Clinical and Periprocedural Pain Management for Uterine Artery Embolization

Elizabeth Brooke Spencer, MD, FSIR¹ Peter Stratil, MD, MBA¹ Heidi Mizones, NP¹

¹RIA Endovascular, Greenwood Village, Colorado

Semin Intervent Radiol 2013;30:354–363

Address for correspondence Elizabeth Brooke Spencer, MD, FSIR, RIA Endovascular, 8200 E Belview Avenue, Suite 600E, Greenwood Village, CO 80111 (e-mail: brooke.spencer@riaco.com).

Abstract

Keywords

- uterine fibroid embolization
- UAE
- pain
- superior hypogastric nerve block
- postembolization syndrome
- interventional radiology

Uterine artery embolization has Level A data supporting excellent safety and efficacy in treating symptomatic uterine leiomyomata. However, there is a perception that either postprocedural pain is severe or poorly managed by the physician performing these procedures. This has led some primary care physicians to omit this procedure from the patients' options or to steer patients away from this procedure. A few simple techniques (pruning of the vascular tree and embolizing to 5–10 beat stasis) and fastidious pre-, intra-, and post-procedural management can nearly eliminate significant pain associated with embolization. Specifically, early implementation of long-acting low-dose narcotics, antiemetics and anti-inflammatory medications is critical. Finally, the use of a superior hypogastric nerve block, which takes minutes to perform and carries a very low risk, significantly reduces pain and diminishes the need for narcotics; when this technique was used in a prospective study, all patients were able to be discharged the day of the procedure. In the authors' experience, patients treated in this manner largely recover completely within 5 days and have a far less traumatic experience than patients traditionally treated with only midazolam (Versed) and fentanyl citrate (fentanyl) intraprocedurally, and narcotics and nonsteroidal antiinflammatory drugs postprocedurally.

Objectives: Upon completion of this article, the reader will be able to discuss the potential etiologies of pain caused by uterine fibroid embolization (UFE) and identify pre-, intra-, and post-procedural techniques to minimize pain.

Accreditation: This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of Tufts University School of Medicine (TUSM) and Thieme Medical Publishers, New York. TUSM is accredited by the ACCME to provide continuing medical education for physicians.

Credit: Tufts University School of Medicine designates this journal-based CME activity for a maximum of **1 AMA PRA Category 1 Credit™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Uterine artery embolization (UAE) has been evaluated and scrutinized in an effort to perfect the procedure for many years. Published studies have confirmed a high degree of efficacy in improving patient symptoms and satisfaction.^{1–7} However, the balance of managing nausea and providing adequate postprocedure pain control has always been the greatest challenge in treating patients in the short term after UAE. The hurdle to gain acceptance as a widely offered treatment for symptomatic fibroids, despite level A data accepted by the American College of Gynecology,⁸ has largely been the perception that postprocedural pain is severe and can be difficult to manage. Roth et al addressed this issue in early studies but could not determine any baseline variables, such as size or number of fibroids, and other factors to predict the degree of postprocedure pain. In addition, the degree of pain did not correlate with outcomes in that study.⁹

Issue Theme Women's Health and Interventional Radiology; Guest Editors, Kimi L. Kondo, DO and Laura Findeiss, MD, FSIR

Copyright © 2013 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.
Tel: +1(212) 584-4662.

DOI <http://dx.doi.org/10.1055/s-0033-1359729>.
ISSN 0739-9529.

Figure 1 Demonstration of 5-beat stasis during uterine artery embolization. (A) Pre-embolization angiogram with the microcatheter in the left uterine artery (arrow). (B–E) Postembolization angiography of the left uterine artery, with significantly decreased flow in the left uterine artery. Some antegrade flow is thought to help prevent severe pain, but still results in sufficient embolization for fibroid devascularization.

This prompted investigators to further evaluate techniques to determine if a specific endpoint and/or particle type could be identified to minimize pain while maintaining efficacy.^{10,11} There has been a trend in the past 5 to 10 years toward less aggressive embolization; many interventional radiologists now accept that pruning of the vascular tree and embolizing to 5- to 10-beat stasis (→Fig. 1) are adequate endpoints, as opposed to the initial belief that complete uterine artery stasis is necessary. This less-aggressive embolization may aid in reducing pain and emergency room visits.¹²

In addition to changing procedural technique, several fairly simple principles can be employed to significantly limit intraprocedure anxiety and diminish post-procedural pain. The objective of this article will be to discuss the potential causes of pain and determine pre-, intra-, and post-procedure techniques to minimize pain and nausea.

