UPDATE ARTICLE

Uterine Artery Embolization: A Nonsurgical Cure for Fibroids

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Abstract

Uterine leiomyomata commonly known as fibroids are benign tumors of the uterus that are a common cause of heavy menstrual bleeding, pelvic pain and pressure symptoms in women. The traditional method of treatment for these benign tumors has been surgery as long-term medical therapies have not shown to be effective. Uterine artery embolization (UAE) a minimally invasive, interventional radiological technique, wherein complete occlusion of both the uterine arteries with particulate emboli are carried out, has been found to be an effective and safe alternative in the treatment of menorrhagia and other fibroid-related symptoms in women not desiring future fertility or who are poor surgical candidates. This treatment modality available in all major institutions may be instituted as an alternative to hysterectomy in young women wishing to preserve the uterus. UAE a cost-effective modality associated with a short hospital stay has significant advantages over conventional surgeries in the treatment of myomas.

Keywords: Uterine leiomyomata, uterine artery embolization, fibroids.

INTRODUCTION

Uterine leiomyomata, commonly known as fibroids, are common benign lesions of the uterus. It has been seen that 25% of women during reproductive life and over 40% of women over the age of 40 years are affected by these tumors.[1] Most women with fibroids are asymptomatic and do not require active intervention.

The main symptoms of uterine leiomyomata are excessive menstrual bleeding and pressure symptoms. When fibroids are large they may produce disabling pelvic pain and urinary frequency. These symptoms can have tremendous impact on women's health and well-being. The effect of fibroid on fertility is unclear. Impaired gamete transport, distorted uterine cavity, and abnormal blood supply to the endometrium may be a reason for poor implantation in patients with myomas.[2]

The traditional treatment of symptomatic fibroids has been surgical, namely myomectomy or hysterectomy. However surgery is associated with significant morbidity in terms of increased blood loss, postoperative complications, longer hospital stay and permanent infertility, inspite of advantages like complete resolution of menstrual symptoms and a higher patient satisfaction rate. Myomectomy whilst aiming to preserve fertility, is also associated with morbidity, and carries the risk of proceeding to emergency hysterectomy. In addition, it can further compromise the reproductive potential and increase the difficulties in long-term management owing to high recurrence rate of fibroids and adhesion formation.[3]

Medical treatment such as the levonorgestrel intrauterine system (Mirena IUS) and gonadotropin-releasing hormone (GnRH) analogues have also been used to treat fibroid associated menorrhagia and pain but with limited success. The Mirena IUS is applicable only if the fibroids are small and there is minimal distortion of the uterine cavity.[4] Another alternative treatment is hormonal therapy using gonadotropin releasing hormone (GnRH) agonists which is used primarily as a temporary preoperative measure to reduce tumor size, vascularity and peri-operative blood loss.[5] Though these approaches dramatically improve symptoms and reduce fibroid size, the tumors regrow to their original size within a few months of discontinuing treatment and are associated with adverse effects; such as osteoporosis, menopausal symptoms and amenorrhea.

Changing attitudes towards uterine preservation, and evolution of minimally invasive surgical and nonsurgical techniques, has increased the popularity of conservative treatment modalities over the last decade. Uterine artery embolization (UAE) also known as fibroid embolization is a minimally invasive angiographic procedure increasingly being used as an alternative to surgery for symptomatic fibroids. This treatment modality available in all major institutions is instituted as an alternative to hysterectomy in young women wishing to preserve the uterus. UAE is also cost-effective and is associated with a short hospital stay and may also be an option in those women with major medical illness contraindicating surgery.

HISTORY

UAE has been used for control of acute pelvic hemorrhage for more than two decades. This concept of artery embolization was originally used in obstetrics and gynecology in 1979 to treat postpartum hemorrhage.[6] Its use, however, in the treatment of fibroids, was first reported in France by Ravina and colleagues, in 1995.[7]

PRINCIPLE

UAE represents a relatively new, minimally invasive approach to the treatment of leiomyomata. It selectively blocks the feeding arteries that supply blood to the fibroids and causes ischemic necrosis and subsequent absorption or expulsion of the leiomyoma.[8] Unlike the leiomyoma, the normal myometrium is supplied by multiple collateral arteries and it escapes the vascular deprivation resulting from UAE.

PATIENT SELECTION

Appropriate preprocedural selection of women is vital for high clinical success rate and prevention of complications following UAE. Women who have symptomatic fibroids in the absence of other pelvic pathology and do not desire future fertility are suitable candidates. Exclusion of women with adenomyosis is necessary as this uterine pathology alone or when coexistent with fibroids responds less well to embolization. [9] Pedunculated subserosal myomas also need exclusion owing to the risk of ischemic necrosis and potential for the fibroid to disintegrate and become free in the abdomen.

