Transradial and Transfemoral Uterine Fibroid Embolization Comparative Study: Technical and Clinical Outcomes

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ABSTRACT

Purpose: To compare clinical and technical outcomes of transradial (TRA) uterine artery embolization (UAE) with those of the transfemoral (TFA) approach.

Materials and Methods: Consecutive patients who underwent UAE with TRA and TFA in an academic hospital between May 2014 and June 2018 were included in this study. The ability to perform the procedure as planned, complication rates, and reduction in uterine volume, fibroid enhancement, and symptomatic improvement were compared using descriptive statistics, Student *t*-test, and chi-square test.

Results: There were 91 patients in the TFA group and 91 patients in the TRA group, with 1 crossover to TFA due to vasospasm (1 of 91; 1%). The tallest patient in the TRA UAE group was 178 cm and 4 patients taller than 178 cm in the TFA UAE group. Larger particles (900–1,200 μm) were more often used in the TFA group than in the TRA group ($P < .001$). There were similar low rates of minor access site complications. In the TFA group (6 of 91, 7%), 5 patients had groin hematomas, and 2 patients had groin pain compared to the TRA group (5 of 91, 5%): in which 4 patients had transient focal occlusion of the radial artery and 1 patient had focal pain, all of which resolved with conservative management. There were similar rates of uterine volume reduction in 40% ± 17% in the TFA versus 36% ± 16% in the TRA group ($P = .22$) and no residual enhancement in 49 of 58 [84%] in the TFA group versus 66 of 77 [86%] in the TRA group ($P = .84$). There were similar reductions in modifying symptoms (60 of 64 [94%] in the TRA group; and 37 of 40 [93%] in the TFA group; $P =$ NS) was noted at follow-up.

Conclusions: Transradial UAE in women up to 178 cm tall and transfemoral UAE have similar technical and clinical outcomes, with low rates of access site complications.

ABBREVIATIONS

TRA = transradial, TFA = transfemoral, UAE = uterine artery embolization

Uterine artery embolization (UAE) has been performed for more than 2 decades using the transfemoral approach (TFA), with very low complication rates and good technical and clinical outcomes (1). Patients undergoing UAE are mostly young or middle-aged women, most without atherosclerotic disease. Therefore the usual benefits of the transradial approach (TRA) compared with the TFA, including reduced access site complications, especially in elderly and patients with coagulopathy, easier site access in obese patients, faster time to ambulation and discharge, and improved patient compliance (2–9) may not be as substantial in the UAE patient population. Nevertheless, improved safety and feasibility in obese patients, patients with coagulopathy, and early ambulation and discharge that can be achieved by the TRA are potential impactful advantages for UAE patients (3,10).

In 2014, Resnick et al (10) demonstrated the feasibility of TRA for UAE, showing it to be a safe alternative to TFA. However, there was no comparison to uterine fibroid embolization with the TFA in that study. Mortensen et al (11) compared 39 TFA and 27 TRA uterine fibroid embolization procedures and showed comparable

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None of the authors have identified a conflict of interest.

J Vasc Interv Radiol 2020; 31:123–129

https://doi.org/10.1016/j.jvir.2019.08.016

EDITORS' RESEARCH HIGHLIGHTS

- In this retrospective single institution study, there were no substantive differences found between uterine fibroid embolization done from a transfemoral versus transradial approach.
- In obese patients, there were no differences found in access site complications between routes.
- Clinical outcomes between both groups were similar despite differences in embolic size between routes. Larger particles were used more commonly in transfemoral procedures.
- Until prospective randomized studies are performed, the best available retrospective published data suggest transfemoral and transradial approaches for uterine fibroid embolization are equally efficacious, with similar safety profiles.

fluoroscopy time, but that study did not evaluate other clinically relevant outcomes. Therefore, the purpose of the present study was to determine whether UAE using the TRA compared to the TFA would result in similar technical and clinical outcomes when performed in the same practice setting.

MATERIALS AND METHODS

The study complied with Health Insurance Portability and Accountability Act regulations and was conducted with the approval of the institutional review board. The requirement for informed consent for the study was waived by the institutional review board.

Patients

The cohort for this study consisted of 182 consecutive patients with uterine fibroids treated by artery embolization at an academic hospital between May 5, 2014, and June 20, 2018. Patients' electronic medical records were reviewed for demographic information, medical and surgical history, medications, and the presenting symptoms. Patients' comorbidities were calculated using updated Charlson comorbidity index (12).