Etiology of Pain Associated with Postembolization Syndrome

UAE is highly effective to treat symptoms associated with leiomyomata; however, this treatment initiates a cascade of events resulting in a typical postembolization syndrome (PES) experienced by a majority of patients who undergo UAE.

PES is the constellation of symptoms experienced by patients who have infarcted all or a portion of an organ. It usually consists of pain, nausea and/or vomiting, fever, fa-

tigue, and malaise. In the field of interventional radiology, this syndrome is commonly observed in patients who, for example, undergo hepatic artery bland embolization or chemoembolization, preoperative embolization for nephrectomy or splenectomy, and UAE.

The cause of PES is thought to be ischemia of the treated organ. In the case of UAE, ischemia of the normal myometrium is believed to be the primary source of pain.^{12–14} Ischemic pain, in general, is only partially understood, but perhaps is best studied in the case of cardiac angina. Ischemia reduces the formation of adenosine triphosphate, which results in acidosis from anaerobic metabolism, the loss of membrane integrity, and the release of chemical mediators such as lactate and adenosine that stimulate chemosensitive receptors. Such mediators are thought to cause the symptoms of PES.¹⁵

The symptoms of PES after UAE follow a typical pattern. In our experience, pelvic pain and cramping worsen during the first 2 to 3 hours after the procedure, reaching a constant level for 8 to 12 hours, after which the pain usually subsides to a significantly lower level. This is variable, however, depending on the treatment regimen employed (see below). Whether this is due to partial recanalization of the uterine arteries is unknown.¹² Patients experience other symptoms such as fever and fatigue that typically peak 2 to 3 days after the procedure.

The largest assessment to date regarding the symptoms associated with UFE was performed by Pron et al, who

assessed 555 women who underwent UFE. In this study, the intraprocedural pain was 0/10 in 70% of the women. However, the postprocedure pain could be severe, with a mean pain score of 7/10 ($\pm$ 2.47) and a mean hospital stay of 31.2 hours. Other reported symptoms were fever (29%), vaginal discharge (21%), spotting (22%), and bleeding (32%).¹⁶

Bruno et al studied in detail the symptoms experienced by 99 patients following UAE. In this study, the highest mean visual analog score of symptoms was seen at noon postoperatively on day 2 with a mean score of 4.33 out of 10. This pain continued to decrease during the first week. One-third of patients reported having a fever of greater than 37.5°C, which was most common on the third postprocedural day. Overall, the symptoms in weeks 2 to 4 were limited.¹⁷

Understanding the cause of pain and the typical timeline of patient symptoms allows the interventional radiologist to tailor patient care efforts toward addressing these symptoms.

Preprocedure Routine

The management of fibroid patients before embolization varies from institution to institution. At the authors' initial consultation before the procedure, expectations of the procedure as well as expected recovery and postprocedure symptoms are outlined. The patient is comforted by knowing what will happen from the time she arrives in the department until the time she is discharged. It is helpful to provide the patient with an information sheet with frequently asked questions and an outline of expected parameters in the postprocedure setting as well. Specifically, the authors have found that if a patient expects pain at a certain time and is aware that such pain is not a sign of a serious complication, her anxiety and perception of the pain are reduced.

Before the procedure, it is important to follow preprocedure routines and medications. Once informed consent is obtained, the patient is given intravenous ondansetron (Zofran) followed by a loading dose of hydromorphone hydrochloride (Dilaudid) along with a patient-controlled analgesia (PCA) using the same drug. Ketorolac (Toradol) is also administered, preferably in an intramuscular injection, due to the prolonged effect (approximately 8–10 hours). In extremely thin patients, the injection can be quite painful so intravenous ketorolac can be substituted (►Table 1). At the authors' institution, these medications are administered at least 30 minutes before the procedure begins.

Ondansetron has become the antiemetic of choice because it is well tolerated, effective, and does not carry the same side-effect profile and potential risks of other commonly used antiemetics. Hydromorphone hydrochloride is the authors' narcotic of choice because of a perceived decreased risk of nausea. For years, radiologists have been aware of the mechanism of action involving contraction of the sphincter of Oddi from morphine from its use in hepatobiliary scans (hepatobiliary iminodiacetic acid (HIDA)).¹⁸ In the setting of HIDA scans, this can be associated with a greater degree of nausea. However, in a small prospective randomized trial of 50 general surgery and gynecologic surgery patients comparing morphine and hydromorphone PCAs, there was no difference

