Uterine Artery Embolization

This therapeutic option for treating fibroid disease has steadily gained acceptance due to its advantages over surgical therapies.

BY ROBERT L. WORTHINGTON-KIRSCH, MD

Fibroids are benign tumors of the uterine myometrium. They occur in all populations and are the most common tumor of the female reproductive tract. In some populations, fibroids are present in >70% of adult women.[1] Fibroids cause symptoms in approximately half the women who have them, most commonly bleeding abnormalities such as menorrhagia and pressure symptoms such as urinary frequency and nocturia. Given its prevalence in the population and the symptoms they can cause, fibroid disease is a major public health problem, accounting for significant losses in productivity in our society.[2]

Among women between the ages of 30 and 50, fibroid disease is by far the most common indication for hysterectomy, and this is the age group in which the majority of hysterectomies are performed.[3] Among African American women, approximately 1 in 5 has had a hysterectomy by age 50, and >70% of these have been because of fibroid disease.

GENESIS OF UTERINE ARTERY EMBOLIZATION FOR FIBROIDS

Almost from the first reports of the procedure, embolization of the uterine arteries has been the standard of care for management of postpartum[4] or postsurgical[5] uterine hemorrhage that does not respond to conservative measures. Given the fact that excessive bleeding is a major cause of intraoperative (as well as postoperative) morbidity associated with myomectomy,[6] it is surprising that preoperative uterine artery embolization (UAE) was not attempted in the early 1980s.

In the late 1980s, a gynecologist in Paris named Jacques Ravina started to investigate the utility of preoperative embolization of the uterine arteries as a maneuver to prevent intraoperative and postoperative hemorrhage. Given the nature of the French medical system, women in his series often had their embolizations performed several days or as much as a few weeks before their surgeries were scheduled. Some of these women contacted Dr. Ravina and refused to proceed to surgery, claiming that the embolization alone had relieved their symptoms of menorrhagia and/or pressure (Ravina JH, personal communication, 1999).

Dr. Ravina published his findings in 1995; the first such publication was an article demonstrating the utility of embolotherapy as a preoperative therapy to decrease hemorrhagic complications of myomectomy.[7] Second, and more important in the long run, was his report in *The Lancet* demonstrating the utility of embolization as a definitive therapy for fibroid disease.[8]

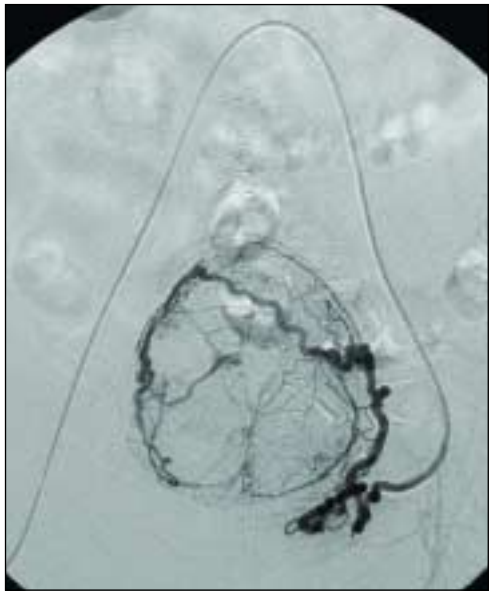

Figure 1. Selective injection of the left uterine artery. Note how the vessels wrap around the dominant fibroid.

In late 1995, an American gynecologist, Bruce McLucas, met Dr. Ravina at a meeting in Paris and was exposed to the concept of embolization for fibroid disease. Upon returning to UCLA, he and interventional radiologist Scott Goodwin began to offer embolotherapy as a primary treatment for fibroid disease. The first

American publication about UAE appeared in 1996.[9]

This article caught the eye of a gynecologist in Philadelphia named Francis Hutchins. He and I had met a few weeks earlier while making rounds, and he came looking for me with the article in hand. After reading the article and speaking by telephone with Dr. Goodwin, I began to perform UAE for fibroid disease in Philadelphia in September 1996.

Dr. Goodwin presented his early experience with UAE at the 1997 SCVIR meeting,[10] and the technique made a significant media splash. Since that time, UAE as a definitive therapy for fibroids has mushroomed in popularity among patients, interventional radiologists, and (to a lesser extent) gynecologists. As of the close of 2003, it was estimated that the worldwide experience with UAE was more than 50,000 cases, approximately half of which have been performed in the US. UAE currently accounts for approximately 50% of my practice (20 to 25 procedures/month) and accounts for a significant portion of the practice time of many others.

PREOPERATIVE CONSULTATION AND EVALUATION

Candidates for UAE must have symptomatic fibroid disease. Absolute exclusion criteria are pregnancy and untreated infection. The major relative contraindications are the presence of other pelvic pathology—such as endometriosis, coexisting adenomyosis, or an adnexal mass—and those issues that would be general contraindications to an angiographic procedure, such as renal failure or contrast allergy.

