Original Article

Gelfoam in Uterine Artery Embolization for Acquired Symptomatic Uterine Arteriovenous Shunting and Myomas: Insights from a Retrospective Study

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Abstract

Objective: To evaluated the clinical and post procedural success rates of gelfoam bilateral Uterine Artery Embolization (UAE) for symptomatic acquired arteriovenous shunting and myomas.

Methodology: A retrospective study was conducted on women of childbearing age at a tertiary referral center Shaheed Mohtarma Benazir Bhutto Institute of Trauma Karachi from January 2022 to June 2023. Outcome was measured at 3 and 6 months, in terms of bleeding, resolution of myoma, reduction in uterine size or both, and relief of pain intensity following the procedure. A paired t-test was conducted to assess the mean difference in the number of pads used between baseline (pre-operative) and 3 and 6 months post-procedure. A p-value of less than 0.05 was considered the threshold for statistical significance.

Results: Around 46.9% of women found with pain reduction at three months, increasing to 53.1% at six months. Regarding the impact of surgery on the uterus and myoma resolution, 31.3% of patients showed a decrease in uterine size, 25% had reduced myomas, and 37.5% had a reduction in both. The mean number of pads used per day significantly decreased from 15.34/day before the procedure to 8.44/day at three months and 4.88 at six months, as a statistically significant reduction in pad usage between the third and sixth months post-surgery (P=0.001).

Conclusion: The method of gelfoam UAE observed as a safe and effective alternative procedure to myomectomy or hysterectomy to treat symptomatic uterine arteriovenous shunting and myomas with a high technical and clinical success rate and low rate of the complications.

Keywords: Gelfoam, Uterine artery embolization.

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Introduction

Uterine fibroids are common in reproductive-aged women, affecting 40% by age 35, and 70% by age 50.[1] Fibroids are asymptomatic mostly, but 20% to 50% of women with fibroids needs treatment to reduce bulk effects and relieve menstrual symptoms.[2] Fibroids have the characteristic of appearing de novo and, if left untreated, continue to grow until menopause. Hysterectomy has remained the mainstay of treatment for ages.[2] Recent treatment strategies such as, Uterine artery embolization, are proven to be successful for managing excessive bleeding.[3] The prevalence of UAE has increased since the procedure was first performed with approximately 25,000 procedures being performed in 2008.[4,5] Moreover, UAE has demonstrated fairly acceptable outcomes especially among women of younger age group with fertility need to be preserved.[6]

Abnormal communication of arteries and veins without an intermediating capillary bed is Arteriovenous malformation (AVM).[7] It can be life threatening when for uterus presenting as intermittent, sometimes heavy bleeding with no prior intervention.[8] Congenital and acquired forms of AVMs are seen.[9] Acquired type are frequently the consequence of previous uterine trauma, such as curettage procedures, cesarean section, or

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pelvic surgery.[10] Treatment depends on the symptoms, age and desire for unborn fertility, localization, and size of the lesion. Embolization of the uterine artery is an efficient and effective system of treating AVM, particularly in cases of reproductive age.

Initially, hysterectomy was the favorable treatment option for AVM and fibroids, however, uterine artery embolization has become the preferred method of treatment considering its minimally invasive feature, efficacy, and its ability to preserve uterine functions especially for women of childbearing age.[11] Bilateral UAE is 90% effective as studies suggest procedural complications, deficient embolization and sometimes uterine artery rupture resulting in technical failures.[12] Variety of embolic agents are used like polyvinyl alcohol, histoacryl glue, stainless steel coils, detachable balloons, and hemostatic gelatin.[13]

However, there is a lack of data to compare the efficacy of various embolic agents. Besides, data are lacking on assessing the clinical and post procedural success rates of gelfoam bilateral uterine artery embolization for symptomatic acquired arteriovenous shunting and myomas. To address this gap in knowledge, this study has been done to assess the clinical and post procedural success rates of gelfoam bilateral uterine artery embolization for symptomatic acquired arteriovenous shunting and myomas.