There were 91 patients in each group (1 patient required an access crossover from TRA to TFA due to radial artery vasospasm during initial cannulation of the uterine artery). The average age in the TFA group was 45.4 ± 5.4 years old and 46.2 ± 4.9 years old in the TRA group (P = .31). There were no differences in mean height, weight, and body mass index between the groups (Table 1). Patients' height ranged from 147 to 180 cm. The tallest patient who underwent successful TRA UAE was 178 cm (5 feet 10 inches), whereas there were 4 patients who were taller than 178 cm who underwent TFA UAE. Using a 125-cm 5-F catheter was technically challenging to cannulate the uterine artery using a radial approach due to the catheter length restriction; therefore, TFA has since been elected for use in women taller than 178 cm (5 feet 10 inches) after that patient.

Table 1. Patient Demographics, Comorbidity Score, Surgical History, and Anticoagulation Status

	TFA (n = 91)	TRA (n = 91)	*P* Value
Age, y	45.4 ± 5.4	46.2 ± 4.9	.309
Height, cm	165.0 ± 6.9	164 ± 6.8	.378
Weight, kg	80.9 ± 21.7	84.9 ± 28.6	.294
BMI, kg/m^2	29.7 ± 7.6	31.5 ± 9.8	.176
Updated Charlson comorbidity score	0.2 ± 0.8	0.2 ± 0.5	.908
Prior abdominopelvic surgery	47 (52)	53 (58)	.371
Anticoagulation medications	6 (7)	1 (1)	.053

Note–Values are mean ± SD or n (%).
BMI = body mass index; TFA = transfemoral; TRA = transradial.

A total of 47 of 91 patients (52%) in the TFA group and 53 of 91 patients (58%) in the TRA group had prior abdominopelvic surgeries (P = .37). A total of 6 of 91 (7%) and 1 of 91 patients (1%) were taking oral anticoagulant drugs in the TFA and TRA groups, respectively (P = .053). Based on the updated Charlson comorbidity Index, the average score was 0.2 in each group (0.21 ± 0.8 vs. 0.20 ± 0.5, respectively; P = .91).

The 2 most common presenting symptoms were menorrhagia (87% in TFA group vs. 89% in TRA group, P = .64) and pelvic pain or pressure (65% vs. 70%, respectively; P = .42) in both groups. Other presentations including metrorrhagia, dysmenorrhea, dyspareunia, back pain, urinary symptoms, and anemia were similar in both groups (Table 2).

The percentages of patients with uterine fibroids only (without adenomyosis) were similar in both groups (98% vs. 92%, respectively; P = .08). Two of 91 TFA patients (2%) and 7 of 91 TRA patients (8%) had both uterine fibroids and adenomyosis.

Information regarding the procedure, including radiation dose, total procedure duration, fluoroscopy time, number of vials, and size of the microparticles (Embosphere microspheres, Merit Medical, South Jordan, Utah) used for embolization was obtained from picture archiving and communication system and procedure reports.

In November 2016, 1 of 2 interventional radiologists performing UFE in the institution changed the access for UAE from TFA to TRA, so the study cohort was divided retrospectively into 2 groups: UAE performed with the TFA versus TRA. With the implementation of the TRA for UAE a new postprocedure observation protocol was also implemented that allowed the patient to be discharges home 4 hours after the procedure if the postprocedural pain was

Table 2. Prevalence of Presenting Symptoms at the First IR Consultation for Patients with Uterine Fibroids and Adenomyosis

Presenting Symptom	TFA (n = 91)		TRA (n = 91)		*P* Value
	n	%	n	%	
Menorrhagia	79	**87**	81	**89**	.649
Metrorrhagia	26	**29**	21	**23**	.397
Dysmenorrhea	24	**26**	16	**18**	.152
Dyspareunia	7	**8**	11	**12**	.321
Back Pain	13	**14**	10	**11**	.503
Pelvic pain/pressure	59	**65**	64	**70**	.428
Urinary symptoms	51	**56**	41	**45**	.138
Anemia and related symptoms	11	**12**	16	**18**	.297

TFA = transfemoral; TRA = transradial.

sufficiently controlled with oral pain medications and there was no nausea.

UAE Technique

All the procedures were performed by an interventional radiology fellow with direct supervision by 1 of the 2 interventional radiologists with 5 (O.R.B.) and 15 (S.F.) years of post-fellowship experience. The supervising physician was either the primary operator or the secondary operator to interventional radiology fellow.

