

# Uterine Artery Embolization Using a Transradial Approach: Initial Experience and Technique

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## ABSTRACT

This study investigates the feasibility of performing uterine artery embolization (UAE) via transradial access (TRA). Growing evidence demonstrates significant benefits of TRA versus standard transfemoral access during percutaneous coronary intervention, now making it the preferred approach at many centers worldwide. At a single institution from March 2013 to October 2013, 29 consecutive patients were treated by transradial UAE. Technical success rate was 100%, with no immediate major or minor complications. The radial artery was patent at 1-month follow-up evaluation in all cases. These preliminary data suggest that transradial UAE is feasible and safe.

## ABBREVIATIONS

PCI = percutaneous coronary intervention, TFA = transfemoral access, TRA = transradial access, UAE = uterine artery embolization

Uterine artery embolization (UAE) has traditionally been accomplished via common femoral artery access. The first UAE procedure was performed by Merland in 1974 to treat uterine fibroid tumors (ie, leiomyomas) in the context of life-threatening hemorrhage (1). In 1995, Ravina et al (also at Hôpital Lariboisière in Paris) reported the first series on UAE as a safe, effective, minimally invasive primary treatment alternative for symptomatic fibroid tumors (2). Subsequent animal and human studies have led to protocol refinements, including the use of more reliable and efficacious embolic agents (3). Technical variations in transfemoral access (TFA), such as the use of bilateral femoral access, have resulted in reduced fluoroscopy time and procedure time (4,5). To date, no alternate vascular access sites for transcatheter UAE have been described.

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During the past two decades, the use of transradial access (TRA) to perform coronary interventions has markedly increased. This paradigm shift has been driven by a growing body of evidence that favors TRA over TFA during percutaneous coronary intervention (PCI). Among cardiac patients, TRA is associated with improved patient comfort, fewer access site complications, earlier ambulation, and reduced cost (6–10). This access technique was first described in 1989 by Campeau (11) in a series of 100 patients who underwent diagnostic coronary angiography at the Montreal Heart Institute. Kiemeneij and Laarman (12) reported the first successful cases of transradial coronary angioplasty in 1992 and transradial coronary stent placement in 1993 (12). By 2013, one in every six PCIs in the United States was performed by using TRA (10). Some high-volume operators in Canada, Europe, and Asia perform more than 95% of endovascular coronary procedures via TRA (13).

Few reports in the literature have explored the application of TRA to interventional radiology procedures. Given its established benefits during coronary artery catheterization, our team sought to investigate the feasibility of using this approach to successfully perform UAE.

## MATERIALS AND METHODS

Institutional review board approval was obtained for this retrospective review, which examined 29 consecutive

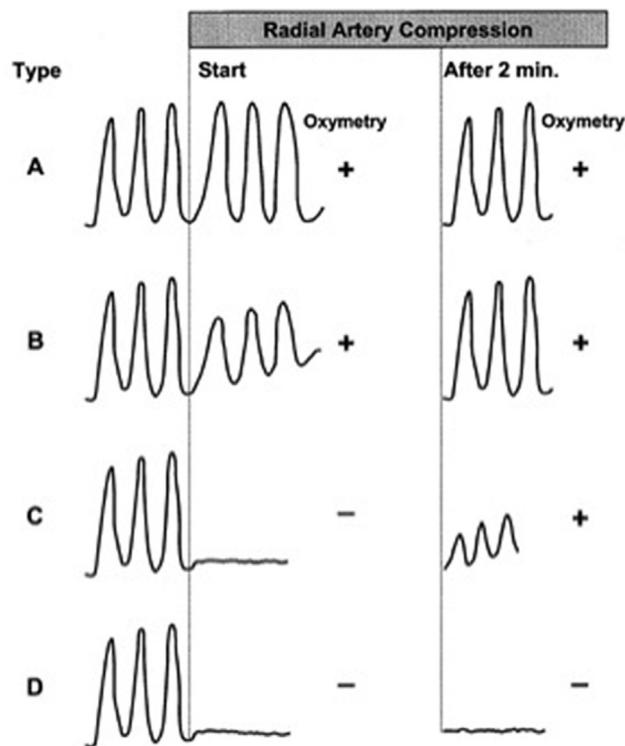
patients (mean age, 44 y; range, 23–58 y) treated by transradial UAE at a single institution from March 2013 to October 2013. Electronic medical records were reviewed for demographic information and clinical presentation. Angiographic images of procedures were analyzed to assess for technical success. The Society of Interventional Radiology (SIR) reporting standards for uterine artery embolization for the treatment of uterine leiomyomata (14) and the SIR classification of complications were applied.