Table 1 Nonsteroidal anti-inflammatories

Medications	Dosing	Preferred dosing for UAE	Mechanism of action	Half-life	Common reactions
Ketorolac (Toradol)	10 mg IV, 30 mg IM	30 mg IM q6 h	Exact mechanism of action unknown, inhibits cyclooxygenase, reducing prostaglandin and thromboxane synthesis	5.3 h	Headache, nausea, abdominal pain, dyspepsia, dizziness, somnolence, constipation, diarrhea, edema, rash, ALT/AST elevation, tinnitus, hypertension, pruritus, flatulence, diaphoresis, ecchymosis, photosensitivity
Naproxen (Aleve, Naprosyn)	250, 375, 500 mg; 125 mg/5 mL PO, IV	500 mg PO q12 h $\times$ 7 days postprocedure then PRN	Exact mechanism of action unknown, inhibits cyclooxygenase, reducing prostaglandin and thromboxane synthesis	12–17 h	Dyspepsia, nausea, abdominal pain, constipation, headache, dizziness, drowsiness, rash, ALT/AST elevation, fluid retention, tinnitus, ecchymosis, dyspnea, photosensitivity
Ibuprofen (Motrin)	100, 200, 400, 600, 800 mg	600–800 mg PO q8 h $\times$ 7 days postprocedure then PRN	Exact mechanism of action unknown, inhibits cyclooxygenase, reducing prostaglandin and thromboxane synthesis	1.8–2 h	Dyspepsia, nausea, abdominal pain, constipation, headache, dizziness, drowsiness, rash, ALT/AST elevation, fluid retention, tinnitus, ecchymosis, dyspnea, photosensitivity

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; IM, intramuscular; IV, intravenous; PO, per oral; PRN, as needed.

in nausea, pain scores, or systemic side effects. These authors suggested that the choice between hydromorphone and morphine sulfate PCA should be based on patient history.¹⁹ Standard dosing regimens, adverse reactions, and alternative medications are listed in ► **Table 2** (antiemetics) and ► **Table 3** (narcotics).^{18,20}

The routine use of midazolam (Versed) and fentanyl citrate (fentanyl) during the procedure is effective intraprocedurally and is largely used in interventional radiology for moderate sedation. However, most UAE patients do not develop pain until after the procedure is complete. By the time they are in recovery, fentanyl citrate (► **Table 3**) begins to wear off, after which the patient often requires large boluses of narcotics to “catch up.” Long-acting narcotics can take 20 to 30 minutes to take full effect. By administering longer-acting medications before the patient begins to experience pain, the dose required to control the pain is less. A lower dose of narcotics may decrease the level of nausea many patients experience as well.

The authors have found that Foley catheter placement improves visualization of pelvic structures during embolization by emptying the bladder of contrast. The catheter is always placed after administration of the narcotic loading dose, which decreases anxiety associated with catheter placement. In addition, the patient does not need to get out of bed to void in the immediate postprocedural period when pain can be greatest. Hydration is also very important to speed recovery. Foley catheter placement allows for hydration without frequent trips to the rest room. After the period of bed rest that helps prevent complications related to femoral artery access, the authors allow the patient to decide if the catheter is removed that day or the following morning. Surprisingly, most patients who initially balk at placement of the catheter later choose to keep it in place until the following morning.

Intraprocedural Pain Control Measures

Administration of buffered local 1% lidocaine hydrochloride (lidocaine) at the femoral artery access site with ultrasound guidance removes pain and discomfort associated with both sheath access and placement of a closure device. In addition, it can be used to create a plane between the vessel and adjacent soft tissues, improving ease of placement and effectiveness of some closure devices as well (► **Fig. 2**).

Tumescent anesthesia revolutionized liposuction and other plastic and dermatologic surgical procedures by enabling large areas to be anesthetized and treated without needing general anesthesia.^{21–23} In interventional radiology, this technique has been adopted to allow saphenous vein ablation to be performed in an office setting, often without any sedation.^{24,25} Ultrasound-guided administration of local anesthetic around veins is thus a common technique to many interventional radiologists. However, the adoption of this technique on a smaller scale for routine vascular access has not been widely adopted but can make a significant difference the patient's perception of the experience whether used for arterial or venous access.

Table 2 Antiemetics

Medications	Dosing	Preferred dosing for UAE	Mechanism of action	Half-life	Common reactions
Ondansetron (Zofran)	4, 8, 16, 24 mg; 4, 8 mg ODT; 4 mg/5 mL IM; IV; PO	4–8 mg IV or PO q4 h PRN	Selectively antagonizes serotonin 5-HT ₂ receptors	4.6–5.7 h, 20 h (severe hepatic impairment)	Headache, constipation, fatigue, diarrhea, hypoxia, pyrexia, urinary retention, dizziness, agitation, pruritus
Promethazine (Phenergan)	12.5, 25, 50 mg; 6.25 mg/5 mL IM, IV, PO	12.5 mg IV or PO q6 h PRN	Nonselectively antagonizes central and peripheral histamine H ₁ receptors, possesses anticholinergic properties, resulting in antiemetic and sedative effects	7–14 h	Drowsiness, sedation, blurred vision, dizziness, confusion disorientation, extrapyramidal signs, xerostomia, photosensitivity, dermatitis, rhinitis, urinary retention

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; IM, intramuscular; IV, intravenous; PO, per oral; PRN, as needed.