Though recently there are multiple case reports of successful pregnancy after embolization for fibroids, the existing evidence has not fully established its application in younger age as an alternative for medical or surgical therapy (myomectomy). Therefore the procedure should be offered to women who desire future fertility, with much caution.

CONTRAINDICATIONS OF FIBROID EMBOLIZATION

UAE should not be considered if any of the following are present:

- Presence of active infection (*risk of abscess formation and sepsis)
- Suspected leiomyosarcoma or any other pelvic malignancy
- Presence of severe endometriosis or pelvic adhesions which distorts vascular anatomy
- Associated pregnancy
- Presence of immunocompromised condition
- Presence of coagulopathy, severe contrast material allergy, renal Impairment
- Chronic endometritis
- Peripheral vascular occlusive disease
- Desire to maintain childbearing potential.

PREPROCEDURAL EVALUATION

Detailed gynecological and general medical history should be taken and a gynecological examination performed. All candidates for embolization should be reviewed by both a gynecologist and an interventional radiologist, as a team approach is the key to successful outcome. There should be a documentation regarding most recent Papanicolaou test or other results like endometrial histopathology as the procedure is contraindicated in patients with genital malignancy. A hormonal profile may be considered to provide information about ovarian reserve, as there is some evidence that ovarian devascularization may follow UAE, subsequently resulting in iatrogenic menopause though the reported incidence is less than 1%.[10, 11]

Uterine imaging must be performed, first to confirm the diagnosis of fibroids, and second to provide information on their location, size and number. Other pelvic pathologies can also be excluded by the imaging procedure which may be the cause for a woman's symptomatology. Whilst Doppler ultrasound is used in some centers for uterine imaging, MRI is currently considered to be the most accurate imaging technique for detection and localization of fibroids.[12] The capability of MRI to demonstrate the uterine zonal anatomy allows accurate classification of individual masses as submucosal, intramural, or subserosal.[13]

PROCEDURE

Bilateral UAE, a sterile procedure is carried out by an interventional radiologist in a specialized angiographic suite having digital subtraction angiography with measures to minimize X-ray dosage.[14] It can be performed as an outpatient procedure using conscious sedation, although spinal or epidural anesthesia may also be used as alternatives. Prophylactic antibiotics are given intravenously before the embolization procedure.

A single groin puncture with catheter placement into the femoral artery is required. A 5-French angiographic catheter is placed via the groin and advanced over the aortic bifurcation to the contralateral internal iliac artery, and digital angiography is done to identify the origin of the uterine artery (Fig. 1). To avoid spasm, a 3-French microcatheter is used coaxially to safely catheterize the uterine artery. After the microcatheter has been placed deeply into the uterine artery, (Fig. 2) this vessel is carefully embolized under fluoroscopic guidance with a solution of polyvinyl alcohol particles (PVA, 500-710 μm) mixed with sterile saline and iodinated radiographic contrast medium (Fig. 3). The embolization is continued until there is nearly complete blockage of flow in the vessel. If necessary after embolization of the artery with particles, pledgets of an absorbable gelatin sponge may be placed via catheter to complete the embolization. The 5-French catheter is then formed into a "Waltman loop," and the catheter is placed into the ipsilateral internal iliac artery; the embolization procedure is then repeated in the right uterine artery. Another postembolization angiogram (Fig. 4) is taken to confirm complete blockade and all catheters are then removed. The entire procedure takes approximately 1 to 1 ½ hours.

Initially embolization was considered complete when there was virtually no demonstrable flow in the distal uterine artery.[7,9] With increasing experience and the evolution of embolic

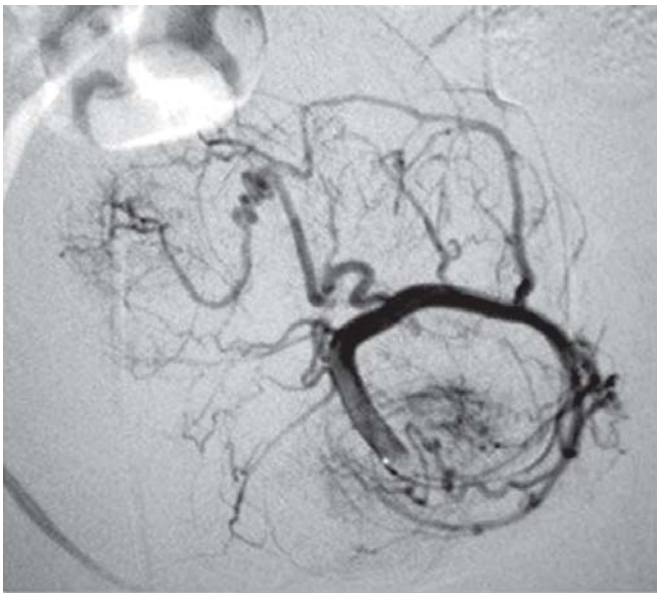

Fig. 1: Left uterine artery pre-embolization (dilated tortuous branches supplying the fibroids)