### Radial UAE Technique

Procedure benefits and risks, including the rare complication of cerebral infarction secondary to transradial technique, were discussed with patients before informed consent was obtained. All procedures were performed by one of five interventional radiologists and assisted by a fellow or resident physician in a single-plane angiography suite (Philips Healthcare, Andover, Massachusetts). Patients were positioned supine on the angiography table. The left wrist was visually inspected, and the radial pulse was palpated. A Barbeau test (15) (ie, a modified Allen test with the use of pulse oximetry) and radial and ulnar artery sonography were required before arterial puncture. The Barbeau test (15) was performed by placing a pulse oximeter on the patient's left thumb, followed by baseline pulse waveform analysis. The left radial artery was then manually compressed. Waveform analysis was continued for as long as 2 minutes. Pulse waveform responses to compression were graded according to Barbeau classification (Fig 1). A response type of A, B, or C—suggesting ulnopalmar arch patency (15)—was confirmed before radial artery puncture. Preliminary sonographic evaluation of the left radial artery was then performed to ensure adequate vessel size. Barbeau type D response and radial artery diameter of less than 3 mm were considered contraindications to TRA.

Proper positioning of the left wrist was achieved by using a long arm board. The wrist was supinated and slightly hyperextended, and a folded sheet was placed under the distal forearm for support. The hand was gently taped to the arm board. The arm was then repositioned flush against the patient's side, thereby placing the wrist in close proximity to the traditional femoral access site. Standard surgical preparation of the radial access site was performed. Typical femoral access groin drapes were used. The pulse oximeter was maintained on the left thumb during the procedure.

In all cases, the left radial artery was punctured under direct ultrasound (US) visualization by using a 21-gauge, 2.5-cm echogenic-tip needle (Cook, Bloomington, Indiana) and single-wall technique. When pulsatile arterial blood return was visually confirmed, a 0.018-inch wire was advanced into the radial artery. If any resistance was encountered, the microwire was retracted and