TRA UAE was performed similarly to that described in a previous report (10). A preprocedural radial artery assessment was performed using the Barbeau or modified Allen test (13). A mixture of lidocaine cream and nitroglycerin paste were placed at the radial access site for 30 minutes to provide local anesthesia and radial artery dilation. The left radial artery was accessed using a 5-Fr hydrophilic sheath (Prelude Ease, Merit Medical, South Jordan, Utah), using the Seldinger technique. A bolus of 2,000 IU of heparin, 200 μg of nitroglycerine, and 2.5 mg of verapamil was given over 20 seconds through the sheath to prevent spasm and thrombosis of the radial artery. A 5-F angled catheter (Berenstein Performa catheter, 125 cm, Merit Medical, or Vertebral catheter, 125 cm, Cook Medical, Bloomington, Indiana) and a J-tip Glidewire (Terumo, Somerset, New Jersey) were used to access either internal iliac artery. The catheter without wire was used to cannulate the uterine artery. A Maestro 150-cm microcatheter (Merit Medical) and microwire (Transcend 160 cm, Stryker Neurovascular, Fremont, California; or Fathom, 180 cm, Boston Scientific, Marlborough, Massachusetts) were used to cannulate the horizontal component of the uterine artery. The parent 5-F catheter was then withdrawn from the uterine artery into the anterior division of the internal iliac artery to facilitate the inflow. Embolization was performed (Embosphere, Merit Medical) by using an incremental increase in size with 2 vials of 500- to 700-μm and 700- to 900-μm microspheres until satisfactory stasis was achieved. In the presence of adenomyosis, provided that no arteriovenous shunting was present, embolization was begun with 2 vials of 300- to 500-μm microspheres, followed by embolization with 500- to 700-μm microspheres until near stasis was achieved. The endpoint of embolization was defined as slow flow over 6 cardiac cycles, according to institutional protocol. A contralateral UAE was then performed using the same technique. A digital subtraction aortogram at the level of the renal arteries was performed to evaluate for any additional feeders to fibroids through a 5-F 110-cm pigtail catheter. A TR band (Terumo) was used to achieve patent hemostasis. Deflation of the balloon was performed according to institutional protocol, starting 30 minutes after removal of the sheath. The first third of the air from the balloon was removed in 1-cm^2 increments at 1–2 s/ml. After 5 minutes, the second third of the air was removed in the same manner if there was no bleeding. Similarly, after another 5 minutes, the final third of the air was removed in the same manner.

TFA UAE was performed using a procedure similar to that previously reported (14). Right common femoral artery access was obtained using palpation or ultrasound guidance. Uterine artery was cannulated with a 5-F pudendal 80-cm catheter (Cordis, Miami Lakes, Florida) through which a microcatheter (135-cm Renegade Hi Flo, Boston Scientific) and a Transcend 165-cm microwire (Boston Scientific) were used to cannulate a transverse portion of the uterine artery. The remaining TRA procedure was performed as described above. After completion of the embolization, the pudendal catheter was exchanged for an Omniflush catheter (Angiodynamics, Amsterdam, the Netherlands), and a digital subtraction aortogram at the level of the renal arteries was performed to evaluate for any additional feeders to fibroids. Access site hemostasis was achieved by manual compression for 15 minutes or vascular closure device (Angioseal, St. Jude Medical, Saint Paul, Minnesota; or Starclose SE, Abbott Vascular, Santa Clara, California) according to the operator's preference. None of the cases included in the study required ovarian artery embolization.

All procedures were performed in a dedicated angiography suite with a flat panel detector (Siemens, Artis, Erlangen, Germany). The use of fluoroscopy was minimized, with the pulse rate varying between 3 and 7.5 pulses(s), depending on the operator's preference. Maximum collimation was used at all times. No angulation projections were routinely used.

Postprocedural Follow-up

Patients were followed for 3 to 6 months after the procedure. Duration of the postprocedural monitoring and hospital admission were recorded. All complications, including access site complications (hematoma, pseudoaneurysm, and vessel occlusion), thromboembolic events, and related infections were recorded. Duration of monitoring after the

Table 3. Number of Microparticle Vials Used for UAE in TFA and TRA UAE

	TFA		TRA		*P* Value
	Vials	%	Vials	%	<.001
300–500 μm	28	4	23	4	
500–700 μm	487	70	426	71	
700–900 μm	140	20	138	23	
900–1,200 μm	41	6	10	2	

TFA = transfemoral; TRA = transradial; UAE = uterine artery embolization.

