Uterine Artery Embolization in the Management of Symptomatic Uterine Fibroids: An Overview of Complications and Follow-up

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ABSTRACT

Uterine artery embolization (UAE) evolved as a treatment for symptomatic uterine fibroids in the early 1990s, after initially being used as a temporizing measure prior to hysterectomy or myomectomy. Since that time, over 100,000 UAEs have been performed. Technical success rates have been quoted ranging from 94 to 99%. The overall incidence of major complications associated with the procedure is low, the majority of which can be prevented. Knowledge of the potential complications and the measures that can be taken to avoid these complications is essential. Furthermore, because UAE is a relatively new procedure, no standardized recommendations for patient follow-up exist. Common practice for patient follow-up includes both clinic visits at increasing time intervals postprocedure, as well as telephone follow-up, and imaging follow-up when necessary. As symptomatic improvement is subjective, some institutions have developed standardized questionnaires to better assess patient improvement postprocedure. Aggressive pain control is a crucial component of follow-up, as uncontrolled pain can result in readmission and patient dissatisfaction.

KEYWORDS: Uterine artery embolization, fibroids, leiomyomata

Objectives: Upon completion of this article, the reader will be able to (1) explain the major and minor complications associated with uterine artery embolization, (2) identify factors that increase the risk of complications, (3) list the health care issues a physician should consider in a postembolization patient, and (4) define current practices in patient management and follow-up after uterine artery embolization.

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Uterine leiomyomata or fibroids are benign tumors composed of smooth muscle cells and fibrous connective tissue which arise from the muscular layer of the uterus. Fibroids are the most common benign neo-

plasm in women, and may affect anywhere from 25 to 50% of the female population during reproductive years. Although fibroids often are asymptomatic and do not require treatment, symptomatic fibroids can cause

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significant morbidity. These symptomatic fibroids are the most common cause of abnormal menstrual bleeding. Additionally, fibroids can result in uterine enlargement causing abdominal distention, pelvic pressure, urinary frequency, and mass effect on other adjacent organs/structures. Infertility or late miscarriages can also occur as a result of uterine fibroids.

Until the past two decades, surgical management was the most commonly practiced therapy for uterine fibroids. Fibroids can be managed surgically with hysterectomy or with less aggressive procedures such as myomectomy, endometrial resection, or endometrial ablation. Both hysterectomy and myomectomy carry a risk of intraoperative bleeding, adhesions, ureteral injury, structural damage, and other serious complications. Endometrial resection and ablation are associated with a high failure rate, postprocedural bleeding, ectopic pregnancy, and pelvic pain. Hormonally mediated therapy with gonadotropin releasing hormone (GnRH) is time-limited due to the increased risk of osteoporosis after 6 months of therapy.¹

Uterine artery embolization (UAE) was first used as a temporization procedure prior to hysterectomy or myomectomy.² In the 1990s, it evolved as an independent therapy for uterine fibroids. In 2004, it was estimated that 13,000 to 14,000 UAE procedures are performed annually in the United States as therapy for symptomatic uterine fibroids.³ Since the evolution of uterine fibroid embolization, a small number of multicenter trials have been published, comparing UAE and surgical management of uterine fibroids, including both hysterectomy and myomectomy. The comparison mainly focuses on resolution of the symptoms as well as minor and major complications in the short- and long-term follow-up of these patients. The majority of the literature supports the theory that UAE shortens hospital stays and decreases the overall rate of major complications.^{1,4-7}

With the increasing popularity of UAE, it is necessary to be aware of the potential complications of the procedure to prevent and manage complications effectively. Postprocedural follow-up varies between institutions, but there does appear to be an evolving practice of patient follow-up, including imaging and clinical assessment. Some centers have developed specialized pain assessment scales and quality of life scales to better assess the efficacy of therapy.

symptom of a more serious complication related to the procedure. Pain, in these rare cases, has been the presenting symptom of endometritis, pelvic abscess formation, and endometrial ischemic necrosis.⁴⁻⁸ Hence, persistent pain cannot be taken lightly, and may require clinical and laboratory evaluation as well as imaging.