Table 3 Narcotics

Narcotics	Dosing	Preferred dosing for UAE	Mechanism of action	Half-life	Common reactions
Hydromorphone (Dilaudid)	2, 4, 8 mg; 3 mg supp; SC; IM; IV		Binds to various opioid receptors, producing analgesia and sedation (opioid agonist)	2.3 h (IV), 2.5 h (PO)	Dizziness, somnolence, nausea/vomiting, hyperhidrosis, flushing, dysphoria/euphoria, xerostomia, pruritus, headache, constipation, anorexia, rash, insomnia, anxiety/agitation, muscle spasms, depression, abdominal cramps, injection site reaction
Morphine sulfate (Morphine)	15, 30 mg; 15, 20, 30, 50, 60, 80, 100, 200 mg ER; 2, 4, 20 mg/mL sol; 5, 10, 20, 30 mg supp; SC; IM; IV; INJ		Binds to various opioid receptors, producing analgesia and sedation (opioid agonist)	2–4 h	Somnolence, constipation, nausea/vomiting, dizziness, diaphoresis, dysphoria, euphoria, headache, edema, abdominal pain, pruritus, flushing, xerostomia, asthenia, paresthesia, urinary retention, decreased libido, miosis
Fentanyl citrate (Fentanyl)	25, 50, 100 µg IM, IV		Binds to various opioid receptors, producing analgesia and sedation (opioid agonist)	3.7 h	Somnolence, nausea, vomiting, confusion, asthenia, constipation, xerostomia, diaphoresis, dizziness, urinary retention, nervousness, euphoria, hallucinations, dyspnea, pruritus, hypotension, bradycardia, muscle rigidity, biliary spasm, impaired coordination
Hydrocodone/acetaminophen (Vicodin)	5/500 mg	1–2 tablets PO q4–6 h PRN	Binds to various opioid receptors, producing analgesia and sedation, acetaminophen exact mechanism of action unknown, produces analgesia and antipyretic effects	3.8–4.9 h	Lightheadedness, dizziness, sedation, nausea/vomiting, constipation, drowsiness, psychomotor impairment, rash, pruritus
Oxycodone/acetaminophen (Percocet)	2.5/325, 5/325, 7.5/325, 7.5/500, 10/325, 10/650mg	1–2 tablets PO q4–6 h PRN	Binds to various opioid receptors, producing analgesia and sedation (opioid agonist), acetaminophen exact mechanism of action unknown, produces analgesia and antipyretic	3.5–4 h	Constipation, nausea, somnolence, dizziness, pruritus, vomiting, headache, insomnia, xerostomia, asthenia, diaphoresis, anorexia, nervousness, fever/chills, confusion, diarrhea, abdominal pain, dyspepsia, rash, anxiety, dysphoria/euphoria

Abbreviations: IM, intramuscular; IV, intravenous; PO, per oral; PRN, as needed.

Figure 2 Demonstration of tumescent anesthesia. (A) Vessel and subcutaneous soft tissues before local anesthetic administration. (B) Local anesthetic administered directly adjacent to the vessel before vascular access. (C) Needle access through tumescent lidocaine field.

Another local technique proven to be safe and effective is the superior hypogastric nerve block (SHNB). In the authors' practice, there is no doubt that this is the key to improved patient satisfaction. The superior hypogastric nerve plexus courses along the anterior surface of the aorta and then onto the spine at the aortic bifurcation. This divides into the right and left plexus extending inferiorly. Each division is considered a hypogastric nerve, which continues into the pelvis and form the inferior hypogastric nerve plexus that supplies the uterus (►Fig. 3).

In 2004, Rasuli et al evaluated 139 patients in a prospective trial with the goal of same-day discharge after UAE. All patients were treated with a SHNB during the procedure. Patients were given 1 of 2 postprocedure drug regimens: (A) short-acting morphine and indomethacin rectal suppositories, or (B) long-acting morphine for baseline pain; short-acting morphine for breakthrough pain; and naproxen rectal suppositories. All patients were able to be discharged the

same day. Seven patients (5%) returned because of pain. The mean peak pain score in the first 5 days in patients in group A was $4.8 (\pm 2.6)$, while the peak pain score for patients in group B was only $2.7 (\pm 2.5)$.²⁶ Similarly, the authors have found that the combination of SHNB and anti-inflammatories have significantly reduced the need for narcotics and, therefore, the associated side effects after UAE.

