



Unilateral versus Bilateral Femoral Arterial Access for Uterine Artery Embolization

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Abstract

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BACKGROUND: Uterine fibroids are the most common benign tumors in women. Their clinical presentation includes menorrhagia, metrorrhagia, lower abdominal pain, and infertility. Treatment of uterine fibroids includes medical management, surgical resection known as myomectomy, as well as minimally invasive options like uterine artery embolization. Uterine artery embolization can be done through unilateral or bilateral femoral arterial access.

AIM: We aim to define the differences between unilateral and bilateral femoral access in concern to radiation dose, procedure time, fluoroscopy time, as well as the number of angiographic images.

METHODS: A total of 48 patients were divided into two groups equally; one with a unilateral femoral access and the other group with a bilateral femoral arterial access.

RESULTS: The age of the patients ranged between 25 and 40 years, embolization was done with calibrated spheres. Bilateral procedures compared to the unilateral ones had less fluoroscopy times (8.6 min vs. 24.3 min), less total procedure time (28.4 min vs. 54.4 min), and less dose area product (155 Gy cm² vs. 340.5 Gy cm²) as well as less mean number of angiographic images (93.8 vs. 176.5) with no significant difference in puncture site complications.

CONCLUSION: Fluoroscopy times, procedure times, number of angiographic images, as well as radiation dose were significantly lower in the bilateral approach with no significant difference in the rates of puncture site complications between the two approaches.

Introduction

Uterine fibroids are benign tumors that arise from the monoclonal proliferation of uterine smooth muscle cells. They are the most frequent benign tumors in women. Menorrhagia, pain, anemia, abortion, infertility, bladder, and rectal compression symptoms are some of the clinical manifestations of uterine fibroids [1].

Uterine artery embolization (UAE) is a minimally invasive treatment for uterine leiomyomas that involve injecting embolic agents into the target artery through a percutaneously inserted catheter causing tumor infarction, while leaving the uterus intact. Embolic agents, particularly calibrated microspheres such as tris-acryl gelatin microspheres, should be delivered very slowly in the uterine artery under free flow [2].

UAE necessitates catheterization of both uterine arteries, which is usually through a common femoral arterial access. In most centers, a single arterial puncture is the typical procedure, with one uterine artery catheterized and embolized first then the other. Fluoroscopy is used to guide the procedure, and angiographic images are taken before and after embolization [3].

Bilateral femoral puncture, with simultaneous angiographic filming and embolization of both uterine arteries, is an alternative approach. This method may be more efficient in terms of procedure time and radiation dose [4].

However, there is some concern about the potential complications of the second puncture. In this group of patients, puncture site complications are usually minor, but femoral puncture can cause pain and has the potential for complications that may necessitate intervention [5].

Aim of work

We aim to compare between unilateral and bilateral femoral arterial access as regards to the effect on the technical success, procedure and fluoroscopy times, radiation exposure, as well as puncture site complications.

Methods

Type of study

This was a comparative cross-sectional study.

Study setting

The study was conducted at the radiology department – Ain Shams University.

Study period

The study period was 2 years.

Study population**Inclusion criteria**

The following criteria were included in the study:

1. Female patients undergoing elective uterine artery embolization for uterine fibroids with ages ranging from 25 to 40 years.
2. The presenting symptoms:
 - Abnormal vaginal bleeding: Menorrhagia or menometrorrhagia.
 - Back pain.
 - Subfertility in cases of large number of uterine fibroids where myomectomy would result in a useless mutilated uterus.
 - The presence of surgical contraindications such as bad general condition or being not fit for anesthesia.

Exclusion criteria

Patients with malignant uterine pathology, pedunculated subserous fibroids, pregnancy, severe uncorrectable coagulopathy, and renal impairment (the procedure was not done if the GFR is $<30 \text{ ml/min/1.73 m}^2$) were excluded from the study.

Sampling method

Convenience sample.

Sample size

Twenty-four cases per group (48 total cases), patients were divided randomly into two equal homogenous groups.

Ethical considerations

Informed consents were discussed with the patients. Signed consent was obtained after agreement of the patients. Approval from the ethical committee was obtained.