The preprocedure evaluation for UAE is cooperative between the interventional radiologist and the gynecologist. Communication and cooperation between the physicians is important because the interventional radiologist must take primary responsibility for the UAE, whereas the gynecologist will treat most other conditions identified during the evaluation. This need for cooperation carries over after UAE is performed because the interventional radiologist is responsible for overall follow-up and management of post-UAE issues, except when a gynecologic procedure is needed.

Two important components of the pre-UAE evaluation are endometrial evaluation and preprocedure imaging. In my practice, I request endometrial evaluation on all women over the age of 40 and on all women who have intermenstrual bleeding (metrorrhagia). This is usually done as an office endometrial biopsy performed by the gynecologist. However, some gynecologists prefer office hysteroscopy or even dilation and curettage.

Preprocedure imaging is important to confirm the diagnosis of fibroids, evaluate for some specific anatomic features that may affect patient or procedure selection, and to exclude other pelvic pathologies, especially adenomyosis. Because patients come from many different referring physicians and may be capitated to any of a number of different diagnostic radiology sites, I have found ultrasound to be largely useless for preprocedure imaging. While ultrasound may confirm the presence of fibroid disease, it is relatively insensitive for adenomyosis and usually does not provide the anatomic detail necessary for decision making in some situations. At this point, I insist that all patients undergo MRI examination of the pelvis, and that I personally review the films, as part of the pre-UAE evaluation.

I also obtain a complete blood count, BUN/creatinine, random follicle-stimulating hormone level, and a lactate dehydrogenase (LDH) isoenzyme panel. If the LDH is elevated with an abnormal isoenzyme distribution, I then obtain a dynamic contrast-enhanced MRI of the uterus to evaluate for early enhancement. Should this show abnormal early enhancement of the uterine masses, I recommend that the patient have surgery rather than UAE.[11]

Figure 2. Injection of the left internal iliac artery after embolization of the left uterine artery with 6 mL of 500-µm to 700-µm diameter tris-acryl microspheres. The arrow is beside the main uterine artery trunk, which remains patent with slow flow.

The presence of dominant adenomyosis or a suspicious adnexal mass are, in my practice, exclusion criteria for UAE. If a woman has a surgically removable submucosal or intracavitary fibroid and would likely obtain symptom relief from hysteroscopic myomectomy, I believe that this procedure is arguably less invasive than UAE. I do not have any upper limit on the size of the uterus or fibroids for UAE.[12,13] Pedunculated subserosal fibroids with narrow stalks are rare, but appear to be at risk for sloughing into the peritoneal

cavity. In these women, a combination of UAE followed by laparoscopic resection of the exophytic fibroid may be the best solution.[14]

> "The presence of dominant adenomyosis or a suspicious adnexal mass are, in my practice, exclusion criteria for UAE."

All patients for UAE must be seen by the interventional radiologist in an office-consultation setting to review history, laboratory and imaging studies, and to discuss treatment options. As the treating physician, the interventional radiologist is responsible for obtaining the informed consent for UAE.

UAE PROCEDURE

On arrival at the hospital, patients are admitted into the same-day surgery unit. A serum pregnancy test is drawn on admission, a small-bore (8-F or 10-F) Foley catheter is placed, and an IV is started. Patients are premedicated with a single dose of antibiotics and a transdermal scopolamine patch as antibiotic and antiemetic prophylaxis. In my practice, a pelvic ultrasound is obtained immediately before UAE to be sure that there has been no significant change since the pre-UAE evaluation and to provide a baseline for ongoing volume measurements.

The procedure itself is done from the right femoral approach. I offer patients a choice between IV conscious sedation (with hydromorphone, midazolam, and fentanyl citrate) and spinal analgesia (with morphine, fentanyl, and bupivicaine) augmented with IV midazolam. Patients also receive IV ketorolac tromethamine during the procedure. The left and right uterine arteries are sequentially catheterized and embolized (Figure 1). I use 5-F catheters for the procedure, placing the catheter tip in the midportion of the transverse segment of the left uterine artery, and at or beyond the junction of the descending and transverse segments of the right uterine artery. Spasm of the uterine arteries is, in my experience, usually due to excessive catheter and guidewire manipulation. If there is absolutely no flow around the 5-F catheter, or a 5-F catheter cannot be advanced into appropriate position, I will use a microcatheter. The exact choice of catheter is in my opinion irrelevant, and operators should use the catheter or catheters with which they are comfortable. In my practice, I accomplish >85% of cases using a Levin 1 curve (Cook Incorporated, Bloomington, IN). Most other cases are done using an Osborn 2 curve (Cook Incorporated), and I occasionally use a Roberts uterine artery curve (Cook Incorporated).