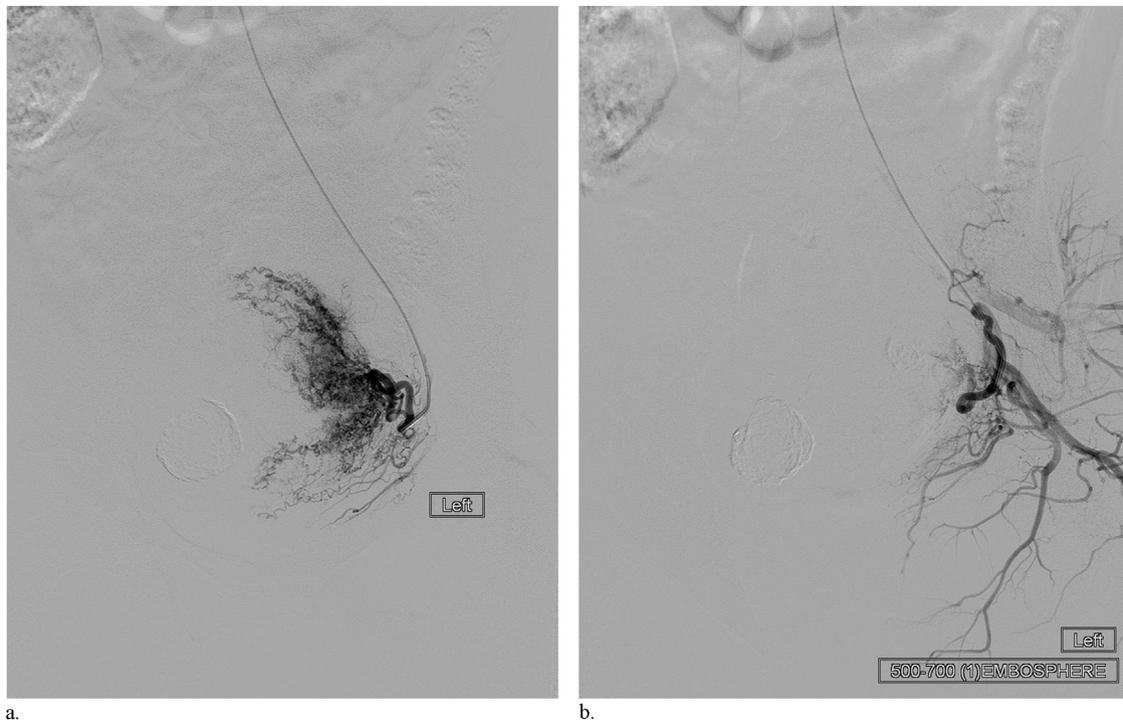


Drawing representing the 4 types of ulnopalmar arch patency findings with PL and OX, as recorded with the finger clamp applied on the thumb.

**Figure 1.** Barbeau classification of pulse waveform responses to compression of the radial artery. (Reprinted with permission from Barbeau GR, Arsenault F, Dugas L, Simard S, Lariviere MM. Evaluation of the ulnopalmar arterial arches with pulse oximetry and plethysmography: comparison with the Allen's test in 1010 patients. *Am Heart J* 2004; 147:489–493.)

readjusted. If the wire could not be advanced, fluoroscopic visualization was used. When the vessel had been properly accessed, the needle was removed and a 0.021-inch tapered hydrophilic 4-F Glidesheath (Terumo, Somerset, New Jersey) was placed without the use of a skin nick. A solution of heparin 3,000 U, nitroglycerin 200 µg, and verapamil 2.5 mg (16) was subsequently administered through the access sheath. This combination of medications is used to reduce radial artery spasm and prevent thrombus formation. Slow injection was performed to mitigate the burning sensation caused by verapamil.

After radial sheath placement, a 120-cm, 4-F angled-tip hydrophilic-coated Glidecath (Terumo) was negotiated down the aorta in standard fashion. The Glidecath was used to navigate the internal iliac artery and catheterize the left uterine artery. The tip of the catheter was positioned within the proximal horizontal segment of the uterine artery. In cases of difficult anatomy, a Renegade Hi-Flo (Boston Scientific, Natick, Massachusetts) or Progreat (Terumo) microcatheter was additionally employed. Arterial embolization was performed by using Embosphere particles (Merit Medical, South



**Figure 2.** (a) Subselective left uterine artery injection before UAE shows normal opacification of the uterine artery and branches, which are stretched across the distended uterus. Note that the 4-F, 120-cm angled-tip hydrophilic-coated Glidecath was sufficient to catheterize the horizontal segment of the uterine artery. (b) Subselective left uterine artery injection after embolization demonstrates truncation of the uterine artery branches, stasis of antegrade flow, and reflux into nonuterine branches.

Jordan, Utah) with pre- and postprocedural angiography (Fig 2). After left UAE, the catheter was retracted into the distal aorta and was easily redirected and advanced into the right internal iliac artery. The right uterine artery was catheterized and embolized in similar fashion.

After bilateral UAE, all wires and catheters were removed. A TR Band (Terumo) was placed on the left wrist over the arteriotomy site. The cuff was inflated with 15 mL of air, and the sheath was removed (Fig 3). Air was then slowly deflated until a strong radial pulse was palpated or bleeding was observed at the access site. Nonocclusive “patent hemostasis” was subsequently maintained for 90 minutes. Arterial hemostasis was reconfirmed as the cuff was incrementally deflated. Upon cuff removal, the radial pulse was rechecked and sterile dressings were applied to the skin. The patient was directly monitored and administered analgesic agents by nursing staff in the recovery unit from the end of the procedure until ready for discharge. Repeat evaluation of the access site and radial pulse was performed for all patients before discharge and at the 1-month follow-up visit in the interventional radiology clinic.