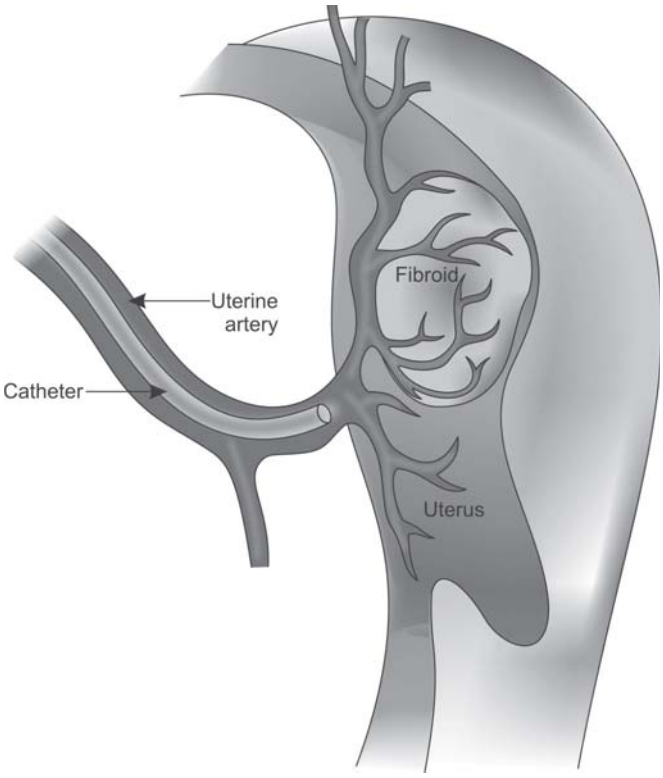

Fig. 2: Catheterization of the uterine artery

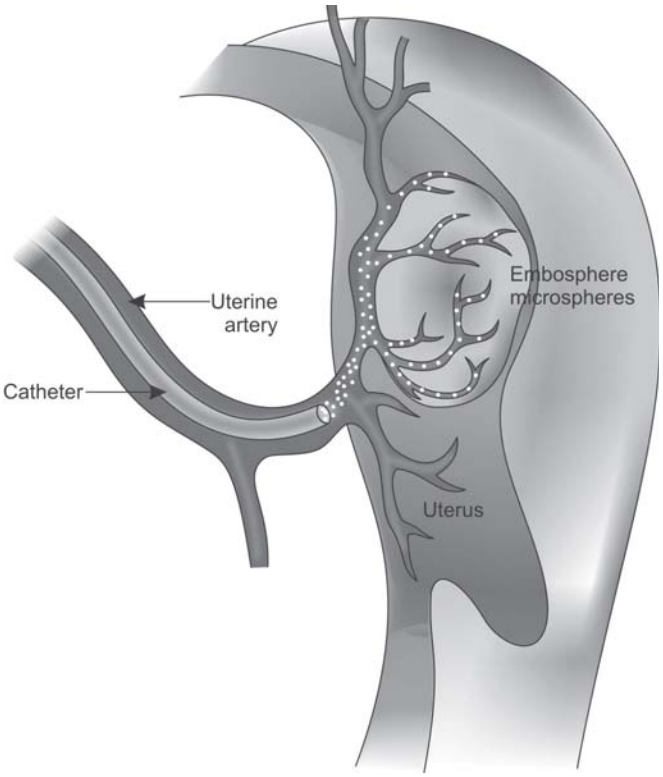

Fig. 3: Fibroid embolization

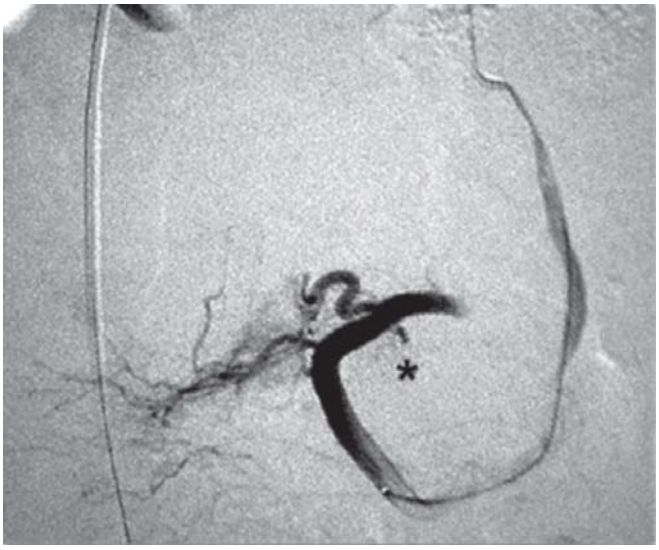

Fig 4: Left uterine artery post-embolization (notice absence of large fibroid vessels)

materials, the degree of arterial occlusion has become more precise and therefore the aim is to achieve arterial blushing rather than stasis where the main arterial trunk is left patent at the end of the procedure.[15] The improved precision allows more targeted fibroid embolization and reduces unnecessary devascularization of the myometrium and ovarian vessels.

POSTPROCEDURAL CARE

Pain control, particularly in the first twelve hours, is important as some patients develop pelvic pain of severe intensity. Patient controlled analgesia with use of intravenous morphine, meperidine, or fentanyl has been found to be effective. Post

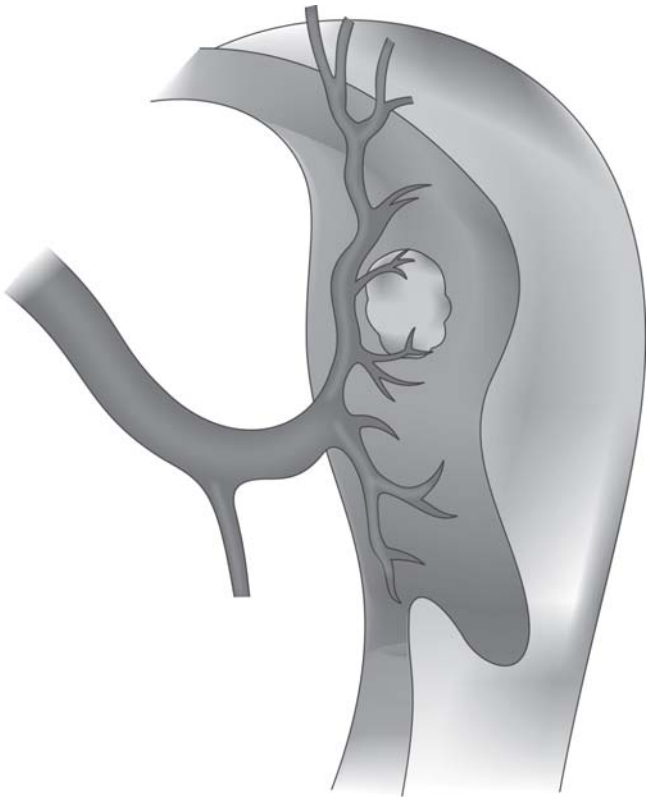

Fig. 5: Postembolization shrinkage of the fibroid

procedural pain cannot be predicted from baseline uterine or fibroid volume and the severity of pain experienced cannot be used to predict outcome.[16] Nausea is a common side effect of the embolization procedure and/or the medications used for pain control and hence there is a significant role for preoperatively administered antiemetic agent. Oral anti-inflammatory agents and narcotics are commonly used for several days after the procedure (usually 7-10 days) and most women return to normal activities within a couple of weeks. Patient is asked to return for follow-up 2 weeks after the procedure for confirmation of the healing of the puncture site and screening for unusual symptoms or potential problems.[17]

All women should undergo postembolization uterine imaging, usually with contrast enhanced MRI. This is to assess fibroid shrinkage and vascularity, and should be performed 6 months after the procedure (Fig. 5). Reassuringly, this MRI reveals rapid revascularization of the normal myometrium and an essentially normal appearance of the endometrium.

COMPLICATIONS

Postembolization Syndrome

In the first postoperative week, approximately 10 to 15 percent of patients experience "postembolization syndrome" which is characterized by nausea, vomiting, malaise, low-grade fever, pain abdomen and elevated white blood count. The pain is due to ischemia induced by vascular occlusion and fever is because of the release of tissue breakdown products from degenerating uterine fibroids.[18] This condition must be distinguished from the more serious complication, i.e. sepsis. Management includes adequate pain control, hydration, prophylactic antibiotics and reassurance.