Methodology

A retrospective study was conducted on women of childbearing age at a tertiary referral center Shaheed Mohtarma Benazir Bhutto Institute of Trauma Karachi from January 2022 to June 2023. The study included patients with abnormal uterine bleeding following recent gynecological procedures, obstetric events, or due to underlying fibroids. Patients who underwent serial uterine artery angiography during this period were included. Convenient sampling was used, and a sample of 32 patients was considered eligible for the analysis. The exclusion criteria included a history of active pelvic infection or malignancy, coagulopathy disorders, previous hysterectomy or any other surgical treatment for fibroids, and cases with incomplete or missing data according to the study criteria. This retrospective study was conducted following compliance and approval from the Institutional Review Board letter no ERC-000121/SMBBIT/Approval/2023. Due to the study's retrospective design, a waiver for informed consent was obtained from the participants. Angiograms were performed on reproductive-age patients presenting with abnormal uterine bleeding following recent gynecological or obstetric procedures or secondary to fibroids. All eligible patients underwent bilateral uterine artery embolization using Gelfoam to achieve embolization of arteriovenous malformations (AVMs) and fibroids while minimizing complications.

The technical success of the procedure was defined as the angiographic resolution of the arteriovenous shunt or fibroids. Clinical success was determined based on pain relief, cessation of symptomatic bleeding, reduction in uterine and myoma size on follow-up imaging, and post-procedure blood loss measured by the number of pads used. Patients were followed up at three and six months. A telephonic follow-up was conducted at three months to assess symptom improvement and disease surveillance. At six months, a comprehensive evaluation was performed, including clinical assessment and pelvic ultrasound, to monitor treatment outcomes and resolution of symptoms. The demographic information including age, time since marriage, pre-procedure hemoglobin level, blood pressure and pain was assessed. Pre-operative bleeding was also assessed based on the number of pads used per day and findings from ultrasound or MRI were also noted. Outcome data were documented at 3 and 6 months post-procedure, including bleeding measured by the number of pads used per day, resolution of myomas or reduction in uterine size, and relief of pain intensity following the procedure.

SPSS version 26 was used for the data analysis. For continuous variables, means and standard deviations were calculated. For categorical variables, frequencies and percentages were generated. T-test and chi-square test were applied to assess the mean difference in the number of pads used between baselines and at 3 and 6 months post-operatively, taking a p-value < 0.05 considered as significant.

Results

According to the socio-demographic characteristics, the majority of participants were aged 30 to 40 years (53.1%), with a mean time since marriage of 7.88 years. Most common presenting complaint was heavy menstrual bleeding (40.6%), followed by pain (12.5%), irregular cycles (21.9%), and a combination of pain and heavy bleeding (25.0%). Most patients reported their complaints for more than six months (53.1%). According to fertility pattern, 46.9% had no infertility, while 18.8% had primary infertility and 34.4% had secondary infertility. Pre-operative assessments

indicated normal blood pressure in 75.0% of participants, and all patients were found to have pre-operative anemia (hemoglobin < 11 g/dL), with a mean hemoglobin level of 9.5 g/dL. The mean fluoroscopic time was 36.31 minutes, and the average pre-operative bleeding was 15.34 pads per day. Ultrasound or MRI findings revealed various fibroid locations and tortuous vascularity among the participants as shown in table I**.**

Table I: Socio-demographic characteristics of women. (n=32)

Variables	**Descriptive statistics**	
Age groups	N	%
20 to 30 years	10	31.3%
30 to 40 years	17	53.1%
> 40 years	5	15.6%
Time since marriage (Mean ± SD)	7.88 ±5.26 years	
Presenting complaint	N	%
Heavy menstrual bleeding	13	40.6%
Pain	4	12.5%
Irregular cycle	7	21.9%
Pain and heavy menstrual bleeding	8	25.0%
Time of presenting complaint	N	%
< 1 week	6	18.8%
1 week to 6 months	9	28.1%
> 6 months	17	53.1%
Type of infertility	N	%
No infertility	15	46.9%
Primary infertility	6	18.8%
Secondary infertility	11	34.4%
Pre-operative blood pressure	N	%
Normal blood pressure reading	24	75.0%
Low blood pressure reading	8	25.0%
Pre-operative bleeding	15.34 pads	
Pre-operative hemoglobin, (Mean ± SD)	9.5±0.86 g/dL	
Pre-operative anemia, Hb < 11 g/dL		
Yes	32	100.0%
No	0	0
Fluoroscopic time, (Mean ± SD)	36.31± 8.6	
Pre-operative bleeding,		
Mean Pads per day	15.34 ±2.25 per day	
Previous surgery/intervention	N	%
No previous surgery	23	71.9%
Previous surgery	9	28.1%
Ultrasound or MRI findings, n %		
Tortuous vascularity	9	28.1%
Fibroid in fundus	6	18.8%
Fibroid in anterior wall	5	15.6%
Fibroid in posterior wall	6	18.8%
Multiple fibroids	5	15.6%
Fibroid in cervix	1	03.1%