Study tools

- Full history taking.

- Lab. investigations: CBC, coagulation profile, and KFTs.
- Pelvic MRI done by the patients was reviewed to identify the number, site, and size of the fibroids.

Study procedures**Patient preparation**

- Fasting for 6 h before the procedure.
- Cannula was inserted in the antecubital vein for continuous analgesics infusion throughout the procedure.
- Gowning and sterilization of the right groin in cases of unilateral access and both groins in the bilateral cases group.

Procedure

- The procedure was done under local anesthesia at the site of the femoral puncture. The procedure was performed by the same radiologist in all cases.
- Puncture of the common femoral artery in one side in the first group and bilaterally in the second group.
- A 5 F Cobra catheter was then used over a hydrophilic 0.35 inch Terumo guide-wire to catheterize the internal iliac vessels followed by selective catheterization of both uterine arteries. Microcatheter was not needed in any of the cases.
- In cases of unilateral access, a Waltman loop was used to obtain access into the ipsilateral uterine artery, and in cases of bilateral access; crossing over was done with simultaneous imaging of both uterine arteries.
- Diagnostic angiography was done to look for the tumoral blush and identify the dominant uterine artery.
- The contrast used in angiography was a non-ionic low osmolar iodine-based contrast.
- Microspheres under the name of Embosphere were used with starting sizes 500–700 μm to occlude the capillary bed of the tumor followed by larger particles 700–900 and 900–1100 μm to occlude the feeding arterioles.
- Control angiography was done to confirm the embolization evidenced by disappearance of the tumoral blush and stasis of contrast in the feeding arteries.

Post-procedure care and medications

- Removal of the femoral sheath was done followed by manual compression for 10–15 min.
- The patient was instructed to stay in bed and

keep his thigh straight for 6 h.

- Prescription of proper antibacterial drugs and adequate analgesia.

Side effects and complications

- Radiation exposure: ALARA principle was applied (as low as reasonably achievable).
- Non-target embolization: Could lead to premature ovarian failure; avoided by proper identification of the ovarian blush before injection of the microspheres.
- Groin hematoma formation: The only puncture site complication encountered in our study and was avoided by proper manual compression and treated conservatively.

At the end of the procedure; the following parameters were measured:

- Total procedure time (from puncture to catheter removal in min).
- Fluoroscopy time (in min).
- Radiation dose calculated by the fluoroscopy machine.
- Local complications at the puncture site (assessed 1 h after the end of the procedure).
- Number of angiographic images.

Statistical analysis

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 23. Data summarized by the use of mean, standard deviation, median, minimum, and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between the quantitative variables were done using Chi-Squared and paired tests.

Table 1: The mean age and the range of the unilateral and the bilateral groups

Age	Unilateral No. = 24	Bilateral No. = 24	Test value	p-value	Sig.
Mean ± SD	30.13 ± 4.91	32.08 ± 4.84	-1.391	0.171	NS
Range	25-40	25-40			

Results

Table 1 shows that there is no statistical difference regards the age between the unilateral and the bilateral groups.

Table 3: The mean procedure times in the unilateral and the bilateral groups (in min) as well as the standard deviation among them

Procedure time (min)	Unilateral No. = 24	Bilateral No. = 24	Test value	p-value	Sig.
Mean ± SD	54.38 ± 11.39	28.38 ± 10.78	8.122	0.000	HS
Range	34-76	14-48			

Table 2: The mean fluoroscopy times in the unilateral and the bilateral groups (in min) as well as the standard deviation among them

Fluoroscopy time (min)	Unilateral No. = 24	Bilateral No. = 24	Test value	p-value	Sig.
Mean ± SD	24.25 ± 7.10	8.58 ± 3.62	9.640	0.000	HS
Range	13-35	5.1-22			

Hence, we found that the fluoroscopy times are much lower in the bilateral group compared to the unilateral group (Table 2).

Hence, we found that the procedure times are much lower in the bilateral group compared to the unilateral group (Table 3).

Hence, we found that the radiation doses are much lower in the bilateral group compared to the unilateral group (Table 4).