## RESULTS

Twenty-nine consecutive female patients with symptomatic fibroid disease were treated by transradial UAE after self-referral. Indications included abnormal vaginal



**Figure 3.** Patent hemostasis technique. Following bilateral transradial UAE and removal of all wires and catheters, a TR Band was placed on the left wrist over the arteriotomy site. The cuff was inflated with 15 mL of air, and the sheath was removed. Air was then slowly deflated until a strong radial pulse was palpated or bleeding was observed at the access site. Nonocclusive patent hemostasis was subsequently maintained for 90 minutes, at which time the cuff was removed. (Available in color online at [www.jvir.org](http://www.jvir.org).)

bleeding ( $n = 26$ ) or bulk symptoms ( $n = 3$ ) attributable to uterine fibroid tumors. Preprocedural magnetic resonance imaging demonstrated tumor burden likely contributing to patient symptoms as follows: single dominant ( $n = 5$ ), two to five ( $n = 18$ ), and greater than five ( $n = 6$ ). Mean dominant tumor size was 5.9 cm (range, 3.0–10.7 cm). Intramural leiomyomas were most

prevalent, and submucosal and subserosal tumors were less commonly present. Concomitant adenomyosis was identified in a single patient.

Preprocedural evaluation of left radial arteries revealed the following Barbeau responses: type A ( $n = 9$ ), type B ( $n = 19$ ), and type C ( $n = 1$ ). None of the patients who presented for UAE during the study period were excluded from TRA based on Barbeau grade (type D) or radial artery size less than 3 mm. During the procedure, there were no access-related complications. Specifically, there was no incidence of radial artery occlusion, nor did any TRA cases require conversion to TFA.

UAE performed via left TRA was technically successful in all 29 patients. A 4-F, 120-cm angled hydrophilic Glidacath was used to catheterize the bilateral internal iliac arteries in each case. In 17 cases, this catheter alone was sufficient to cannulate the horizontal segment of the uterine arteries (Fig 2). Twelve cases (41.4%) required additional use of a microcatheter system for this purpose. Hypertrophic uterine arteries arose from the proximal portion of the anterior division of the internal iliac arteries in all patients. Flow stasis within the uterine arteries was accomplished by using 500–700- $\mu\text{m}$  and 700–900- $\mu\text{m}$  Embosphere particles. Mean procedure duration was 55 minutes (range, 25–80 min). Mean fluoroscopy time was 18.9 minutes. Mean radiation dose (ie, dose–area product) was 499 Gy·cm<sup>2</sup>. No major or minor complications were encountered during UAE.

After the procedure, the TR Band was removed by 90 minutes in all cases. A normal radial pulse examination was documented in each case. No hematoma or other access site complications were observed. All patients who underwent transradial UAE were discharged home by early evening on the day of the procedure. No patients required overnight admission. No periprocedural Foley catheterization was required.

Postprocedure and 1-month follow-up clinical evaluation revealed a normal left radial artery pulse in 100% of cases. Further imaging to evaluate for the possibility of silent cerebral infarction was not pursued given that the risk was considered very low and no clinical issues were encountered.

## DISCUSSION

Data from consecutive cases of successful transradial UAE are presented here. The transradial technique described here is optimized for subdiaphragmatic intervention. Positioning of the left wrist adjacent to the traditional groin access site allowed for familiar room setup, groin drape placement, and access sheath positioning, and facilitated subsequent wire and catheter exchanges over the patient. The longer distance to the uterine arteries from the wrist was mitigated by the use of an exchange-length guide wire and 120-cm Glidacath, which was capable of catheterizing the horizontal

segments of the uterine arteries. A newer 150-cm Glidacath is currently available in the United States but was not needed in any of the cases. A microcatheter was used for distal catheterization in 41% of cases given the presence of particularly tortuous anatomy.