To perform a SHNB, the arterial access catheter is placed over the aortic bifurcation, which helps to splay the aorta and creates an easier access for needle placement (►Fig. 4A). The periumbilical region is sterilely prepped and draped. Local lidocaine is placed in the skin and anterior peritoneal lining with a 25-gauge needle. Using a long hemostat and fluoroscopic guidance, a 22-gauge needle is advanced directly onto the anterior surface of the vertebral body (usually L4–L5) just beneath the aortic bifurcation (►Fig. 4B). Care should be taken to avoid the disc space secondary to the exceedingly rare risk of discitis. Some operators cite concern for passing the needle through bowel as a reason to defer the SHNB. Radiologists have biopsied lesions with a 22-gauge needle through bowel for years without significant adverse outcomes.²⁷ Using connector tubing, contrast is injected to confirm spread in the extravascular space, after which 15 to 20 mL of 0.5% bupivacaine hydrochloride is injected. Brief fluoroscopic evaluation shows spread of the contrast and confirms continued extravascular spread (►Fig. 4C). It is important to apply gentle pressure to the needle with the hemostat during administration of bupivacaine hydrochloride, and it is critical to be extravascular as a rare but catastrophic potential side effect of intravascular injection is cardiac arrest (►Table 4). The anesthetic effect lasts some time between 8 and 12 hours, significantly decreasing the patient's need for narcotics, and thus the risk of nausea.

Figure 3 Schematic of the hypogastric nerves. The hypogastric nerves originate from the superior hypogastric nerve plexus just below the aortic bifurcation. The hypogastric nerves then continue into the pelvis to form the inferior hypogastric nerves, which innervate the uterus.

Postprocedure Care

Postprocedural care includes hydration, nonsteroidal anti-inflammatories, antiemetics, and narcotics. The typical patient population undergoing UAE tends to be narcotic naïve; therefore, nausea can be a prevalent problem with use of PCA pumps in the postoperative setting. At the authors'

institution, patients are admitted to the hospital overnight for pain and nausea management, and supportive care.

Postprocedure Outpatient Care

The PCA is continued and ketorolac (Toradol) is given every 6 hours (30 mg intravenously) until the following morning. At that time, the patient is transitioned to oral narcotic pain medicine and nonsteroidal anti-inflammatories. Ketorolac (Toradol) is stopped and naproxen (500 mg orally twice daily) is started for a total of 7 days (► **Table 1**). Oral narcotics may be prescribed (► **Table 3**). If continued narcotic use is anticipated, the patient should be given medication early to combat constipation (► **Table 5**). Polyethylene glycol 3,350 (Miralax (Merck, Whitehouse Station, NJ)) and sennosides (Sennakot (Purdue, Stamford, CT)) are two preferred stool softeners, but these can take days to take full effect.

Once pain and nausea are adequately controlled, the patient is discharged from the hospital. This occurs typically within 23 hours of admission, and therefore qualifies as an outpatient procedure at most institutions.

Discharge Medications

A narcotic pain medicine such as oxycodone/acetaminophen (Percocet) or hydrocodone (Vicodin) is prescribed as needed at discharge (► **Table 3**). Many women choose not to fill this prescription, opting for nonsteroidal antiinflammatory drugs (NSAIDs) alone. The authors encourage NSAID use for 7 days and then as needed. Over-the-counter stool softeners and/or laxatives are continued (► **Table 5**).

Postprocedure Patient Instructions

Patients are provided with postprocedure instructions as follows:

1. *Decrease physical activity.* For 3 to 5 days after the procedure, refrain from strenuous physical activity and lifting greater than 15 to 20 pounds.

2. *Avoid using tampons for 1 week.*
3. *Do not have intercourse for 1 week.*
4. *Showering is permitted.* Avoid bath tubs, hot tubs, and swimming pools for 5 days.
5. *Be aware of PES.* Low-grade temperatures less than 101.5 F, myalgia, pelvic cramping, generalized flu-like symptoms, and generalized fatigue should be expected. Symptoms typically last 3 to 5 days postprocedure and improve by the end of 7 days. For these reasons, patients are encouraged to take 1 week off from work.
6. *Expect vaginal discharge.* Passage of leiomyoma tissue and brown and/or reddish brown vaginal discharge can be expected for 1 to 2 weeks after the procedure.
7. *Call with questions or warning signs.* Contact the interventional radiologist and/or interventional radiology clinic if any of the following occur:
 - (a) Fever greater than 100.5 F lasting 3 days.
 - (b) Thick or foul-smelling vaginal discharge.
 - (c) Severe pelvic pain uncontrolled by narcotic pain medicines.
 - (d) Intractable nausea or vomiting.
 - (e) Any bleeding concerns.