Table 4: The mean radiation dose in Gy cm² in the unilateral and the bilateral groups as well as the standard deviation among them

Radiation dose (DAP Gy cm ²)	Unilateral No. = 24	Bilateral No. = 24	Test value	p-value	Sig.
Mean ± SD	340.54 ± 75.21	155.00 ± 84.84	8.017	0.000	HS
Range	202-520	96-511			

Hence, we found that the total number of angiographic images is much lower in the bilateral group compared to the unilateral group (Table 5).

Table 5: The mean number of angiographic images in the unilateral and the bilateral groups as well as the standard deviation among them

No. of angiographic images	Unilateral No. = 24	Bilateral No. = 24	Test value	p-value	Sig.
Mean ± SD	176.46 ± 51.52	93.83 ± 15.80	7.511	0.000	HS
Range	95-269	62-118			

Hence, we can conclude that there is no statistical difference in the rate of the puncture site complications between the two groups (Table 6).

Table 6: The number and the percentage of the puncture site complications in the unilateral and the bilateral groups (the only complications encountered in our study were groin hematomas and all were treated conservatively)

Puncture site complications	Unilateral No. %	Bilateral No. %	Test value*	p-value	Sig.
No	23 95.8	22 91.7	0.356	0.551	NS
Yes	1 4.2	2 8.3			

p-value >0.05: Non significant (NS); p-value <0.05: Significant (S); p-value < 0.01: highly significant (HS)

From the above tables, we can say that bilateral femoral arterial access in cases of UAE results in significantly lower fluoroscopy, procedure times, radiation doses, as well as lower number of angiographic images with no significantly higher rates of puncture site complications.

The previous data can be made clearer by the following examples:

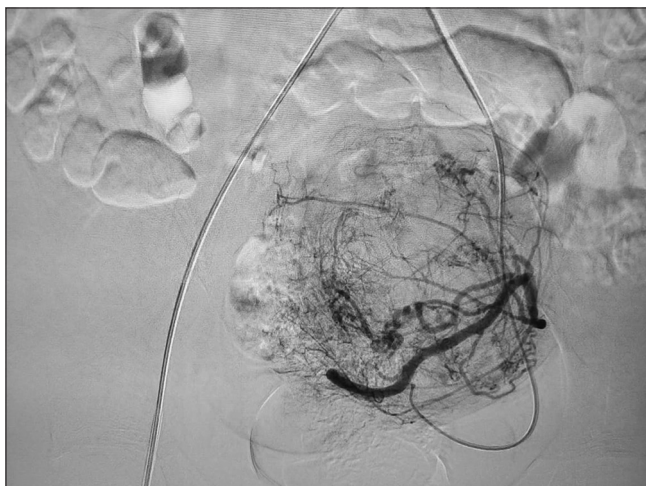


Figure 1: A Cobra catheter inserted from the right femoral artery into the left uterine artery with angiography showing the blush of the uterine fibroids (before embolization)

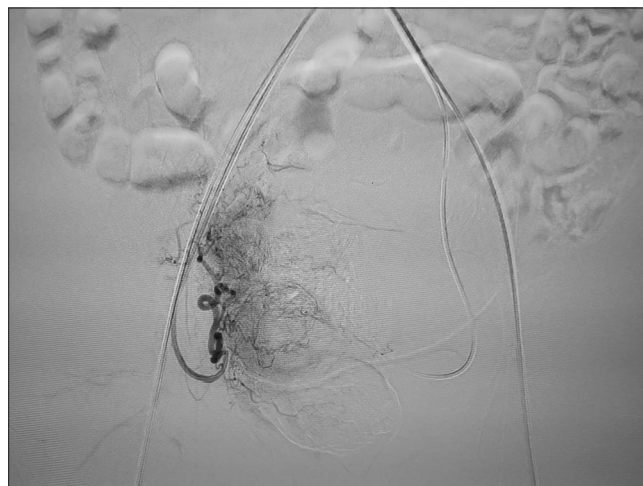


Figure 2: A Cobra catheter inserted from the left femoral artery into the right uterine artery with angiography showing the blush of the uterine fibroids (before embolization)

Case 1

A 40-year-old female with large submucosal and interstitial fibroids presenting with menorrhagia for which embolization was done using 500–700 μm particles with each uterine artery embolized from the contralateral femoral artery (Figures 1-3).