For transradial UAE, access through the left radial artery was preferred. Left TRA reduces the number of extracranial carotid and vertebral arteries whose origins are crossed during the procedure (left vertebral only). Although approaching the aorta from either upper extremity introduces the rare potential complication of cerebral emboli, access via the left radial artery minimizes intracranial risk associated with this approach. An investigation of acute cerebral emboli following cardiac catheterization performed by right TRA demonstrated new small focal diffusion-weighted imaging abnormalities in 4.9% of patients, all of whom remained asymptomatic (17). A subsequent series showed a lower risk of brain embolization when cardiac catheterization was performed from the left TRA compared with the right (18). A metaanalysis of 124,616 British cardiac patients who underwent TRA (irrespective of laterality) for PCI demonstrated an overall 0.11% rate of neurologic complications, defined as periprocedural transient ischemic attack, hemorrhagic stroke, or ischemic stroke occurring before hospital discharge (19). Of note, PCI involves more manipulations across the aortic arch to access the coronary vasculature, often in patients with considerable atherosclerotic plaque burden. Further research is needed to evaluate the correlation of neurovascular complications among patients with symptomatic cardiovascular disease to the younger and healthier female population undergoing UAE.

Although of uncertain correlation to the UAE experience, the diminished rate of access site complications when comparing TRA versus TFA is well established in the PCI literature (6–8,10). No access-site complications were identified during transradial UAE in the present series. US guidance was used to gain left TRA. There was a preference for the use of a 4-F tapered hydrophilic Glidesheath, followed by administration of heparin, verapamil, and nitroglycerin. A smaller transradial sheath caliber, use of a hydrophilic sheath, and increased heparin dose have been associated with decreased radial artery occlusion during PCI (20). A more recent review (16) suggests that a combination of heparin, verapamil, and nitroglycerin best prevents radial artery spasm and occlusion, although there is no agreement on a standard regimen. The 2008 study of Pancholy et al (20) demonstrated the superiority of so-called patent hemostasis to occlusive pressure in minimizing radial artery thrombosis during access closure. Following transradial UAE, patent hemostasis was employed in all cases by applying a wristband device whose constant external compression over the arteriotomy could be carefully titrated (60–90 min of compression was sufficient to achieve hemostasis for a 4-F arteriotomy). It has been

observed that inadvertent injury to the radial artery, such as dissection or thrombosis, is rarely detrimental to the patient because of the dual blood supply to the hand (11). However, radial artery occlusion would result in loss of an arterial conduit if needed for subsequent coronary artery bypass (21). Clinical pulse assessment at 1-month follow-up confirmed 100% patency of the radial artery in the present patient population. However, the absence of posttransradial UAE Doppler US to evaluate for sub-clinical arterial thrombosis represents a major study limitation.

One apparent advantage of transradial UAE was patient comfort immediately after the procedure. Patients were not restricted in flexing the hip and could move freely in bed. Sitting up and assuming the most comfortable position may assist in pain control after UAE, although the choice of access site has no direct bearing on postembolization syndrome–related pain, the most significant of which can last for several hours after the procedure. The threat to arterial hemostasis in the setting of early retching or emesis was also abated. Our patients cited the ability to immediately sit and eat in a customary position and get out of bed to use the toilet (obviating Foley catheter placement) or ambulate as meaningfully improving their experience. Cooper et al (9) demonstrated a strong patient preference, improved quality of life metrics, and decreased hospital costs in a randomized trial of TRA versus TFA during cardiac catheterization. Further research will be necessary to evaluate whether these metrics are also favored during transradial UAE.

In summary, the present limited initial investigation suggests that TRA offers a feasible alternative to TFA for patients undergoing UAE. A much larger-scale prospective, randomized trial will be needed to validate conclusions about potential clinical benefits of this novel transradial approach compared with existing transfemoral UAE techniques.

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