Table 4. Residual Fibroid Enhancement Grading at Follow-up MR Imaging

Residual Enhancement	TFA Group (n = 58)		TRA Group (n = 77)		*P* Value
	n	%	n	%	
No fibroid enhancement	49	84	66	86	.841
Single fibroid with residual enhancement	5	9	8	10	
Multiple fibroids with residual enhancement	4	7	1	1	
Residual enhancement of all fibroids	0	0	2	3	

TFA = transfemoral; TRA = transradial.

procedure, complications, and technical and clinical outcomes in the TFA group were compared with those in the TRA group.

Technical and Clinical Outcomes

A board-certified radiologist, currently pursuing abdominal imaging fellowship, reviewed the preprocedure and follow-up magnetic resonance imaging (MRI) and obtained the following data: size of the uterus in 3 dimensions and enhancement of the fibroids on the follow-up MRI compared to the MRI obtained prior to the procedure.

Technical outcome was evaluated by the percentage of overall uterine volume reduction and degree of residual fibroid enhancement. The volume (*V*) was calculated by measuring the maximum length and anteroposterior (*AP*) and transverse (*T*) diameters of the uterine corpus and using the formula for the volume of a prolate ellipsoid: $[V = 0.52 \times (L \times AP \times T)]$. The enhancement of fibroids on the follow-up MRI was divided into 4 groups: no fibroid enhancement, single fibroid with residual enhancement, multiple fibroids with residual enhancement, and residual enhancement of all fibroids.

Clinical outcome was assessed at the follow-up clinic visit, which occurred at 3– 6 months after the procedure. A comparison of presenting symptoms was performed and was categorized as either improvement with no residual quality of life-modifying symptoms; some improvement, but still some residual quality of life modifying symptoms; or no change in symptoms. The number of patients who visited the emergency department for treatment of abdominal or pelvic pain within 7 days after the procedure was also compared between the 2 groups.

Statistical Analysis

Continuous variables were described as mean ± SD where applicable. Categorical variables were described as a percentage. To compare differences between the 2 groups, a Student *t* test was used for continuous variables (age, body mass index, fluoroscopy time, radiation exposure, and percentage of uterine volume reduction), and a chi-square test was used for categorical variables (early discharge rate, access site complications, and residual enhancement on follow-up MRI). A *P* value of less than .05 was considered statistically significant.

RESULTS

There were no differences in radiation exposure (660.4 ± 711.1 mGy vs. 679.3 ± 998.1 mGy; $P = .88$), total procedure time (177.1 ± 93.9 minutes vs. 163.3 ± 38.4 minutes; $P = .21$), and fluoroscopy duration (41.1 ± 16.0 minutes vs. 39.8 ± 13.6 minutes; $P = .56$) between the TFA and TRA groups, respectively.

There were fewer large (900- to 1,200-μm) particles used in the TRA group than in the TFA group ($P < .001$) (Table 3). All patients in the TFA group underwent transfemoral UAE as intended whereas for 1 of 91 patients (1%) in the TRA group transradial embolization was not successful due to vasospasm, and the procedure was converted to transfemoral.

More patients in the TRA group (30 of 91; 33%) were discharged on the day of the procedure in comparison to 4 of 91 TFA patients (4%) ($P = .002$). The number of patients who visited the emergency department for treatment of abdominopelvic pain within 7 days after the procedure was 7 of 91 (8%) in TFA and 6 of 91 (7%) in the TRA group ($P = .77$).

Six of 91 patients (7%; 95% confidence interval [CI], 3%–14%) patients in TFA group and 5 of 91 (5%; 95% CI, 2%–13%) in the TRA group had access site complications ($P = .75$). In the TFA group, 5 of 91 patients (5%) experienced access site hematoma without pseudoaneurysm, and 1 of 91 patients (1%) had groin pain without hematoma. In the TRA group, 4 of 91 patients (4%) had symptomatic focal radial artery occlusion diagnosed due to focal access site pain. The symptoms related to radial artery occlusion resolved in all patients. Furthermore, follow-up ultrasonography 3 months after the procedure demonstrated complete resolution of the occlusion in 3 of 4 patients. One of 91 patients (1%) had access site pain without neurological

deficits on examination or any abnormality on ultrasonography. There was 1 case (1%) of lower extremity deep vein thrombosis in each group.