The parameters in that case are as follows:

- Fluoroscopy time: 5 min and 13 s.
- Procedure time: 14 min.
- Radiation dose: 96 Gy cm^2 .
- Number of angiographic images: 98.
- Puncture site complications: Small right groin hematoma treated conservatively.

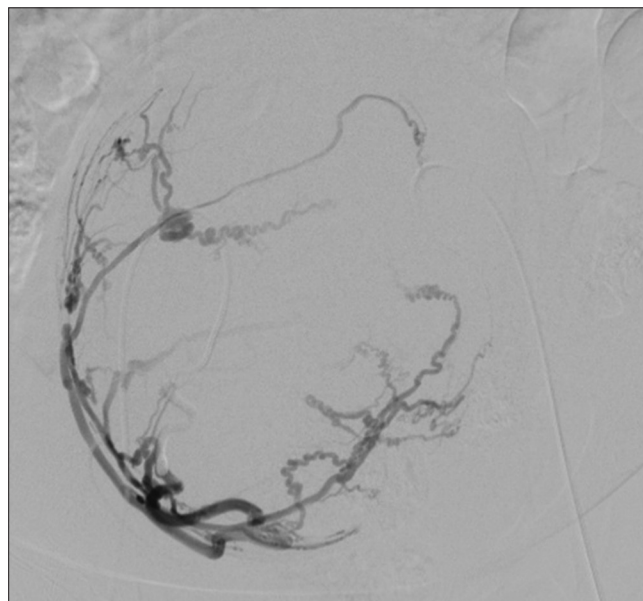


Figure 4: Angiography of the right uterine artery from a Cobra catheter inserted in the right femoral artery (before embolization)



Figure 3: Disappearance of the abnormal tumoral blushes during the simultaneous injections into both uterine arteries from both catheters

Case 2

A 38-year-old female with large submucosal and interstitial fibroids, presenting with menorrhagia, back pain, and urinary frequency for which embolization was done using 500–700 μm and 700–900 μm particles with each uterine artery catheterized and embolized from the ipsilateral femoral artery (Figures 4-7).

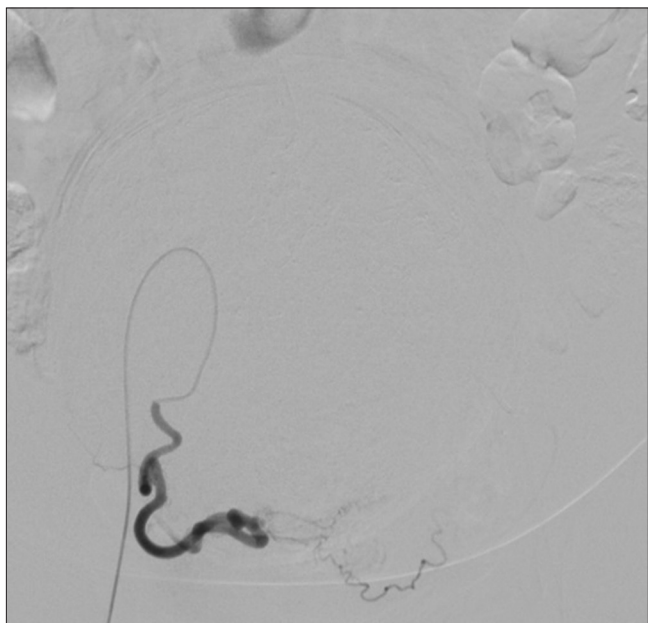


Figure 6: Disappearance of the abnormal tumoral blushes supplied from the right uterine artery