Postembolization syndrome is another common morbidity of UAE. Postembolization syndrome is well recognized by physicians who perform embolotherapy and includes fever, pain, and nausea lasting from a few hours to a few days. It is reported to occur in ~50% of patients,⁷ typically occurs after embolization of a solid organ and is part of an immune-mediated response. The syndrome is usually easily controlled with analgesic, antiinflammatory, and antipyretic medication.⁹

Other side effects of UAE include vaginal discharge and passing expelled fibroid tissue. Vaginal discharge has been reported up to 6 months, but usually resolves by one month.¹⁰ Passing disintegrated fibroid tissue has been reported up to one year. On some occasions, the fibroid tissue is incompletely expelled, and may require assisted removal by either dilatation and curettage, or laparoscopic removal (Table 1).

Beyond the expected side effects of UAE, other complications are often categorized into minor, major, and severe complications, according to the difficulty of managing the complication, as well as the severity of the morbidity or even mortality. Most major and minor complications present within the first month postprocedure.⁶

Major complications documented in the acute postprocedure phase (up to 24 hours postprocedure) include septicemia, bleeding requiring transfusion, pulmonary embolus, structural damage, hematoma at puncture site, vasovagal response requiring atropine, and drug reaction. In the subacute (from 24 hours to 1 week postprocedure) to chronic phase (> one week postprocedure), major complications reported include sepsis, pneumonia, pelvic abscess, hematometra, uterine rupture secondary to uterine necrosis, and uterine necrosis requiring hysterectomy.^{4-7,10-12} In cases of uterine necrosis, the patients usually present with prolonged and intractable pain; a hysterectomy is the recommended treatment. Only 2 deaths have been reported in association with UAE, one occurring from lethal sepsis, and the second from pulmonary embolus (Tables 2 and 3).¹

COMPLICATIONS

Reported Complications

Pelvic pain is the most commonly reported generalized systemic effect of UAE. Although the pain may last for a few hours postprocedure, pain more typically lasts anywhere from 48 to 72 hours, and may persist for as long as one month postprocedure.⁴ Rarely, pain is actually a

Table 1 Side effects of Uterine Artery Embolization

General Side Effects of Uterine Artery Embolization

Pain
Postembolization syndrome
Vaginal discharge
Natural expulsion of part/whole of the fibroid
Temporary amenorrhea

Table 2 Acute Phase Complications and Management**Acute Phase Side Effects**

Pain

- Narcotic analgesic pump or IV narcotic

Postembolization syndrome

- Anti-emetics/Anti-inflammatories

Sepsis

- IV antibiotics, IV fluids

Bleeding

- Transfusion, IV fluids

Groin hematoma

- Manual pressure

Contrast reaction

- IV antihistamine, corticosteroid

Vasovagal response

- Atropine

Pulmonary embolus

- Anticoagulation

IV, intravenous.

In multicenter trials, the major complication rates reported consistently reflect a lower number of major adverse events (AE) related to UAE as opposed to major AEs related to surgical management. In the REST trial (2007), the major complication rate for UAE was 12% within the first year versus 20% for surgically managed patients.⁷ In the HOPEFUL trial (2007), UAE patients experienced a 4.5% major complication rate compared with 14.8% in the surgical patients.⁶ In the EMMY trial (2005), a 1.3% major complication rate was assigned to UAE and a 1.2% major complication rate was assigned to surgical patients. However, when bleeding requiring

blood transfusion is added to the calculations, the UAE major complication rate remains 1.3%, but the surgical major complication rate increases to 14.5%.⁴ Serious complications reported for surgically managed patients include pulmonary embolism (PE), bleeding requiring transfusion, structural damage caused by the procedure, organ failure, pneumonia, septicemia, pelvic vein thrombosis, and vesicovaginal fistula.^{4-7,10-12}

Minor complications reported include endometritis requiring antibiotic therapy, delayed contrast reaction, tubo-ovarian abscess, temporary or permanent amenorrhea, urinary retention, and fibroid expulsion requiring assisted extraction.^{4-7,10-12} Minor complication rates reported in the literature range from 21 to 64.2%.^{4-7,10-12} The reported minor complication rate varies greatly because of the disagreement as to what constitutes a minor complication. Some consider transient amenorrhea and vaginal discharge as general side effects of the procedure, whereas others may classify these as minor complications. When compared against surgical management, some studies report UAE as having a higher minor complication rate, whereas other studies report equal rates of minor complications, or even slightly less minor complications associated with UAE.