Follow-Up

A 2-week follow-up visit at the interventional radiology clinic is scheduled on the day of discharge. The follow-up office visit is designed to ensure PES has resolved, to check the groin site for complications, and to provide time for both questions and patient reassurance.

At 3 months postprocedure, the patient is called to monitor for symptom resolution and provides the opportunity to address any concerns.

At 6 months postprocedure, patients are scheduled for a pelvic magnetic resonance imaging (MRI) with and without gadolinium to evaluate for residual fibroid vascularity and fibroid volume reduction. Benign leiomyoma versus leiomyosarcoma cannot be definitively distinguished on preoperative evaluation such as endometrial biopsy or MRI.^{28,29} Therefore,

Figure 4 Hypogastric nerve block. (A) The proper needle positioning for the nerve block. A catheter is placed over the aortic bifurcation to both splay the bifurcation and to show its location without contrast (black arrow). A 22-gauge needle is advanced from an anterior approach to the vertebral body just below the aortic bifurcation (white arrow). (B) Demonstrates contrast injection in the retroperitoneum in the extravascular space (arrows). This is more easily appreciated in an oblique view. (C) Demonstrates an anteroposterior view during injection of bupivacaine. This is performed with gentle forward pressure on the needle to ensure continued extravascular spread of anesthetic.

Table 4 Local anesthetics

Medications	Dosing	Preferred dosing for UAE	Mechanism of action	Half-life	Common reactions
Lidocaine (Xylocaine, LidaMantle)	0.5%, 1%, 1.5%, 2%, 4% IV	1% Lidocaine 9 mL mixed with sodium bicarbonate (4.2%) 1 mL	Inhibits sodium ion channels, stabilizing neuronal cell membranes and inhibiting nerve impulse initiation and conduction (amide local anesthetic), depresses action potential phase 0 (class 1B antiarrhythmic)	1.5–2 h	Injection site pain, lightheadedness, tremor, confusion, hypotension, blurred vision, tinnitus, anxiety, dizziness, euphoria, drowsiness, lethargy, nausea, vomiting, agitation, hallucinations
Bupivacaine (Marcaine, Sensorcaine)	0.25%, 0.5%, 0.75% IV	0.5% 15–20 mL for hypogastric nerve block	Blocks both initiation and conduction of nerve impulses by decreasing the neuronal membrane's permeability to sodium ions, which results in inhibition of depolarization with resultant blockade of conduction	Adults 2.7 h	Hypotension, nausea/vomiting, paresthesia, bradycardia, headache, fever, chills, dizziness, pruritus, restlessness, anxiety, blurred vision, tinnitus, tremor

Abbreviation: IV, intravenous.

Table 5 Over-the-counter medications

Medications	Dosing	Preferred dosing for UAE	Mechanism of action	Half-life	Common reactions
Docusate sodium (Colace)	50, 100, 250 mg	100 mg PO BID	Facilitates mixture of stool fat and water	Unknown	Diarrhea, abdominal cramps, throat irritation. Rash, electrolyte disorder
Sennosides (Senokot)	2–4 tablets PO qHS	2 tablets PO qHS PRN	Increases peristalsis	Unknown	Nausea, abdominal distention, abdominal cramps, flatulence, diarrhea, urine discoloration, melanosis coli
Polyethylene glycol 3350 (Miralax)	17 g/capful	1 capful daily for constipation	Causes water retention in stool, producing laxative effect	Unknown	Nausea, abdominal distention, abdominal cramps, flatulence, diarrhea, urticaria
Bisacodyl (Dulcolax)	5 mg PO	1–3 tabs PO QD PRN constipation	Increases peristalsis	Unknown	Nausea, abdominal cramps, vomiting, diarrhea

Abbreviations: BID, twice daily; PO, orally; PRN, as needed; QD, daily; qHS, every evening.

Table 6 The authors' preferred medical regimen

Before and during UAE
Toradol 10 mg IM/IV 1 h before UAE
Zofran 4 mg IV 30 min before UAE
Dilaudid 0.5 mg IV 30 min before UAE
PCA is started 0.2 mg q10 min without bolus
In-hospital recovery period after UAE
Toradol 10 mg IV q6 h until AM
Zofran 4 mg IV/PO q4 h PRN nausea
Dilaudid PCA 0.2 mg q10 min without bolus
Colace 100 mg PO daily
Discharge
Percocet 5/325 mg 1–2 tab q4–6 h PRN OR
Vicodin 5/500 mg 1–2 tab q6 h PRN
Naprosyn 500 mg PO BID × 7 d then PRN
Colace 100 mg daily
Miralax 17 g daily

Abbreviations: BID, twice daily; IM, intramuscular; IV, intravenous; PCA, patient-controlled analgesia; PO, orally; PRN, as needed.