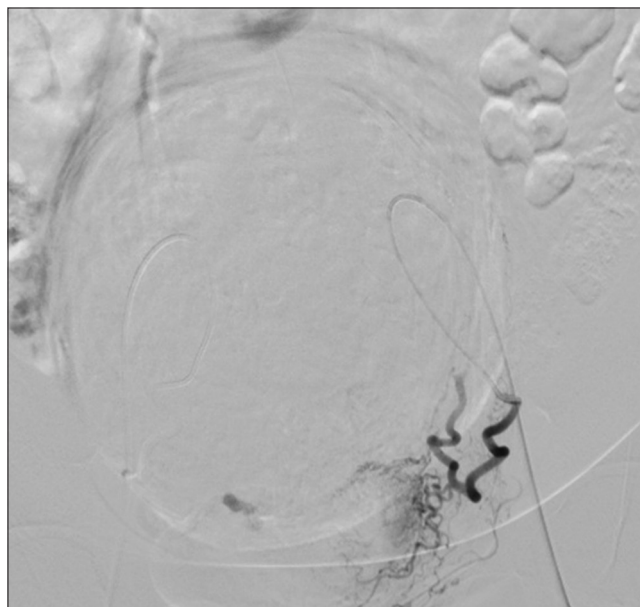


Figure 7: Disappearance of the abnormal tumoral blushes supplied from the left uterine artery

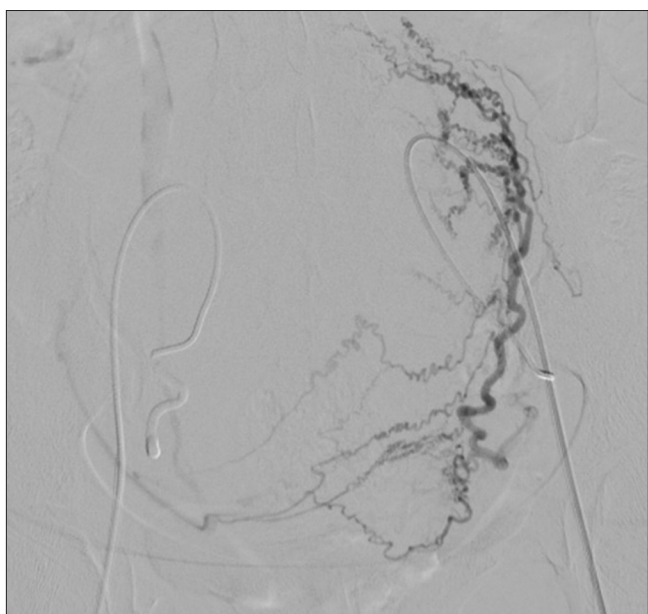


Figure 5: Angiography of the left uterine artery from a Cobra catheter inserted in the left femoral artery (before embolization)

The parameters in that case are as follows:

- Fluoroscopy time: 6 min and 20 s.
- Procedure time: 17 min.
- Radiation dose: 109 Gy cm²
- Number of angiographic images: 106
- Puncture site complications: None.

Case 3

A 30-year-old female with interstitial fibroids presenting with menorrhagia, for which embolization was done using 500–700 μ m and 700–900 μ m particles with single right-sided femoral arterial puncture where the uterine arteries are catheterized sequentially, the right first then the left (Figures 8-11).

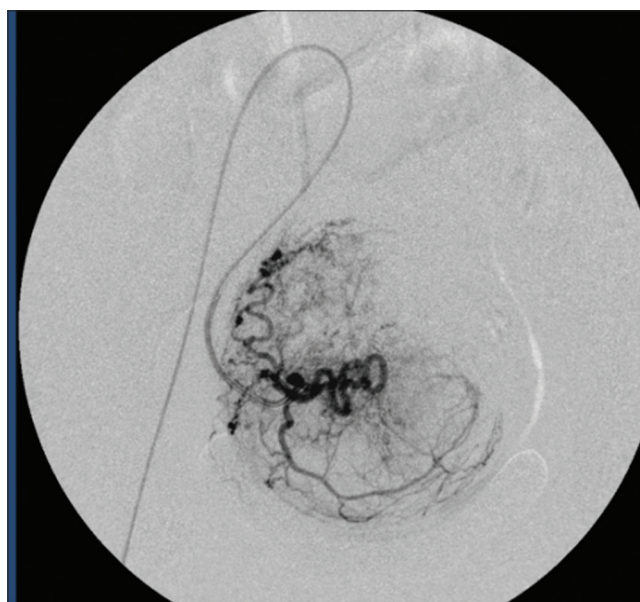


Figure 8: Angiography of the right uterine artery (before embolization)

The parameters in that case are as follows:

- Fluoroscopy time: 35 min.
- Procedure time: 76 min.
- Radiation dose: 520 Gy cm².
- Number of angiographic images: 240.
- Puncture site complications: None.