Nontarget organ embolization has been documented, and is most likely to affect the ovaries, given the extensive collateral vascular network between the ovarian and uterine arteries. In cases of secondary ovarian embolization, patients may experience transient or permanent amenorrhea and may experience premature menopause. It has been reported that ~5% of patients will enter menopause after the procedure.^{1,13} In one study measuring follicle stimulating hormone (FSH) pre- and postprocedure, roughly 6% of women experienced transient menopausal symptoms including amenorrhea and hot flashes with elevated FSH levels. The menopausal symptoms resolved at 8 and 10 months postprocedure.¹⁴ Other reported nontarget embolization includes the gluteal artery resulting in buttock claudication and sciatic nerve injury.¹

Decreased fertility experienced after UAE is believed to be secondary to ovarian damage and decreased uterine arterial blood flow. The risk of infertility is discussed with patients before performing the procedure. In fact, patients are advised against attempting pregnancy postprocedure as there is an increased risk of abortion and still births. In the literature, however, numerous successful pregnancies and successful live births after UAE are documented, including both normal vaginal deliveries and cesarean deliveries.^{1,5-7,14} Dutton et al report as high as 19 successful live births.⁶ Ravina et al report 6 successful pregnancies.² Edwards et al document 2 successful live births.⁷ Despite these successful reports, the most recent study by Mara et al (2008) directly examined the differences in pregnancy

Table 3 Subacute and Chronic Phase Complications and Management**Long-term Complications**

Pain

- Oral narcotics, analgesics, and imaging if needed

Transient or permanent amenorrhea

Endometritis

- Oral antibiotic therapy, imaging if needed
- Prevention: Exclude patients with chronic/acute PID
- Prevention: Antibiotic prophylaxis

Urinary retention

- Catheterization

Passing expelled fibroid tissue

- Imaging; dilatation and curettage if needed

Delayed contrast reaction

- Oral or IV antihistamines, corticosteroids

Tubo-ovarian abscess

- Imaging, antibiotic therapy, percutaneous drainage

Uterine necrosis/rupture

- Hysterectomy

PID, pelvic inflammatory disease; IV, intravenous.

rates in patients who underwent the UAE procedure compared with those who underwent myomectomy. There was a 50% pregnancy rate in the post-UAE group compared with a 78% pregnancy rate in the postmyomectomy group. This study emphasizes the need for additional randomized studies between myomectomy and uterine embolization in the setting of fertility.¹⁵

Renal failure postprocedure has been reported, but the underlying etiology of the renal failure was not discussed.⁶ Potential causes of acute renal failure related to UAE would be rhabdomyolysis or contrast-related nephropathy. Rhabdomyolysis is theoretically possible due to the expected ischemia of large bodies of muscular tissue. However, studies measuring ischemic markers postprocedure fail to demonstrate any significant rise in creatinine kinase and ischemia modified albumin.¹⁶

Preventing Complications

Nontarget organ embolization is a largely preventable complication. Hehenkamp et al describe using larger polyvinyl alcohol (PVA) particles of 500 to 700 μm rather than the 355 to 500 μm particles when anastomosis with an ovarian artery is observed so as to prevent the particles from reaching the distal organ.⁴ If blood supply to the fibroid arises solely from an ovarian artery, and there is absence of a uterine artery, the procedure may be aborted due to risk of ovarian damage, unless the patient is postmenopausal. If extensive collateral vascularization exists between the cervix or vagina and the uterus, the procedure should be aborted. Injecting above the level of the renal arteries can better evaluate for collateral supply from ovarian vessels.⁴

Vaginal ischemia resulting in sexual dysfunction or dyspareunia is a very uncommon, but theoretical, complication. Although the vaginal artery often arises as an independent branch of the internal iliac artery, the vaginal artery can at times share a common trunk with the uterine artery, or can anastomose with the uterine artery and ovarian artery in the broad ligament.¹⁷ When the uterine artery and vaginal artery share a common trunk, or there is a distal anastomosis, embolization of the vaginal artery becomes a possible complication. Only one case of sexual dysfunction is reported in the literature; nevertheless, it is important to attempt to identify the vaginal artery prior to embolization and embolize distal to this artery when possible.¹⁸