6-month postprocedural MRI is performed to document complete devascularization of the fibroids. This helps to both set expectations (as persistent vascular enhancement increases the risk of recurrent symptoms) and to exclude irregular enhancement or unusual growth of a fibroid, which might raise concern for leiomyosarcoma.³⁰

At 12 months postprocedure, patients are again called to monitor symptom resolution and procedural satisfaction.

Although the follow-up regimens are variable among practices, the authors find that the regimen outlined in ▶Table 6 ensures a high level of patient comfort and satisfaction.

Conclusion

UAE has evolved since its inception in the 1990s. Multiple endpoints of embolization have been evaluated and embolic products have been compared. There is now widely accepted, Level A data recognized by the American College of Gynecology⁸ confirming UAE as a viable treatment option for symptomatic fibroids. However, the concern or perception of significant postprocedure pain has historically been one of the greatest impediments to more widespread use of this minimally invasive procedure. New techniques and regimens to manage postprocedure pain can be employed to reduce the pain to a minimum and markedly improve patient acceptance and tolerance of this procedure. A few simple techniques (pruning of the vascular tree and embolizing to 5- to 10-beat stasis^{10,11}) and fastidious pre-, intra-, and postprocedural management can nearly eliminate significant pain associated with embolization. Specifically, early implementation of long-acting low-dose narcotics, antiemetics, and anti-inflam-

matories is critical. Finally, the use of a SHNB (which takes minutes to perform and carries very low risk) significantly reduces pain and diminishes the need for narcotics. In fact in one study, patients treated in this fashion had a mean postprocedural peak pain score of only 2.7.²⁶ In the authors' experience, patients treated in this manner largely recover completely within 5 days and have a far less traumatic experience than patients traditionally treated with only midazolam and fentanyl citrate intraprocedurally, and higher doses of narcotics postprocedurally.

Acknowledgments

The authors would like to thank Meryl Glickman and Pascale G. Duroseau for editorial support.

References

- Andersen PE, Lund N, Justesen P, Munk T, Elle B, Floridon C. Uterine artery embolization of symptomatic uterine fibroids. Initial success and short-term results. *Acta Radiol* 2001;42(2):234–238
- Brunereau L, Herbreteau D, Gallas S, et al. Uterine artery embolization in the primary treatment of uterine leiomyomas: technical features and prospective follow-up with clinical and sonographic examinations in 58 patients. *AJR Am J Roentgenol* 2000;175(5):1267–1272
- Goodwin SC, McLucas B, Lee M, et al. Uterine artery embolization for the treatment of uterine leiomyomata midterm results. *J Vasc Interv Radiol* 1999;10(9):1159–1165
- Liang E, Brown B, Kirsop R, Stewart P, Stuart A. Efficacy of uterine artery embolisation for treatment of symptomatic fibroids and adenomyosis – an interim report on an Australian experience. *Aust N Z J Obstet Gynaecol* 2012;52(2):106–112
- Pelage JP, Le Dref O, Soyer P, et al. Fibroid-related menorrhagia: treatment with superselective embolization of the uterine arteries and midterm follow-up. *Radiology* 2000;215(2):428–431
- Ravina JH, Aymard A, Ciraru-Vigneron N, Ledreff O, Merland JJ. [Arterial embolization of uterine myoma: results apropos of 286 cases]. *J Gynecol Obstet Biol Reprod (Paris)* 2000;29(3):272–275
- Edwards RD, Moss JG, Lumsden MA, et al; Committee of the Randomized Trial of Embolization versus Surgical Treatment for Fibroids. Uterine-artery embolization versus surgery for symptomatic uterine fibroids. *N Engl J Med* 2007;356(4):360–370
- American College of Obstetricians and Gynecologists. ACOG practice bulletin. Alternatives to hysterectomy in the management of leiomyomas. *Obstet Gynecol* 2008;112(2 Pt 1):387–400
- Roth AR, Spies JB, Walsh SM, Wood BJ, Gomez-Jorge J, Levy EB. Pain after uterine artery embolization for leiomyomata: can its severity be predicted and does severity predict outcome? *J Vasc Interv Radiol* 2000;11(8):1047–1052
- Abramowitz SD, Israel GM, McCarthy SM, Pollak JS, White RI Jr, Tal MG. Comparison of four embolic materials at uterine artery embolization by using postprocedural MR imaging enhancement. *Radiology* 2009;250(2):482–487
- Spies JB, Allison S, Flick P, et al. Polyvinyl alcohol particles and trisacryl gelatin microspheres for uterine artery embolization for leiomyomas: results of a randomized comparative study. *J Vasc Interv Radiol* 2004;15(8):793–800
- Spies JB. Recovery after uterine artery embolization: understanding and managing short-term outcomes. *J Vasc Interv Radiol* 2003;14(10):1219–1222
- Siskin GP, Englander M, Stainken BF, Ahn J, Dowling K, Dolen EG. Embolic agents used for uterine fibroid embolization. *AJR Am J Roentgenol* 2000;175(3):767–773