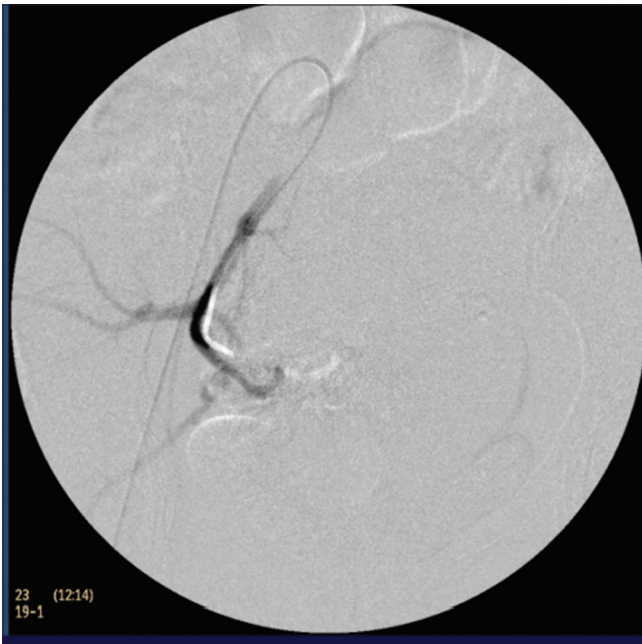


Figure 10: Disappearance of the abnormal tumoral blushes supplied from the right uterine artery

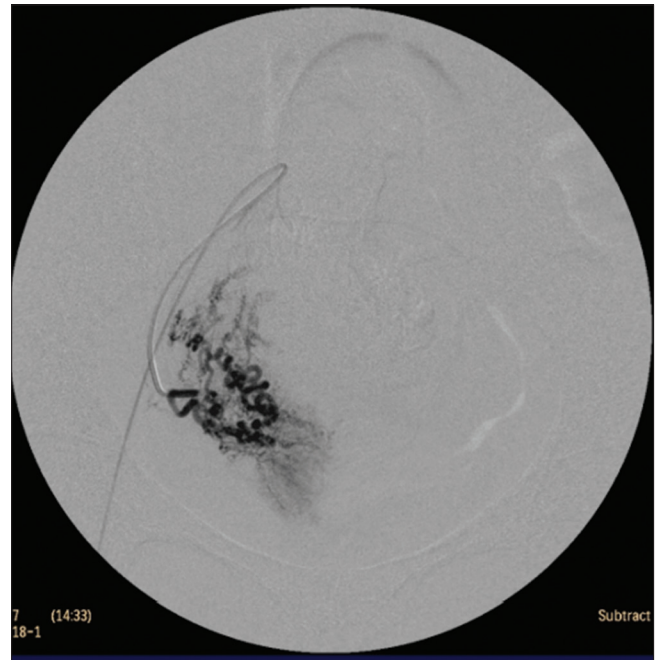


Figure 12: Angiography of the right uterine artery (before embolization)