Radiation dose presents a risk of theoretical complications including radiation burn or ovarian injury resulting in decreased fertility. It is reported that the radiation dose associated with UAE is several orders of magnitude less than that administered during radiation therapy for pelvic Hodgkin's lymphoma.¹⁹ The literature suggests that the radiation dose for UAE is unlikely to

result in acute or long-term radiation injury to a patient or to a patient's fertility. However, it remains important to minimize radiation dose to the pelvis and specifically the ovaries during the procedure. Measures, such as coning down on the catheter tip, can be taken to decrease radiation dose by protecting the ovaries from the primary field. The number of magnified angiographic images should be minimized as these are usually unnecessary and only increase radiation dose. White et al²⁰ examined the total patient radiation dose associated with UAE, specifically addressing the relative merits of performing aortography in routine UAE for looking at ovarian arterial supply. Their study demonstrated that aortography contributes a substantial radiation dose, more than 20% of the total dose. Therefore, the authors recommend that routine use of aortography after UAE should only be performed in a highly selected subset of patients with higher likelihood of having collateral ovarian artery supply.²⁰ New, state-of-the-art fluoroscopy units using pulsed fluoroscopy, are also being used to limit radiation dose.^{1,19}

Some complications can be prevented by rigorous patient selection and exclusion. Patients with vascular diseases or history of irradiation to the pelvis are less likely to form collateral vascularization to the uterus and are at increased risk of uterine necrosis, and should be excluded. Chronic salpingitis or endometritis may increase the risk of postprocedural infection and should be considered a relative contraindication. Recent or ongoing pelvic inflammatory disease (PID) is also a contraindication to the procedure, due to the risk of sepsis. Other contraindications include pregnancy, pelvic malignancy (endometrial hyperplasia with atypia or neoplasia), uncontrollable coagulopathy, and severe renal insufficiency not managed with dialysis.¹ Patients with subserosal or pedunculated fibroids are sometimes excluded due to the risk of necrosis that may affect adjacent bowel loops.⁷

Medication-related side effects have been reported, some of which can be prevented. Patients with life-threatening contrast allergies should be excluded from the procedure. If known minor contrast allergy exists, patients should be adequately premedicated to prevent allergic reaction. Antibiotic prophylaxis is routinely practiced by some centers. At our institution, antibiotic prophylaxis consists of Cefazolin (Eli Lilly & Co., Indianapolis, IN) 1 g preprocedure; if penicillin allergic, vancomycin 500 mg can be substituted. However, other practitioners believe that the risk of adverse reaction related to the antibiotic is higher than that of sepsis related to the procedure. Further research is needed to address the utility of prophylactic antibiotics.⁶ Opiate medications have their own set of side effects and complications, including respiratory depression, sedation, constipation, and urinary retention. Limiting the use of opiate medications and including alternative pain

medications in the postprocedure medication regimen can help to prevent opiate-related complications.

POSTEMBOLIZATION FOLLOW-UP

Acute Phase

In the immediate postembolization period, clinical management largely consists of aggressive pain control. Intravenous (IV) narcotic pain pumps are standard in symptomatic management for the first 24 hours postprocedure. Pinto et al reports using alternating doses of IV ketorolac and paracetamol as an alternative to the narcotic analgesic pump.¹² Antiinflammatory medication and IV antiemetics are also used to manage the symptoms of postembolization syndrome. With effective symptomatic control, most patients are discharged within 24 hours postprocedure.⁷

Pain management remains a vital component of patient care even after discharge, and patients are usually sent home on an aggressive pain medication regimen to be tapered over a period of 7 days.⁶ Persistent pain is reported as the most frequent cause of unscheduled visits in the first 6 months. Fever was the second most common reason for unscheduled visits, and vaginal bleeding and discharge was the third most common reason. Not only may inadequate pain control result in readmission, but also in patient dissatisfaction with the procedure. Prescribed pain medication regimens for patients after discharge vary between institutions; however, the regimen routinely combines an opiate or narcotic analgesic and a nonsteroidal antiinflammatory drug (NSAID).

Multiple patient series in the literature document successful outpatient management of patients' status post UAE.^{11,13,21} In such cases, the procedure is usually performed as the first case of the day, and the patients are observed for 6 to 8 hours postprocedure prior to discharge home.^{11,21} Same-day discharge patients receive IV pain medication during the procedure and regularly thereafter until discharge. Documented medication regimens on discharge usually combine an oral narcotic analgesic, an NSAID, and an antiemetic suppository. Siskin et al describe a regimen using promethazine suppositories as an antiemetic and alternating oral meperidine and oral ketorolac every 3 hours for the first day to manage pain. Meperidine is replaced by hydrocodone after 24 hours, and hydrocodone and ketorolac are then alternated every 3 hours for the next 2 days. After 3 days, oral ibuprofen is recommended for pain on an as-needed basis.¹¹

Patient contact is usually made within the first 7 days of the procedure, by telephone or clinic visit. Some centers practice aggressive patient contact requiring 3 successful phone contacts within the first week.¹¹ Patient contact allows the physician to assess pain con-

trol and optimize the medication regimen as needed. It is reported that 77.8% of readmissions occur within the first 7 days of discharge in the EMMY trial, and are largely related to inadequate pain control.⁴ Readmission increases the cost of health care and can potentially be avoided by very close clinical follow-up in the first 7 days postprocedure. The initial clinic visit postprocedure usually occurs at or before week 6.