Gelatin sponge particles should not be used for UAE. One cannot control the level of embolization because of difficulty in controlling particle size, particle clumping, and vessel spasm incited by the material. In addition, the inflammatory response incited by gelatin sponge material is, in my experience, sufficient to obliterate the uterine artery, eliminating the opportunity for repeat embolization, should the patient's symptoms recur. This is particularly important in younger patients, who may develop new fibroids between UAE and menopause.

"Classic" ground PVA preparations also should not be used for UAE. Again, the level of embolization is unreliable due to particle clumping, and this material has a distinct tendency to clog the delivery catheter. Given the development of calibrated microspheres for embolization, I feel that ground PVA is an obsolete device.

There are many calibrated microsphere products on the market that can be used for UAE. These materials offer more reliable control of the level of embolization and are easy to use because catheter clogging is minimized. In most cases, I use 500-µm to 700-µm–sized particles because the target vessel for UAE is a 550-µm to 650-µm vessel in the perifibroid plexus.[15,16] I will upsize to 700-µm to 900-µm–sized particles if I see the utero-ovarian anastomosis before starting the embolization (to avoid penetration of these small particles into the parenchyma of the ovary if there is reflux of embolic material into the ovarian artery) or after I have administered 6 mL to 8 mL of 500-µm to 700-µm–sized particles into a uterine artery without reaching the desired embolization endpoint (Figure 2).

At a vascular level, the endpoint for embolization is when the perifibroid plexus has been embolized without significant embolization of normal uterine parenchyma. The sign that the endpoint has been reached can be subtle. When embolizing, I look for angiographic evidence that there has been a significant change in the flow distribution within the uterine vascular bed. These signs include the filling of new collaterals in the uterine vascular bed, such as branches of the opposite uterine artery or the utero-ovarian anastomosis, cessation of filling of the branches of the ascending segment of the uterine artery (the "pruned tree"), or reflux of contrast proximal to the catheter tip. After embolization, there should be slow pulsatile flow within the main uterine artery without filling of intrauterine branches.

Patients develop crampy abdominopelvic pain after UAE, a sensation that is often described as similar to dysmenorrhea or labor. Most patients will require IV narcotics in addition to postoperative NSAIDs for the first

several hours after the procedure, and almost all stay overnight on a "23-hour observation" basis. Patients are discharged the next morning on NSAIDs, supplemented with narcotics if needed, and are usually back at work within 2 weeks.[17,18]

The treating interventional radiologist *must* take responsibility for follow-up and management of complications of UAE. Follow-up should be on a regular schedule to assess patients for progress of recovery, complications, and recurrence of symptoms. In my practice, patients are contacted by telephone 24 to 48 hours after discharge after the procedure, have an office visit at 2 weeks after UAE, are contacted again about 1 month after the procedure, are seen in the office at 3 and 12 months postprocedure, and then annually until they have completed menopause. Of course, my staff and I are available to see patients at any point should a problem arise.

Most issues that arise after UAE can be assessed and managed over the telephone or in an office-visit setting. Prolonged post-UAE discomfort, postembolization syndrome, and vaginal discharge are common and need to be addressed with expertise, confidence, and a reassuring manner. Sloughing fibroids can initially be managed on an outpatient basis, but may require gynecologic evaluation and hysteroscopy/dilation and evacuation. For this reason, the interventional radiologist must always keep the referring gynecologist aware of the patient's status and condition. I do this by preparing a letter to the referring physicians about all office visits; the letters and my handwritten notes also serve as a major component of each patient's office chart.

CONCLUSION

UAE is as effective at controlling fibroid symptoms as hysterectomy, and it is more effective for control of most symptoms than myomectomy.[19-23] Symptom control appears to be at least as durable as after myomectomy. Compared to surgical therapy options, UAE has the advantages of shorter hospitalization, faster recovery, and apparently lower risk of significant/severe complications.

There are still many unanswered questions about UAE for fibroid disease. The most important of these are long-term (>3 years) durability and complication rates, and issues surrounding fertility after the procedure. Many of these questions will be addressed by projects such as the SIR FIBROID Registry,[24] the Toronto UFE study, and randomized controlled trial of UAE versus surgery currently being conducted in Scotland (Moss J, personal communication, September 2003) and Holland (Reekers JA, personal communication, September 2003). However, the currently available data firmly establish UAE as a viable and valuable minimally invasive option for the treatment of fibroid disease. ■

Robert L. Worthington-Kirsch, MD, is the Division Chief of Interventional Radiology at Tenet Roxborough Memorial Hospital in Philadelphia, and President of Image-Guided Surgery Associates, Philadelphia, Pennsylvania. He has disclosed that he is a paid consultant for Biosphere Medical. Dr. Worthington-Kirsch may be reached at (215) 508-5261; kirsch@igsapc.com.