Infection

Infection is potentially the most serious complication following UAE.[19] Sepsis is suspected when high grade fever persists beyond the 24 to 48 hours typical of postembolization syndrome. It may vary from mild infection requiring a course of antibiotics to pelvic sepsis necessitating hysterectomy. The latter occurs in less than 1% cases and can be life-threatening. Sepsis is more frequent when UAE is performed on a very large uterus (more than 20 cm in height, when a single fibroid is larger than 9 cm in diameter or when there is a large submucous fibroid).

Fibroid Expulsion

Occasionally submucosal fibroids become necrotic and may be expelled vaginally following UAE. This transcervical fibroid extrusion has been reported in 5% of women[20] and may occur as a result of uterine shrinkage forcing an intramural fibroid into the uterine cavity.

Persistent Vaginal Discharge

This occurs in approximately 4% of women after embolization and may persist for a few weeks to many months.[21] It is due to expulsion of fibroid necrotic tissue.

Amenorrhea and Premature Menopause

Temporary amenorrhea and postprocedure menopause are not uncommon after UAE. As the blood supply to the ovaries is partially from the uterine arteries, the procedure of uterine embolization invariably diminishes the blood supply to the ovaries and results in some reduced ovarian function.[22] Post-embolization amenorrhea is usually transient, limited to a few cycles and is not considered a major complication. Permanent amenorrhea occurs in 15% of women beyond the age of 45 years and in 1% in younger women.[23] Therefore all women should be thoroughly counseled about this potential side effect and its consequences, prior to undergoing embolization.

Procedure Related Complications

There are some risks that are associated with any form of angiographic procedure, such as hematoma formation or infection at the catheter insertion site in the groin, contrast media reactions, and damage to blood vessels. They occur in less than 1% women. There are few case reports of unintended embolization (nontarget embolization) resulting in pelvic organ damage. It occurs either as a result of poor technique or due to presence of aberrant arteries. Radiation exposure occurring during UAE is a significant concern because many women who are candidates for the procedure are of childbearing age. With operator experience and attention to technique, fibroid

embolization may be performed at radiation exposure comparable to those used in routine diagnostic studies. By limiting fluoroscopy time, the use of magnified and oblique views, nonpulsed fluoroscopy and road-mapping, the absorbed ovarian dose may be minimized.[19]

EFFECT ON FERTILITY

The effect of embolization on fertility and pregnancy is still not fully established. Therefore, if UAE is safe for patients who wish to retain future fertility is controversial. In fact, ACOG Committee Opinion from 2004 states: "...There is insufficient evidence to ensure its (UAE) safety in women desiring to retain their fertility, and pregnancy-related outcomes remain understudied. The ACOG considers this procedure investigational or relatively contraindicated in women wishing to retain fertility...". This technique should only be used in patients desiring to remain fertile for whom there are no other feasible options.[24]

Inspite of its controversial status in women of reproductive age, successful conceptions, pregnancies and deliveries have been reported in literature.[9,21,24] It has seen suggested by some authors that the rates of miscarriage, intrauterine growth restriction, preterm delivery and postpartum hemorrhage are higher following UAE, all of which are complication considered to be due to alterations in uterine blood flow after the procedure.[25]

Other uses of uterine artery embolization.

Apart from the treatment of symptomatic fibroids, embolization of the uterine artery has been performed in other situations including:

- Postpartum and postcesarean hemorrhage
- Hemorrhage following gynecological surgery
- Hemorrhage following ectopic pregnancy
- Arteriovenous malformations
- Hemorrhage complicating gynecological cancer
- Management of interstitial twin pregnancy.

CLINICAL OUTCOMES

The efficacy of uterine artery embolization can be determined by the degree of improvement or resolution of symptoms. Fibroid associated symptoms are generally divided into excessive menstrual bleeding, pelvic pain, and bulk related problems. Clinical success rates for treating these symptoms have been found to range from 81-96%, 70-100% and 46-100% respectively.[7,21] A 25-60% reduction in uterine volume has been reported between 3-6 months following UAE.[7,21] However, reduction in fibroid volume do not always reflect an improvement in clinical symptoms.

Comparison of UAE and hysterectomy and their clinical outcome has also been carried out in few clinical trials.[26,27] UAE has been shown to be associated with a shorter hospital stay and recovery time when compared to hysterectomy. Whilst associated with a low complication rate, the higher readmission rates after embolization highlight the need careful post-procedural follow-up.

Long-term data on outcomes after UAE are not currently available and the effects of the procedure on both fertility and pregnancy are controversial. Therefore more prospective studies are required to compare embolization to other uterine sparing surgeries.

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