Long-term Follow-up

The majority of complications arises within the first month postprocedure; however, long-term follow-up is also necessary to evaluate treatment success/failure and to assess for any evolving complications. Long-term complications include incomplete passing of necrotic, disintegrated, or infected fibroid material; uterine necrosis/rupture; premature menopause; infertility; hematometra; pyometra; and abscess.^{1,4-7,10-12} Standard follow-up in the large clinical trials is 3, 6, 12, and either 21 or 24 months, and annually thereafter.^{4,6,7} Siskin et al followed patients with monthly phone calls for 6 months, at which time patients returned to the department for follow-up imaging.²² No specific recommendation guidelines for long-term follow-up exist at the present. In assessing long-term patient response, some centers report the use of patient surveys to evaluate patient satisfaction and health outcomes related to the procedure. Some specific outcomes measured include whether patients would recommend the procedure to a friend, the presence or absence of complications, symptom control, sexual function, and the time until resumption of usual activities. Other questionnaires are designed to assess quality of life before and after the procedure.^{7,10,23}

Imaging Follow-up

Ultrasound (US) and magnetic resonance imaging (MRI) are the modalities commonly used for follow-up after UAE. Some centers routinely image patients at standard intervals postprocedure, whereas others utilize imaging only when complaints arise. Imaging evaluation includes assessment of uterine volume as well as the volume of the dominant tumor. Continuity of imaging modality most accurately documents interval change. If the patient received US imaging before the procedure, US should then be used postprocedure. Reduction in uterine volume or dominant fibroid does not necessarily correlate with symptomatic improvement, a fact which should be explained to the patient. Calcification of the uterine fibroid postprocedure usually indicates involution of the fibroid. In instances of pelvic pain, imaging has been used to document hematoma, endometrial abscess, and tubo-ovarian abscess (Fig. 1).

Contrast enhanced MRI postprocedure has been used to evaluate for ischemia and infarction of the

Figure 1 (A–C) Axial T1-weighted postcontrast and sagittal short inversion time (STIR) images demonstrate a fluid-filled, dilated, enhancing right fallopian tube, compatible with tubo-ovarian abscess, in a patient who was treated with uterine artery embolization 3 months prior.

fibroids. Complete absence of contrast enhancement in the fibroid tissue corresponds with complete fibroid infarction. Pelage et al²⁴ reported a rate of complete fibroid infarction of 70.6% of uterine fibroids at 3 months postprocedure. Furthermore, these fibroids demonstrated complete infarction up to 3 years posttreatment. In their study, 29.4% of uterine fibroids were incompletely infarcted at 3 months. Of these incompletely infarcted fibroids, 30% (2 of 5) progressed to complete infarction at 3 years, while 60% (3 of 5) required further intervention (Fig. 2).²⁴

Treatment Failure

Treatment failure has been defined as insufficient symptomatic control necessitating further intervention. Further intervention may constitute repeat embolization or surgical intervention such as hysterectomy or myomectomy. A projection analysis performed by Dutton et al

determined that, according to the outcomes of the HOPEFUL trial, ~23% of patients receiving UAE would require further intervention within 7 years posttherapy.⁶ The REST investigators report that repeat therapy was required in 20% of patients by 48 months postembolization. Ten of the 21 treatment failures were reported in the first 12 months; the remaining 11 treatment failures occurred in the months thereafter.⁷ Treatment failure rates are higher in subserosal and intramural fibroids when compared against submucosal fibroids.¹ It has also been reported that preexisting adenomyosis increases the failure rate to 50% (Fig. 3).¹⁰ Toor et al²⁵ in a recent study examined the specific patient and imaging characteristics associated with clinical failure after UAE. Their results showed that the measurement of the total fibroid volume was of greater clinical significance than the measurement of a single dominant fibroid volume. Additionally, this study also revealed a significantly greater number of patients with pedunculated subserosal fibroids to undergo

Figure 2 (A) Sagittal short inversion time (STIR) image demonstrates a 10-cm submucosal fibroid prior to treatment. (B) Sagittal STIR image demonstrates involution of the submucosal fibroid 9 months after uterine artery embolization.

clinical treatment failure. The authors speculate this is attributable to the growth of these pedunculated subserosal fibroids away from the uterus, thereby developing specific feeding arteries from other vascular structures, such as the ovarian artery. This is in contrast to the submucosal or intramural fibroids, which have greater uterine arterial supply and allow for more substantial delivery of embolic material. Additional studies are warranted to further identify specific imaging differences and the role of fibroid location in clinical failure after UAE.

