decreased perfusion and up to 54% had complete lack of perfusion (Ryu et al. 2001). Other data have shown a 45% risk of ovarian failure in women over 45 years old after the procedure (Chrisman et al. 2000). There is insufficient data to determine whether UAE is associated with premature ovarian insufficiency.

2.5.2 MRI-Guided Focused Ultrasound (MRgFUS)

MRI-guided focused ultrasound (MRgFUS) utilizes high frequency ultrasound waves focused on fibroids as mapped on MRI. The ultrasound waves stimulate protein denaturation and coagulative necrosis of the fibroids. The MRI helps to focus the ultrasound and map out the location of organs to be avoided. The procedure itself takes approximately 2–4 h.

Data from patients who have undergone this procedure show that approximately 71% of patients will reach their target symptom reduction at 6 months, while 51% will reach this target at 12 months (Hindley et al. 2004; Stewart et al. 2006). By the end of 1 year, 21% of patients required an additional, alternative treatment of their fibroids.

Benefits of this procedure are that it can reduce fibroid size without requiring laparoscopic surgery or invasive catheter placement. The procedure can be performed under conscious sedation, and recovery is immediate.

3 Conclusion

Fibroids are the most common benign tumors of the female reproductive tract. The majority of women with fibroids will be asymptomatic; however, among women who are symptomatic the most common complaints are heavy menstrual bleeding, infertility, and pelvic pressure.

The presence of fibroids rarely constitutes a surgical emergency. Therefore, clinicians should take the time to appropriately assess the patient's symptoms, fibroid location, and personal goals when developing treatment plans.

The management of fibroids is very broad. For those patients who are asymptomatic or who are satisfied with their level of symptoms, expectant management is a reasonable option. Fibroids do not have the potential to become cancerous. As such, clinicians should not feel obligated to treat fibroids to mitigate oncogenic potential. Medical management is a reasonable next step for patients who desire intervention with their symptoms. Effective medical options include the short-term use of GnRH agonists for fibroid size reduction and improved bleeding profile, as well as the use of the levonorgestrel intrauterine device.

Women who desire intervention and are willing to wait several months to see an improvement in their symptoms may be good candidates for ablative and vascular occlusive procedures, including LRVTA, laparoscopic cryomyolysis, uterine artery embolization, and MRgHFU. Other options also include endometrial ablation, which has also been shown to be successful in reducing heavy menstrual bleeding associated with fibroids.

Other options for patients who desire surgical intervention include myomectomy, which can be accomplished through several different routes depending upon the number and location of fibroids, patient symptoms, and patient preferences. While this is not a definitive management of fibroids, it is an acceptable option for women seeking to preserve their uterus or maintain fertility. The risk of appearance of new fibroids is generally low, and the majority of women will not require re-operation for their fibroids after their first procedure.

The final option in the management of fibroids is a hysterectomy, which is the only definitive option available. Fibroids are the most common indication for performance of a hysterectomy. Women who undergo hysterectomy for their fibroids should be counseled that while it is a definitive treatment option, it could be associated with adverse changes in reproductive hormone profile.

Treatment of fibroids represents a unique opportunity for clinicians to tailor treatments specific to patient symptoms and goals. By offering patients a range of treatment options, the clinician has the opportunity to safely care for these patients and significantly improve their quality of life.

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