1. Cramer SF, Patel D. The frequency of uterine leiomyomas. *Am J Clin Pathol.* 1990;94:435-438.
2. Greenberg MD, Kazamel TG. Medical and socioeconomic impact of uterine fibroids. *Obstet Gynecol Clin N Am.* 1995;22:625-636.
3. Myers ER, Barber MD, Couchman GM, et al. Evidence report: management of uterine fibroids. Agency for Healthcare Research and Quality, Contract No. 290-97-0014, Task Order 4, September 2000.
4. Heaston DK, Mineau DE, Brown BJ, et al. Transcatheter arterial embolization for the control of persistent massive puerperal hemorrhage after bilateral surgical hypogastric artery ligation. *AJR.* 1979;133:152-154.
5. Oliver JA, Lance JS. Selective embolization to control massive hemorrhage following pelvic surgery. *Am J Obstet Gynecol.* 1979;135:431-432.
6. Wallach EE. Myomectomy. In: Thompson JD, Rock JA, eds. Te Linde's Operative Gynecology. 7th ed. Philadelphia: J.B. Lippincott; 1992:647-662.
7. Ravina JH, Bouret JM, Fried D, et al. Value of preoperative embolization of uterine fibroma: report of a multicenter series of 31 cases. *Contracept Fertil Sexual.* 1995;23:45-49.
8. Ravina JH, Herbreteau D, Ciraru-Vigneron N, et al. Arterial embolisation to treat uterine myomata. *Lancet.* 1995;346:671-672.
9. McLucas B, Goodwin SC. A fibroid treatment with promise—and a catch. *Obstet Gynecol Manag.* 1996;53-57.
10. Goodwin SC, Vedantham S, McLucas B, et al. Uterine artery embolization for uterine fibroids: results of a pilot study. *J Vasc Intervent Radiol.* 1997;8:517-526.
11. Goto A, Takeuchi S, Sugimura K, et al. Usefulness of Gd-DTPA contrast-enhanced dynamic MRI and serum determination of LDH and its isozymes in the differential diagnosis of leiomyosarcoma from degenerated leiomyoma of the uterus. *Int J Gynecol Cancer.* 2002;12:354-361.
12. Katsumori T, Nakajima K, Mihara T. Is a large fibroid a high-risk factor for uterine artery embolization? *AJR.* 2003;181:1309-1314.
13. Golzarian J, Lohle P, Walker WJ, et al. Uterine fibroid embolization for large symptomatic fibroids. *J Vasc Intervent Radiol.* 2003;14:S40.
14. Pelage JP. Uterine fibroid embolization: indications and results. Paper presented at: CIRSE 2003 Scientific Meeting, September 20-24, 2003, Antalya-Belek, Turkey.
15. Pelage JP, Laurent A, Wassef M, et al. Uterine artery embolization: choice of an embolic particle. *J Vasc Intervent Radiol.* 2000;11:189.
16. Worthington-Kirsch RL, Fueredi GA, Goodwin SC, et al. Polyvinyl alcohol particle size for uterine artery embolization. *Radiology.* 2001;218:605-606.
17. Andrews RT, Spies JB, Sacks D, et al. Patient care and uterine artery embolization for leiomyomata. *J Vasc Intervent Radiol.* 2004;15:115-120.
18. Siskin GP, Bonn J, Worthington-Kirsch RL. Uterine fibroid embolization: pain management. *Tech Vasc Intervent Radiol.* 2002;5:35-43.
19. Razavi M, Hwang G, Jahed A, et al. Abdominal myomectomy versus uterine fibroid embolization in the treatment of symptomatic uterine leiomyomas. *AJR.* 2003;180:1571-1575.
20. Pinto I, Chimeno P, Romo A, et al. Uterine fibroids: uterine artery embolization versus abdominal hysterectomy for treatment—a prospective, randomized, and controlled clinical trial. *Radiology.* 2003;226:425-431.
21. Spies JB, Cooper J, Worthington-Kirsch RL, et al. Outcome from uterine embolization and hysterectomy for treatment of leiomyomas: results of a multi-center comparative study. Paper presented at: Society of Interventional Radiology, 28th Annual Scientific Meeting; March 2003; Salt Lake City, Utah.
22. Goodwin SC, Bradley LD, Lipman JC, et al. Uterine artery embolization versus myomectomy: a multi-center comparative study. Paper presented at: Society of Interventional Radiology 29th Annual Scientific Meeting; March 2004; Phoenix, Arizona.
23. Pron G, Bennett J, Common A, et al. The Ontario uterine fibroid embolization trial. Part 2. Uterine fibroid reduction and symptom relief after uterine artery embolization for fibroids. *Fertil Steril.* 2003;79:120-127.
24. www.fibroidregistry.org