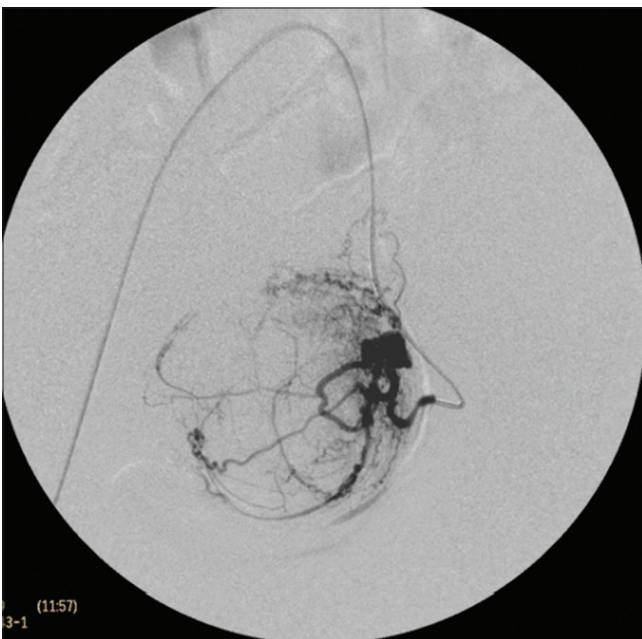


Figure 9: Angiography of the left uterine artery (before embolization)

Case 4

A 29-year-old female with interstitial fibroids presenting with menorrhagia, for which embolization was done using 500–700 μm particles with single right-sided femoral arterial puncture where the uterine arteries are catheterized sequentially, the right first then the left (Figures 12-15).

The parameters in that case are as follows:

- Fluoroscopy time: 18 min.
- Procedure time: 45 min.
- Radiation dose: 278 Gy cm^2 .
- Number of angiographic images: 152.

- Puncture site complications: None.

Discussion

Single right femoral puncture has been the only way to access to UAE procedures for most interventionalists working in this field. That is the standard method for nearly all arterial procedures and it appears to

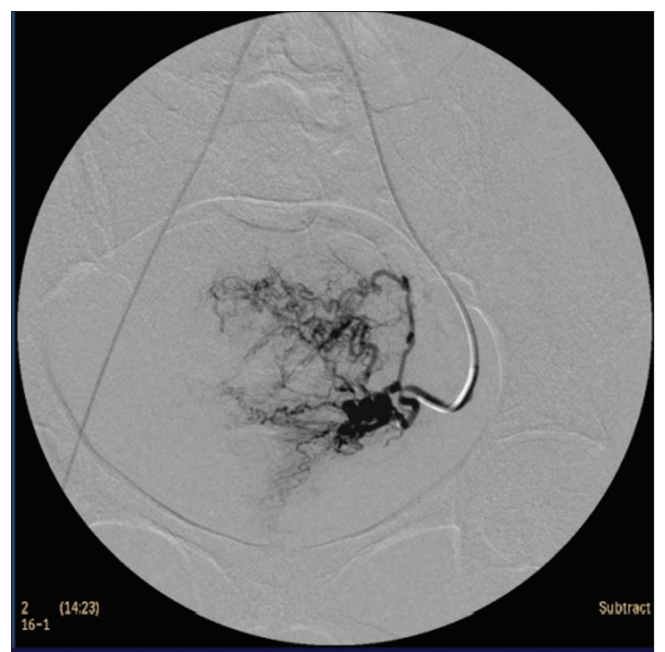


Figure 13: Angiography of the left uterine artery (before embolization)

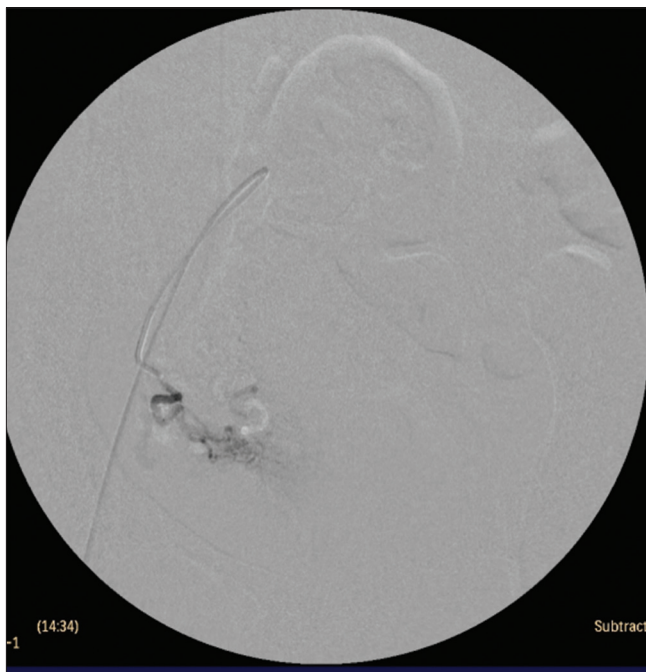


Figure 14: Disappearance of the abnormal tumoral blushes supplied from the right uterine artery