Patients were seen in the clinic for the follow-up 3–6 months after the procedure in 69 of 91 patients (76%) in the TRA group and 53 of 91 (58%) in TFA group. A similar number of patients who presented with menorrhagia and were seen in the interventional radiology clinic for follow-up reported improvement in menorrhagia, with no residual quality of life-modifying menorrhagia (60 of 64 TRA [94%] and 37 of 40 TFA [93%]) at clinical follow-up ($P = .98$). Three of 64 (5%) of the TRA group and 3 of 40 (8%) of the TFA group reported some improvement but still some residual quality of life modifying menorrhagia. One patient (1%) in the TRA group reported no change in menorrhagia.

The time difference between procedure and imaging follow-up was 158 ± 173 days in the TFA group and 117 ± 82 days in the TRA group ($P = .066$).The average uterine volume prior to the procedure was 986 ± 1125 cm^3 in the TFA group and 776 ± 578 cm^3 in the TRA group ($P = .12$). There was similar average uterine volume reduction in both groups: 40% ± 17% in the TFA group and 36% ± 16% in the TRA group ($P = .22$). Follow-up MRI showed no residual fibroid enhancement in 49 of 58 (84%) of TFA and 66 of 77 (86%) of the TRA group ($P = .84$) (**Table 4**).

DISCUSSION

This study of 182 consecutive patients demonstrated that transradial UAE has technical and clinical outcomes similar to those of conventional TFA UAE with a low rate of access site complications, comparable radiation exposure, and fluoroscopy time.

Even though the concept of embolization is the same regardless of access site, different technical specifications may have an unexpected impact on the patients' outcomes. Prior studies showed 100% technical success (10,11,15) but have not evaluated whether TRA UAE resulted in clinical outcomes similar to those of the well-established TFA UAE procedure. The present study shows that symptomatic improvement, degree of uterine reduction in size, and devascularization of the fibroids after UAE were similar between the 2 groups. Therefore, TRA UAE achieves the same technical clinical result as TFA UAE.

In both groups there was a single case of lower extremity deep vein thrombosis after the procedure. We have expected that earlier ambulation with TRA approach would be beneficial in reducing the risk of deep vein thrombosis. It appears that other factors, such as postembolization syndrome and, potentially, patient's risk factors are likely more important in increasing risk for post procedural thromboembolic disease, and ability to ambulate early is not sufficiently protective.

TRA access is associated with a lower incidence of major vascular complications and significantly lower bleeding and hematoma for coronary interventions, especially in patients with obesity or coagulopathy (2,4). On the other hand, there were no differences in access site complications for noncoronary interventions between TRA and TFA (6,16), similar to the results of the present study. There was a low rate of focal symptomatic radial artery occlusion without long-term sequelae and with symptom resolution with conservative management, similar to that in prior studies (1). Patients undergoing UAE usually do not have atherosclerotic disease, likely explaining why no benefit was seen for access site complications.

Previous studies suggested that TRA access is more likely to fail for patients shorter than 165 cm (17) and 170 cm (3). The assumption is that access failure is related to the smaller radial artery diameter in shorter patients. However, in this study, 37% of TRA patients were shorter than 165 cm and none of them encountered technical issues with access; therefore, it appears that with current equipment, procedures can be performed successfully with TRA in shorter patients.

Morbid obesity has been described as a relative contraindication to TFA in cardiac catheterization, with TRA suggested as a way to reduce major vascular complications (4,18). Arterial access is technically less challenging with TRA compared to TFA in morbidly obese patients, but in this population, there were no differences between access site complications among the groups, even though in both groups 12%–13% of patients were morbidly obese.

There were no significant differences in radiation exposure, fluoroscopy time, or total procedure time between the TFA and TRA groups. Some reports have raised the concern of increased radiation exposure and time in TRA procedures; therefore, this approach was limited to patients with coagulopathy or obesity (2,19,20). In contrast, there are studies reporting no significant difference in radiation dose, procedure, or fluoroscopy duration between radial and femoral access (8,9). Yamada et al (7) reported even less radiation exposure to the operator in TRA liver cancer embolization; meanwhile, there were no differences in patient radiation exposure or procedure times compared to those in the TFA group.