- 14 Ruuskanen A, Sipola P, Hippeläinen M, Wüstefeld M, Manninen H. Pain after uterine fibroid embolisation is associated with the severity of myometrial ischaemia on magnetic resonance imaging. *Eur Radiol* 2009;19(12):2977–2985
- 15 Crea F, Pupita G, Galassi AR, et al. Role of adenosine in pathogenesis of anginal pain. *Circulation* 1990;81(1):164–172
- 16 Pron G, Bennett J, Common A, Wall J, Asch M, Sniderman K; Ontario Uterine Fibroid Embolization Collaboration Group. The Ontario Uterine Fibroid Embolization Trial. Part 2. Uterine fibroid reduction and symptom relief after uterine artery embolization for fibroids. *Fertil Steril* 2003;79(1):120–127
- 17 Bruno J, Sterbis K, Flick P, et al. Recovery after uterine artery embolization for leiomyomas: a detailed analysis of its duration and severity. *J Vasc Interv Radiol* 2004;15(8):801–807
- 18 van der Linden W, Kempf V, Edlund G. Function of liver, gallbladder and sphincter of Oddi after major surgery studied by computer-assisted cholescintigraphy and real-time ultrasonography. *Br J Surg* 1983;70(8):497–501
- 19 Hong D, Flood P, Diaz G. The side effects of morphine and hydromorphone patient-controlled analgesia. *Anesth Analg* 2008;107(4):1384–1389
- 20 Pedersen SA, Oster-Jørgensen E, Kraglund K. The effects of morphine on biliary dynamics. A scintigraphic study with 99mTc-HIDA. *Scand J Gastroenterol* 1987;22(8):982–986
- 21 Klein JA. Tumescent technique for regional anesthesia permits lidocaine doses of 35 mg/kg for liposuction. *J Dermatol Surg Oncol* 1990;16(3):248–263
- 22 Roland B. Safety of liposuction of the neck using tumescent local anesthesia: experience in 320 cases. *Dermatol Surg* 2012;38(11):1812–1815
- 23 Theodorou SJ, Paresi RJ, Chia CT. Radiofrequency-assisted liposuction device for body contouring: 97 patients under local anesthesia. *Aesthetic Plast Surg* 2012;36(4):767–779
- 24 Chen JQ, Xie H, Deng HY, et al. Endovenous laser ablation of great saphenous vein with ultrasound-guided perivenous tumescence: early and midterm results. *Chin Med J (Engl)* 2013;126(3):421–425
- 25 Kendler M, Simon JC, Wetzig T. Local anesthesia with lidocaine and prilocaine, using the tumescent technique, for the radiofrequency ablation of lower extremity varicose veins. *Int J Dermatol* 2013;52(6):739–744
- 26 Rasuli P, Jolly EE, Hammond I, et al. Superior hypogastric nerve block for pain control in outpatient uterine artery embolization. *J Vasc Interv Radiol* 2004;15(12):1423–1429
- 27 Perez-Johnston R, Hahn PF, Shenoy-Bhangle AS, Shelly MJ, Gervais DA, Arellano RS. Percutaneous biopsy of focal lesions of the gastrointestinal tract. *Abdom Imaging* 2013
- 28 Joyce A, Hessami S, Heller D. Leiomyosarcoma after uterine artery embolization. A case report. *J Reprod Med* 2001;46(3):278–280
- 29 Gajewska M, Panek G. [Malignant neoplasms of the uterus in women treated with uterine artery embolization for presumed leiomyoma—description of three cases]. *Ginekol Pol* 2013;84(3):229–233
- 30 Chrisman HB, West D, Corpuz B, et al. Primary failure of uterine artery embolization: use of magnetic resonance imaging to select patients for repeated embolization. *J Vasc Interv Radiol* 2005;16(8):1143–1147