Technical failure is another cause of unsuccessful treatment, and is largely due to the inability to catheterize one or both uterine arteries. Reported technical failure rates range from 0.5 to 5.6%.^{4,6,7,10} The skill and familiarity of the operator performing the procedure is believed to affect the technical success rate.⁴

In cases of persistent bleeding and pelvic pressure after the initial procedure, it is hypothesized that this is attributable to the preservation of myometrial perfusion, presumably supplied by recanalized uterine flow or collateral flow.⁶ Collateral flow may arise from the ovarian arteries, vascular beds between the cervix, vagina, or ovaries and the uterus, or flow parasitized from other pelvic branches. When significant vascular supply arising from another source is identified during the procedure, the collateral source can potentially be embolized, but this raises the risk of nontarget embolization.²⁶ For instance, when the collateral supply is the ovarian artery, embolization or coiling of the vessel would result in ovarian injury and premature menopause. Ovarian artery embolization, however, may not be a suitable therapy for younger women.^{4-7,10,26}

Figure 3 (A) Sagittal T2-weighted magnetic resonance image (MRI) demonstrates uterine fibroids in the posterior uterine wall and fundus in a patient with adenomyosis. (B) Sagittal short inversion time (STIR) image postuterine artery embolization demonstrates involution of the uterine fibroids in the posterior uterine wall, with persistent fundal fibroid. Failure rate is reported to be higher in patients with adenomyosis.

Measuring Treatment Success

In determining the success of the procedure, it is important to assess the patient's quality of life before and after the procedure, as the symptoms caused by the uterine fibroids are difficult to measure objectively/qualitatively. It is reported that reduction in fibroid size postprocedure does not correlate with improved symptoms and quality of life. Reduction in bleeding, pain, pelvic pressure, and fibroid volume are commonly used to help determine success. Hehenkamp et al reported a procedural success rate of 88.9% with 90% of patients reporting reduction in bleeding, 95% reporting reduction in pain, and a 70% reduction in fibroid volume.⁴ Anderson et al document improved bleeding in 96% of patients at 6 months out. However, only 70% of patients experienced improved pain, and 61% experienced reduction in bulk symptoms. These patients had a 68% reduction in fibroid volume.⁵

General statements about well being have been used to assess treatment success, as well as whether or not the patient would recommend the procedure to a friend. Dutton et al report relief of symptoms in 85.2% of patients. In their study, 83.8% of patients stated that they "feel better" since the procedure; and 91.4% would recommend the procedure to friends.⁶ In general, treatment success is best assessed over the long-term clinical follow-up of the patient.

CONCLUSION

UAE is minimally invasive when compared with surgical management of symptomatic uterine fibroids. After UAE, the hospital stay and overall disability time is much shorter. Most studies report less major or severe complications associated with UAE, when compared with surgical management. However, the procedure is not without risk of complication, and patients should be adequately educated on the risks prior to the procedure.

Follow-up of UAE varies between institutions, but should include aggressive pain control in the immediate postprocedure period, to prevent readmission. Imaging follow-up is useful in evaluating for treatment success as well as for complications. Reduction in fibroid size does not always correlate with symptomatic improvement. Quality of life should also be assessed, and may be evaluated with patient surveys or in clinical evaluation and patient discussion.

Treatment failure rates are estimated to range between 20 and 23% over the long term. Some patients can be retreated, but other patients will require surgical management. When advising a patient on the procedure, decreased hospital time and less major complications need to be weighed against possible need for repeat procedure.^{6,7} In the literature, cost analysis proved embolization to be more cost effective than surgery, even including repeat hospitalization and imaging follow-up.⁷

Though the procedure carries a risk of complication and treatment failure, UAE is a safe and effective treatment in the management of symptomatic uterine fibroids. Being aware of the risks and having a close clinical relationship with patients and their referring physicians are of the utmost importance in having an effective and successful interventional radiology practice in the management of uterine fibroids.

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