According to the post-operative outcomes, at three months post-operatively, the average number of pads used per day significantly decreased to 8.44 ±1.6, with further reduction to 4.88 ±0.79 by six months (p=0.001). The pre-operative hemoglobin level was 9.5 ±0.86 g/dL and significantly increased to 11.4 ±1.32 g/dL at six months, p-0.048. Regarding pain relief, 46.9% of patients reported a decrease in pain at three months, which increased to 53.1% by six months (p=0.001). (Table II)

Table II: Post-operative outcomes in terms of bleeding, pain, and myoma.

Post-operative bleeding	**Statistics**		**p-value**
Pads per day at 3 months,	8.44±1.6		0.001
Pads per day at 6 months	4.88±0.79		
Pre-operative hemoglobin,			
Hb at 3 months,	9.5±0.86 g/dL		
Hb at 6 months	11.4+1.32 g/dL		0.048
Post-operative pain, n %			
Pain decreased at 3 months	15	46.9%	0.001
Pain decreased at 6 months	17	53.1%	
Resolution of size of uterus and myomas at 6 months,			
Decrease in uterus size	10	31.3%	
Decrease in myomas	8	25.0%	
Decrease in both uterus size and myomas	12	37.5%	
No change in uterus or myoma	2	6.3%	

In terms of myoma resolution at six months, 31.3% of patients experienced a decrease in uterine size, 25.0% had reduced myomas, and 37.5% showed a decrease in both uterine size and myomas. Only 6.3% of patients reported no change in either uterine size or myomas. (Figure 1)

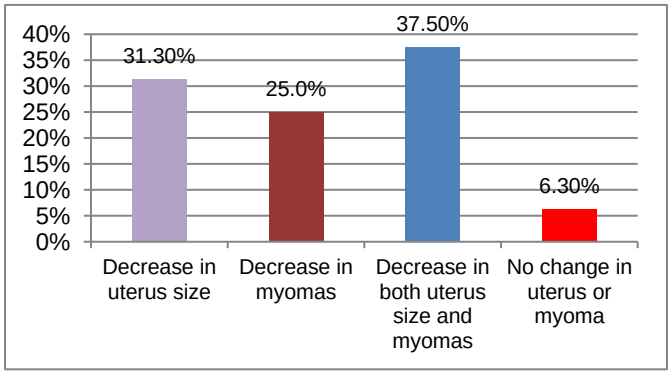

Figure 1. Resolution of size of uterus and myomas at 6 months

Discussion

This retrospective study conducted at a tertiary care hospital aimed to evaluate the effects of Gelfoam bilateral UAE on pain intensity, bleeding, and the size of myomas in women of childbearing age presenting with symptomatic acquired arteriovenous shunting and myomas. The results demonstrated a significant reduction in bleeding, evidenced by a statistically significant decline in the number of pads used per day at both three and six months post-procedure.

Furthermore, nearly half of the patients reported a reduction in pain intensity following the procedure. Regarding the size of the myomas and uterus, more than one-third of the patients experienced a decrease in both uterine and myoma size, highlighting the effectiveness of UAE as a treatment option for these conditions. Despite inherent risk of potential fertility problems following UAE, it remains a suitable choice for women with symptomatic acquired arteriovenous shunting and myomas. The procedure is also considered a suitable option for those who want to retain fertility and show desire to become pregnant after the procedure. The UAE was initially considered a suitable procedure for bleeding before myomectomy or after post-partum hemorrhage. With its recognition, the procedure becomes an effective treatment for uterine myomas, especially with abnormal bleeding. While we did not compare gelofoam with other embolic agents in this study, the findings from literature consider gelofoam as equivalent, if not superior, to other embolic agents. For example, Vilos et al., undertook a prospective, pilot observational study comparing gelfoam to embospheres, and authors found that at 12 months, the reduction in uterine volume was comparable in both groups, meaning that clinical outcomes were equivalent after using gelfoam or gelfoam plus embospheres.[14] While authors did not objectively demonstrate the reduction in pain, the authors reported an immediate decline in pain following use of gelfoam UAE.[14] Similarly, findings of a randomized controlled trial suggest a reduction in fibroid volume for about 40 to 60% of the women underwent for either gelfoam UAE alone or a combination of gelfoam with particles.[15] