Original Article

Degree Of Uterine Leiomyoma Volume Shrinkage After Transcatheter Embolization In Symptomatic Uterine Leiomyomas

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Abstract

Background Uterine artery embolization (UAE) has been proven to be an effective and safe method with a relatively high success rate in minimizing pain, bulk symptoms and bleeding linked to uterine leiomyoma. Uterine artery embolization is increasingly being preferred over surgical hysterectomy or myomectomy due to reduced morbidity, shorter hospitalization and relative uterine preservation when compared to surgical resolution. **Material and methods** Our study protocol was approved by the institutional review board, and informed consent was obtained. The study was done between January 2020 and June 2021, 23 women scheduled for UAE for symptomatic uterine fibroids (median age, 37 years; range, 28-49 years) was included in our study. Pelvic MRI was performed before and 6 months after uterine artery embolization. Uterine leiomyoma shrinkage volume concluded from pre and post-procedure MRI scans. **Results** Our study showed that the dominant fibroid volume significantly decreased from median 125 cm3 to 43 cm3 with percentage of fibroid reduction about 63.0% 6 months after embolization. As regarding uterine volume, it was decreased from 1020.65±359.86 cm3 to 681.17±218.79 cm3 with 33.2% percentage of uterine reduction 6 months follow up after embolization. Also, there was significant improvement in presenting symptoms of patients including heavy bleeding, pelvic pain and pressure symptoms. **Conclusion** Uterine artery embolization is a safe and effective treatment choice for patients with symptomatic fibroids. UAE could significantly reduce the fibroid size as well as the mean menstrual duration and amount.

INTRODUCTION

Uterine fibroids (also known as leiomyomas or myomas) are the most common form of benign uterine tumors. They are tumors of uterine smooth muscle, thus originating from the myometrium. Leiomyomas occur in about 50% of women and in 30% of cases, cause morbidity. **(Donnez and Dolmans, 2016).**

Uterine artery embolization (UAE) is now a well-established uterine preserving and minimally invasive therapy for symptomatic fibroids. Since its introduction in 1995, strong evidence for safety and efficacy of UAE has been generated**. (Maureen and Spies, 2018).**

Leiomyomas are hypervascular benign lesions with large vessels supplying higher vascular flow relative to the normal myometrial vasculature. This permits preferential targeting and occlusion of end arterial branches that perfuse leiomyoma during the delivery of particulate embolization agents used during UAE. Embolization of these end arterial branches ultimately results in infarction, coagulative necrosis, and eventual shrinkage of the targeted leiomyomas **(Chen et al. 2013).**

Material and Methods

Our study protocol was approved by the institutional review board, and informed consent was obtained. The study was done between January 2020 and June 2021, 23 women scheduled for UAE for symptomatic uterine fibroids (median age, 37 years; range, 28-49 years) was included in our study.

Patients complained from heavy or prolonged menstrual bleeding/menorrhagia or pelvic pressure symptoms, discomfort caused by the enlarged uterus.

All patients were subjected to preprocedural unenhanced and contrast enhanced MR imaging followed by uterine artery embolization. A post procedure MRI was performed 6 months after embolization to determine the

percentage of infarction of all leiomyoma tissue. The uterine, dominant leiomyoma volumes were calculated in cm^3 pre-procedural as a baseline and 6 months post-procedural (length x width x depth x 0.54).

MRI analyses

1. Pelvic MRI was performed using 1.5 Tesla MR Scanner (Philips Medical Systems, Achieva) with standard phased array surface coil.
2. Sequences used: Sagittal T2 fast spin echo (FSE) , Axial T2 fast spin echo , Axial T1 fast spin echo , Axial T2 fat-saturated images and Axial T1 fat saturated post-contrast sequences.
3. Slice thickness of 5–6 mm was used.
4. Contrast-enhanced sequences were acquired after intravenous injection of 0.2 ml/kg of gadolinium.
5. Items to be assessed: Confirm leiomyoma diagnosis, determine their location, and exclude other co-existent pathologies like adenomyosis as well as to assess their vascularity.
6. The uterine, dominant leiomyoma volumes were calculated in cm3 pre-procedural as a baseline and 6 months post-procedural (length x width x depth x 0.54). (Fig. 1).
7. Changes between pre- and postembolization uterine volume and dominant fibroid size were calculated.

(A) (B) (C)

Fig. (1) **(A)** present MRI of fibroid prior to UAE
(B) angiography shows uterine blush from left uterine artery
(C) MRI represents fibroid infarction 6 months post UAE.

Embolization technique

Trans-catheter embolization is performed in angiographic suite well equipped with high resolution DSA C- arm machine (Siemens Artis-Z).

A local anesthetic is given at the start of vascular interventional procedure. A 5 or 6-French vascular sheath is placed into right femoral artery then 4 or 5-French Cobra catheters was advanced over hydrophilic guide wire into both uterine arteries. Microcatheters (Progreat 2.7F microcatheter) were reserved for small uterine arteries or those with complicated anatomy. Catheters are typically positioned in the transverse segment of the uterine artery several centimeters away from its origin to prevent reflux into distal internal iliac arterial branches and potential cervico-vaginal branches. Under fluoroscopic guidance, embolization of both uterine arteries was done utilizing PVA of particles size 500- 700 μm up to 700-900 μm. The amount of injected particle was directly related to the size of the lesions and their vascular pattern. Unilateral UAE embolization was performed in three patients due to technical difficulties as a result of iatrogenic arterial spasm. The technical end point was stasis in the main uterine artery for not less than 5 cardiac beats.

Post Procedural outcome

To assess post-procedural success of UAE; the patients were subjected to pelvic MRI 6 months after the procedure to evaluate reduction in uterine and dominant leiomyoma volumes as well as necessity for re-interventions via repeated sessions of UAE or subsequent myomectomies and hysterectomies. The volumes of the uterus and the dominant leiomyomata were calculated in cm3 pre-procedural as a base line and 6 months post-procedural using

the formula for a simplified prolate ellipse (L X W X D X .542) as described by **Orsini et al.** The uterine leiomyoma shrinkage volume concluded from pre and post-procedure MRI scans.

On clinical aspects, follow-up of the patients' symptoms was monitored 1 month after procedure and at 3 months after procedure by verbal questionnaire about symptoms of dysmenorrhea, menorrhagia, mass effects, and urinary urgency/frequency. Patients were asked to assess changes in their symptoms using a 7-point verbal scale as follows: much worse, moderately worse, slightly worse, unchanged, mildly improved, moderately improved, or marked improved. Specific questions about menstruation included: if menstruation had resumed; average duration of flow before and after UAE; and menstrual towels used before and after UAE.

Patient psychological satisfaction with UAE was assessed at 3 months follow up and rated as a 6-point verbal scale: highly dissatisfied, moderately dissatisfied, mildly dissatisfied, mildly satisfied, moderately satisfied, or highly satisfied.

Results

In this study, 23 female patient uterine artery embolization for symptomatic uterine fibroids and showed these results

For the presenting symptoms, 18 patients (78.3 %) presented with heavy or prolonged bleeding, 11 patients (47.8 %) presented with pelvic pain, 8 patients (34.8 %) presented with pressure/mass effects as shown in figure 2. Some of the patients had more than one symptom.

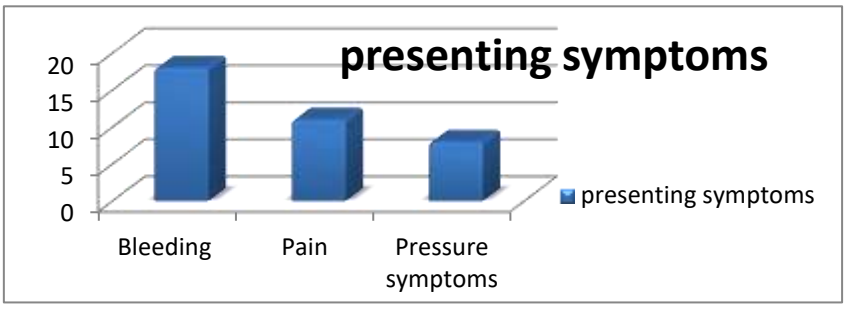
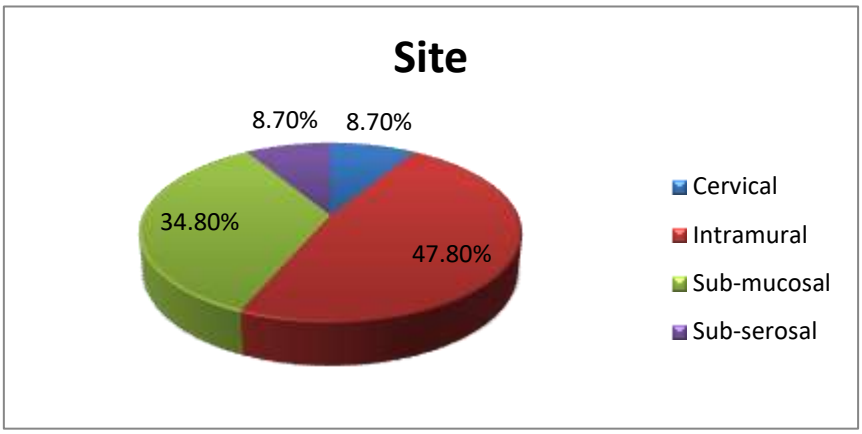


Fig. (2) Simple bar chart for presenting symptoms among the studied group.

Regarding to dominating fibroid location: 47.8 % (n= 11) of fibroids were intramural. whereas 34.8 % (n= 8) were



submucosal located and 8.7% (n=2) were subserosal fibroids. Cervical fibroids were represented only in 8.7% (n=2) as shown in figure 3.

Fig. (3) Pie diagram showing site of dominant fibroid.

The study statistics showed that the dominant fibroid volume significantly decreased from median 125 cm3 to 43 cm3 with percentage of fibroid reduction (tumor burden) about 63.0% 6 months after embolization as shown in table 1 and figure 4.

Table(1) Dominant fibroid volume pre and 6 months' post embolization with MRI among the studied group

	Pre	Post	Sign	P

Size pre	125.0 (11.5-1050) cm3	43.0 (0.96-745.0) cm3	6.85	0.00**

* significant ** highly significant

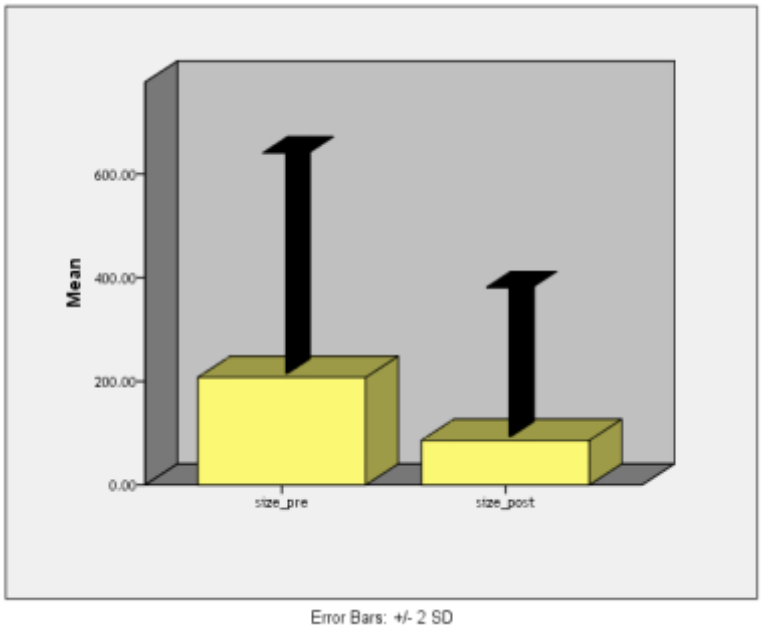
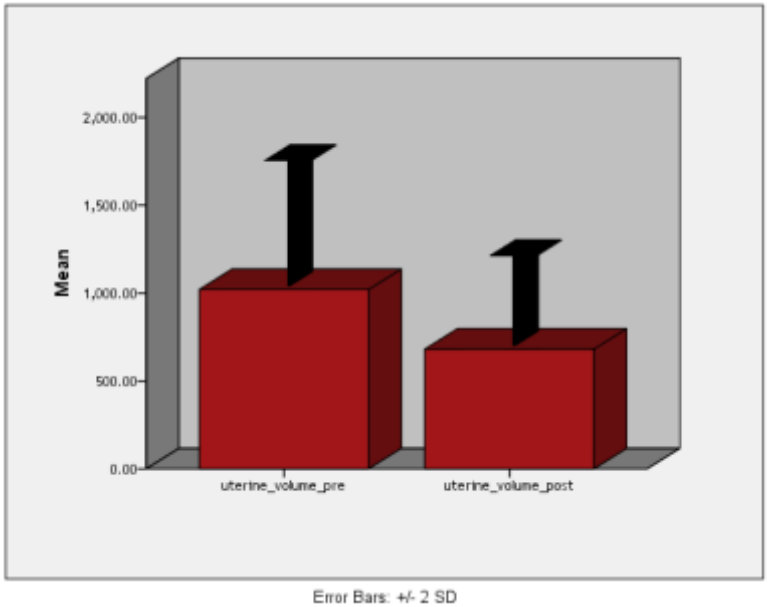


Fig. (4) Distributed bar showing dominant fibroid volume reduction**.**

As regarding uterine volume, it was decreased from 1020.65±359.86 cm3 to 681.17±218.79 cm3 with 33.2% percentage of uterine reduction 6 months follow up after embolization as shown in table 2 and figure 5.

Table (2) Uterine volume pre and 6 months post embolization with MRI among the studied group



	Pre	Post	Paired t	P
Uterine volumes	1020.65±359.86	681.17±218.79	12.207	0.00**

Fig. (5) Distributed bar showing uterine volume reduction.

There was significant improvement in presenting symptoms of patients. From 18 patients presented with heavy bleeding 16 patients showed marked and moderate improvement. And there is highly significant improvement in patients presented with pelvic pain with different degree of pain severity. Also, there is much improvement of patients presented with pressure/mass effects after 3 months clinical follow up.

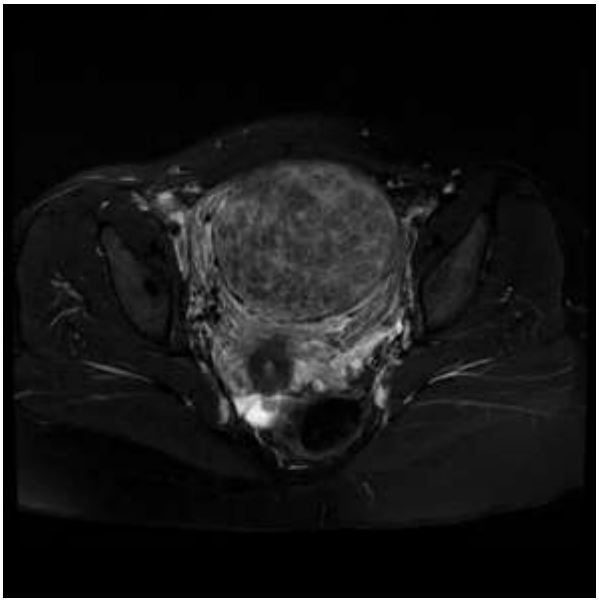
Table (3) Presenting symptoms pre and 3 months post procedure among the studied group

			Pre and post		Mc Nemar	P
			Pre	Post		
Bleeding	-VE	N	5	21		
		%	21.7%	91.3%		
	+VE	N	18	2	18.965	0.00**
		%	78.3%	8.7%		
Pain	-VE	N	12	23		
		%	52.2%	100.0%		
	+VE	N	11	0	13.961	0.00**
		%	47.8%	0.0%		
Pressure	-VE	N	15	22		
		%	65.2%	95.7%		
	+VE	N	8	1	7.412	0.009*
		%	34.8%	4.3%		
Total		N	23	23		
		%	100.0%	100.0%		

This table shows significant improvement in pressure symptoms and highly significant improvement in vaginal bleeding and pelvic pain in studied group.

Cases

Case (1) Premenopausal 35-years-old patient, single, virgin complaining from urinary frequency and urgency.



The patient went to intervention radiology unit and referred to uterine artery embolization.(Fig. 6).

Fig. (6) (A&B) : MRI Sagittal T2WI (A) and Axial T2WI fatsat (B) shows large intramural uterine measuring 8.2x7.5x7.2 cm in three dimensions (of volume about 218 mm3)

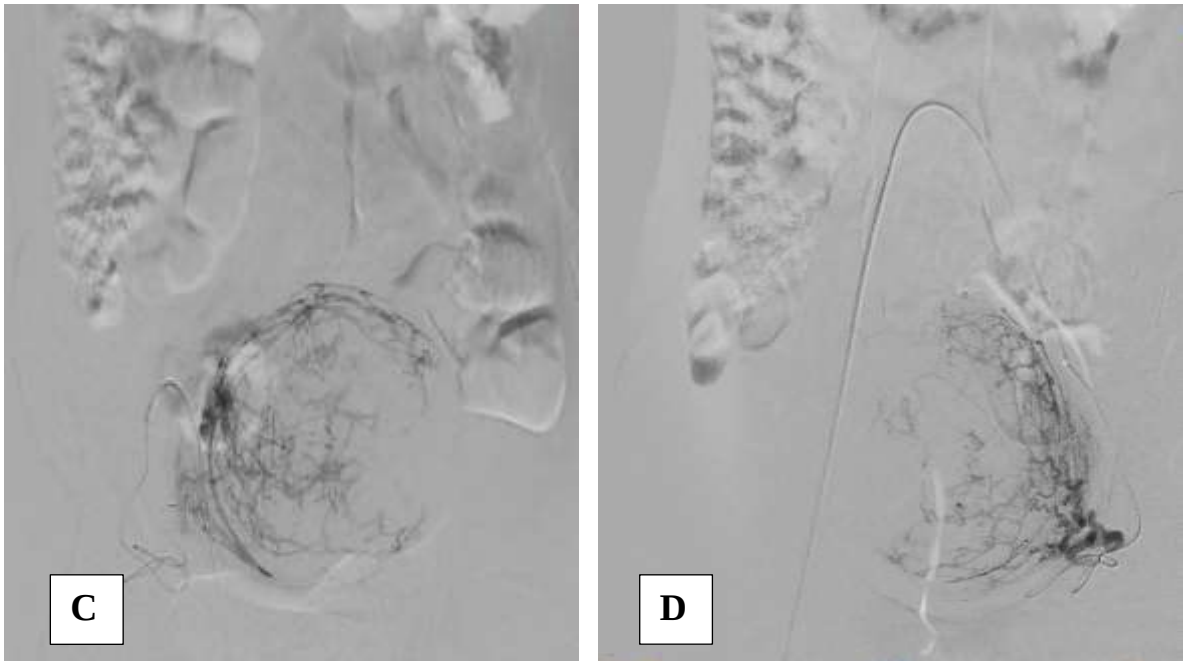


Fig. (6) (C&D) right and left uterine arteries angiography respectively showing tumoral vascular blush.

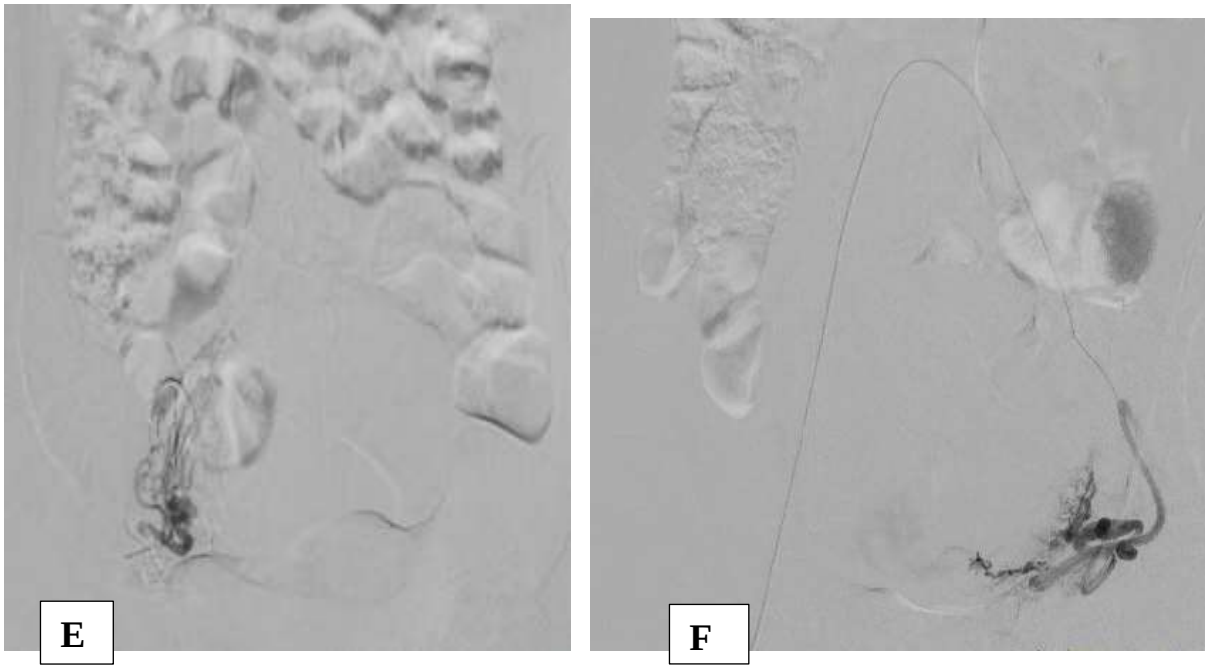


Fig. (6) (E&F) Post embolization right and left uterine arteries angiogram respectively revealed absence of vascular blush.

Fig. (6) (G&H) MRI Sagittal T2WI (A) and Axial T2WI fatsat (B) revealed reduction of size of uterine fibroid to become measuring 5.2.x4.4 x4.3 cm in three dimensions (of average volume 58 mm3).

Case(2) Pre-menopausal 46-year-old patient, married, nulliparous, complaining from abnormal uterine bleeding and pelvic heaviness. The patient refused surgical intervention and counseled to uterine artery embolization. (Fig. 7).

Fig 61(A): MRI sagittal T2WI

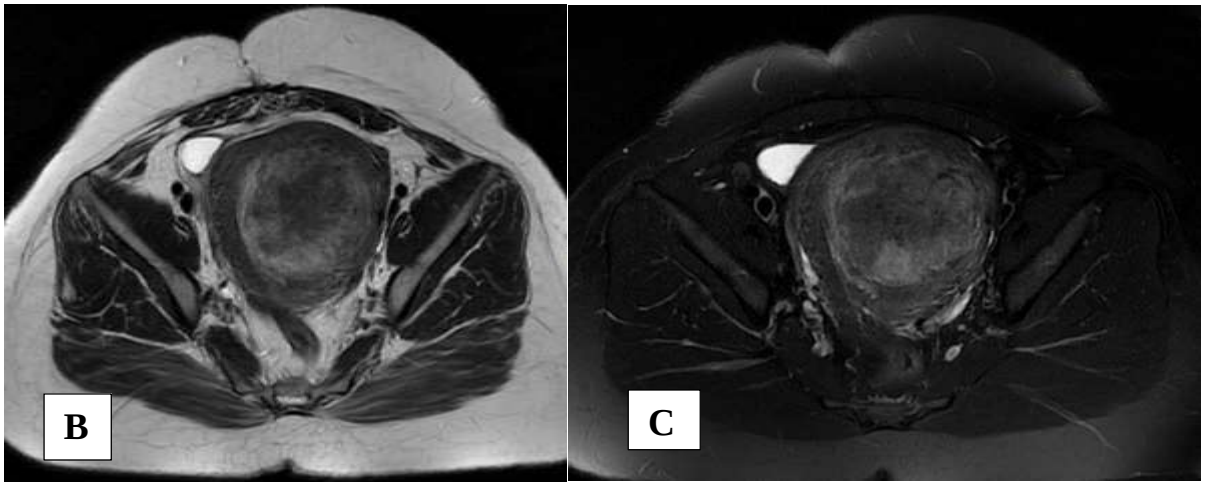


Fig (7) (B & C) MRI Axial T2WI and Axial T2WI fat sat respectively showing intramural uterine fibroid measuring 7.3x7x6.8 cm in three dimensions (of average volume 187 mm3) displaying heterogenous signal intensities consistent with areas of hyaline degeneration.

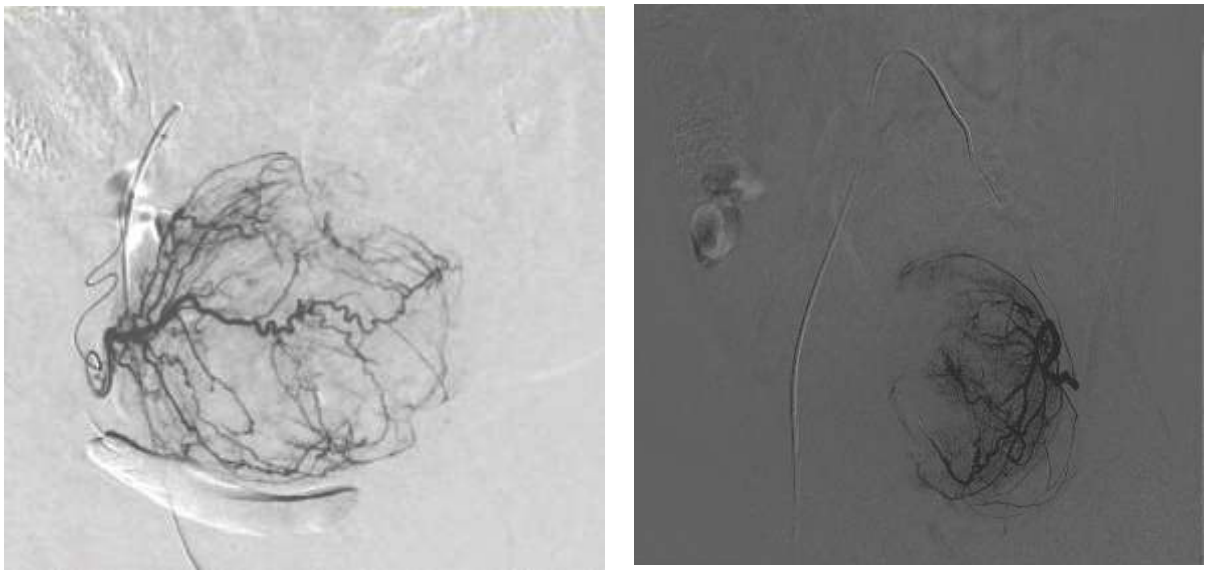


Fig (7) (D,E) Pre embolization right and left uterine arteries angiography respectively showed bilateral vascular tumoral blush.

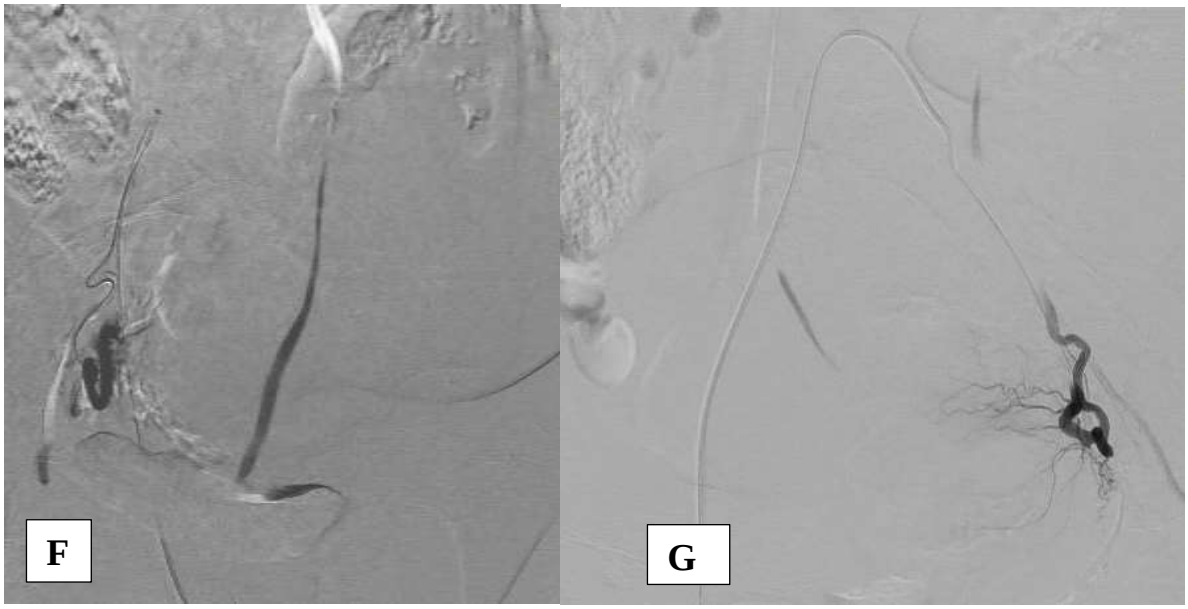


Fig 7 (F&G): Post embolization right and left uterine arteries angiography respectively showed bilateral absence of tumoral blush.

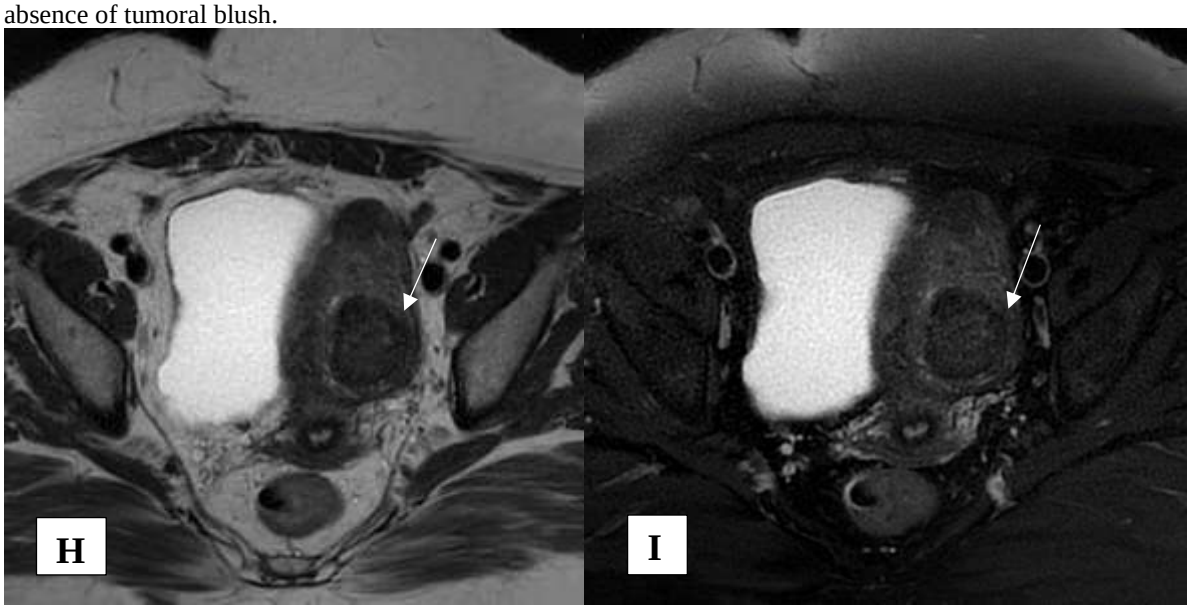


Fig 7 (H&I) MRI axial T2WI and Axial T2WI fatsat respectively showed reduction of size of uterine fibroid (white arrow) to 4x3.6x3.5 cm in three dimensions (of average volume 32 mm3).

Discussion

In our study, 18 patients (78.3%) presented with vaginal bleeding, 12 patients (47.8%) presented with pelvic pain and 8 patients (34.8%) presented with bulk/mass effects which was in agreement of **Zimmerman et al., 2012** who found that 76.3 % of cases with symptomatic uterine fibroids complaining from heavy and prolonged vaginal bleeding.

Embolic materials and embolization endpoints

In the present study, PVA with particle size 500-700 μm and 700-900 μm was the embolizing material used and this was in similarity with **Richard et al., 2014** who compared between PVA and microspheres as embolizing materials and found that PVA is better embolizing agent with more infarction rates for uterine fibroids.

According to **Pelage et al 2002** demonstrated that any type of particle smaller than 500 microns may traverse utero-ovarian anastomoses and cause ovarian infarction and it was determined that peri-fibroid arteries lumen caliber ranged between 500-800 μm in majority of cases so, utilization of PVA more than 500 μm produce fibroid infarction and limiting unwanted ischemia to myometrium and ovaries.

Outcomes

Elimination of the symptoms is the main objective of embolization with fibroid shrinkage as an additional advantage. Our data show that there is a significant improvement in the patients' presenting symptoms. There is also a high degree of satisfaction.

In our study, the UAE could significantly enhance the pain severity, from 11 patients complained mainly from pelvic pain after 3 months of UAE 7 patients reported no pain, 2 patients reported mild pain severity and 2 patients reported no change of the pain. **Toor et al 2012** reported pain improvement rate of 84.4% of the patients at 1- 2 years **(Toor et al., 2012).**

In the present study, 87.5 % of patients were free from the bulk symptoms (frequency and urgency) at 3 months following UAE. The improvement in such symptoms agrees with that reported by a recent meta-analysis by **Toor et al 2012**. In this metanalysis**,** the rate of improvement in bulk symptoms 1 to 2 years of follow-up were 82% **(Toor et al., 2012)**. As well, our results come in consistent with **Katsumori, et al 2002**, who reported that bulk-related symptoms improved markedly or moderately in 97% of patients 4 months after uterine artery embolization **(Katsumori et al., 2002)**.

Also, UAE could significantly decrease the bleeding. In our study heavy menstrual bleeding is controlled in 88% of patient presented mainly with heavy menstrual bleeding. This is consistent with a meta-analysis by **Toor et al., 2012** rates of symptomatic improvement for less than 1 year follow-up were 87.5% (84.7-90.0%) for heavy menstrual bleeding.

Radiological evaluation was done by 6 months post embolization MRI to precisely measure both uterine and dominant leiomyoma volumes. MRI showed significant volume reduction of dominant leiomyoma by 63% and showed decreased uterine volumes by 33.2 %. This is in agreement with various studies. **Katsumori et al., 2002** reported **reduction** of fibroid volume on follow-up imaging studies was averaging 76% on MRI **(Katsumori et al., 2002)**. As well, it revealed that the dominant fibroid volume mean reduction 55% at 4 months and 70% at 1 year respectively. This agrees with **W.J. Walker et al 2002** who reported that 151 out of 155 patients have shown significant reduction in fibroid volume by ultrasound and MRI measurements with an average shrinkage of 73% .and 64%, respectively. Also, dominant fibroid volume decreased similarly by 66% at mid-term follow-up in **Scheurig et al**. (**2006).** Also, this is in line with study by **Jain et al., 2007** revealed that mean reduction in volume of uterus and dominant fibroid was 33 and 59.7% and 48.9 and 75.5% on US at 3 and 12 months respectively, and 33.3 and 58.6% on MRI at 3 months.

Regarding the patients' reported outcomes, there was high level of satisfaction and self-reported improvements. As well, the patient satisfaction was high in our series, 78.2 % showed moderate to great satisfaction. This is also consistent with the Ontario study in which 90 % of patients were satisfied with the obtained outcomes at 3 months after UAE **(Pron & Ph, Bennett, 2003).**

Major complications were very rare with no detectable post-procedural acute major complications which are near the results reported by meta-analysis of **Toor et al., 2012.**

We had five minor complications: two patients with post procedure groin hematoma at the puncture site following sheath removal yet was localized and managed conservatively and are of no clinical consequences. three patients experience post-embolization syndrome in form of pelvic pain, low grade fever, nausea and vomiting in the first few days after UAE that was controlled with analgesics, oral anti-inflammatory drugs and antibiotics for 5 days till total resolution of symptoms.

Pelvic pain is the most frequent reported adverse effect of UAE as a result of ischemia, hence the necessity for an appropriate pain management protocol following the procedure. However, we have no infective complications & none of the patients required intensive care unit admission. This may be attributed to our policy to treat any prior existing infections as well as the prophylactic peri-operative antibiotics. This is in agreement with **Isil Yildiz, 2017** who reported no infective complications & attributed this to exclusion or treatment of pre-existing infection (**Isil Yildiz, 2017)**. Pre-existing infections should be excluded as far as this is possible.

Limitations

The limitations of this study were the small sample size. Embolization technique was consistent. Our technique of embolization includes bilateral femoral artery embolization except for 3 cases was unilateral uterine embolization due to technical difficulties. It was not possible to assess fibroid regrowth or symptom recurrence in this study.

Conclusion

Uterine artery embolization is a safe and effective treatment choice for patients with symptomatic fibroids who wish to preserve their uterus. UAE could significantly reduce the fibroid size as well as the mean menstrual

duration and amount. MRI is the preferred imaging modality for evaluating uterine anatomy and excluding non leiomyomatous etiologies of pelvic pain and abnormal uterine bleeding.

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