In this study, 33% of the TRA group patients were discharged home on the day of the procedure. This is concordant with prior reports showing that transradial interventions are advantageous for earlier ambulation and discharge (6,8,9,11,16). Notably, the option of the same-day discharge was introduced only after the introduction of TRA, likely confounding the results, as same-day discharge has been reported previously after TFA approach as well.

One notable feature of transradial technique for pelvic procedures is increased distance from the access to the site of embolization, requiring longer catheters. Instead of an 80-cm pudendal catheter, a 125-cm vertebral or Berenstein catheter was used to catheterize the uterine artery, with a resultant increase in the length of the microcatheter from 135 cm to 150 cm. This presents 2 potential limitations to the TRA technique. First, longer microcatheter length makes it difficult to use particles larger than 900 μm due to frequent catheter occlusions. The microcatheter that was used for

embolization has an inner diameter of 0.027 inch or 686 μm. This inner diameter enables smooth administration of 500- to 700-μm particles; and due to some compressibility of particles, 700- to 900- and even 900- to 1,200-μm particles can be administered through a 135-cm 0.027-inch microcatheter. However, increasing the microcatheter length to 150 cm proportionately increases resistance to flow according to Poiseuille's rule, making it difficult to use 900- to 1,200-μm particles due to frequent catheter occlusions. The recommended particle size for UAE is 500–700 μm (21) and only if the uterus is very large is a larger particle size used. In the present study, use of 900- to 1,200-μm particles was infrequent in both groups but much rarer, as expected, with the TRA approach. This limitation of TRA technique should be considered when evaluating women with very large uterine fibroids, as these patients may benefit from TFA instead of TRA.

The second potential limitation of the TRA for pelvic procedures is that, even a 125-cm parent catheter may be short of reaching the uterine artery from a radial approach if the woman is very tall or has long arms. Solutions for this issue are to access the radial artery a few centimeters proximally or park the parent catheter in the anterior division of the internal iliac artery and navigate with the microcatheter to the uterine artery. The tallest woman that has been successfully treated with TRA approach in this study was 178 cm. Therefore, the TRA approach can be successfully used for UAE up to 178 cm patient's height, whereas taller patients may need further study.

There are several limitations to this study. First, this is a retrospective cohort study reviewing outcomes of 2 interventional radiologists, with only one of them changing the approach from TFA to TRA, practicing in a single academic center. Therefore, it is unclear how the results would be applicable to private practice or other academic groups. Second, this is a moderately high-volume practice of UAE procedures; therefore, it is again uncertain whether the results would be applicable to a practice with a lower patient volume. On the other hand, because it is an academic center, most procedures were performed with a trainee as the primary operator, therefore explaining the somewhat longer procedure and fluoroscopy times. Even though performing a multi-institutional study could have alleviated some of these limitations, it is also more likely to introduce additional biases due to practice heterogeneity. Therefore, it was decided to compare TRA and TFA in a single practice to reduce variables associated with training and other aspects. Third, a major limitation of this study is lack of use of validated uterine fibroid quality of life questionnaire (UF-QOL), as it was not used in the authors' acility for routine clinical use. However, the patients were seen in clinic by the interventionalist who performed the procedure and evaluated the patient in clinic prior to the procedure. Assessment of clinical response was obtained from medical records notes and addressed improvement in the presenting symptom. Further clinical success was assessed by assessing MRI findings of decrease in uterine volume and residual enhancement. Notably, more patients in the present study had imaging rather than clinic follow-up. The authors believe that the reason why there was more imaging studies than clinic follow-ups is due to availability of imaging reports online to the patients through the institution's patient portal. Therefore, if the patient is satisfied with clinical results and MRI reports describes decrease in size of the fibroids and uterus, then the patient may have decided to save money and time on follow-up appointment with an interventionalist. The fourth limitation is that these results are specific to the authors' technique, including catheter length and use of microcatheters. If one elects to use a 150-cm microcatheter for TFA then flow may be decreased and resistance to embolic delivery increased with the TFA approach (compared to a 135-cm microcatheter) and thus not an additional downside to use TRA. Another limitation is that this study did not focus on evaluating other potential benefits of the TRA technique compared to the TFA such as potential for early ambulation and ease of access of obese patients. Finally, the cost effectiveness of the 2 approaches was not evaluated in this study.

In conclusion, transradial UAE is comparable to transfemoral UAE in regard to technical and clinical outcomes, as well as to rate of complications. Certain limitations due to increased catheter length should be considered when counseling women about access for UAE.

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