be the obvious choice for UAE. This choice is motivated in part by the fear of potential complications from femoral punctures; the reasoning is that creating two punctures doubles the risk of puncture site complications [3].

It has been also thought that that if two punctures are used, the procedure will take longer. However, the use of bilateral punctures with the goal of reducing the radiation dose has been considered for some time. The evidence is somewhat difficult to



Figure 15: Disappearance of the abnormal tumoral blushes supplied from the left uterine artery



Figure 11: Disappearance of the abnormal tumoral blushes supplied from the left uterine artery

assess because measuring the radiation exposure was variable among different studies [3].

Nikolic *et al.* [6] published a study early in the UAE experience that estimated radiation exposure with the use of thermoluminescent dosimeters during UAE procedures done on 20 patients treated in 1997 and 1998. Most patients were treated with a bilateral puncture, but with sequential uterine angiography and embolization. The researchers in that study found a mean angiographic image of 44 image, a mean fluoroscopy time of 22 min, an absorbed skin dose of 162 cGy, and a mean estimated absorbed ovarian dose of 22 cGy.

Andrews and Brown [7] were the first to report the dose area product (DAP) in relation to UAE performed using a standard unilateral puncture technique and found a mean fluoroscopy time of 27 min, a mean DAP of 211 Gy·cm², and a mean of 65 images.

Bratby *et al.* [4] published a prospective comparative study in 2007. They treated 12 patients with bilateral femoral puncture and then a second group of the same number with unilateral access. Their approach was a little different from ours. They used roadmap guidance as we performed in our study, but they did not obtain any angiographic images before or after embolization. There was also a variation in the measurement of the procedure time where they measured it from the beginning of the puncture to the end of hemostasis, whereas we measured it until the femoral sheath(s) was (were) removed.

Bratby *et al.* found similar differences between the unilateral and bilateral approaches. They reported a mean fluoroscopy time for the bilateral group of 12.8 min, compared with a mean of 16.6 min for the unilateral approach [4]

The results in our study are going with the results of Costantino *et al.* [3] and his coworkers who performed a study in 2010 on 57 patients; 22 of them were done through bilateral femoral puncture and 35 through a unilateral puncture.

Costantino *et al.* reported a mean fluoroscopy time of 13 min in the bilateral approach and 16.6 min in the unilateral approach. In our study, we reported a mean of 8.6 min in the bilateral approach and 24.3 min in the unilateral approach.

As regards the procedure time, Costantino *et al.* reported a mean procedure time of 54.9 min for the bilateral approach and 62.7 min for the unilateral approach; while we reported a mean of 28.4 min for the bilateral approach and 54.4 min for the unilateral approach.

As regards the radiation dose, Costantino *et al.* reported a radiation dose of 129.9 Gy cm² for the bilateral group and 162.3 Gy cm² for the unilateral group; while we reported mean radiation dose of 155 Gy cm² for the bilateral group and 340.5 Gy cm² for the unilateral group.

As regards the number of angiographic images obtained, Costantino *et al.* reported a mean of 46.5 images for the bilateral group and 63.8 images for the unilateral group; while we reported a mean number of angiographic images of 93.8 for the bilateral group and 176.5 for the unilateral group.

This study does have some limitations; as we could not obtain long-term follow-up data regarding the improvement of the presenting symptoms. The present study also included moderate number of cases. Involvement of larger number of cases may have resulted in more puncture site complications.

Conclusion

Bilateral femoral arterial access in UAE results in a reduction in fluoroscopy time, angiographic images

used, and procedure time compared with unilateral femoral puncture, with no significant added risk of puncture site adverse events.

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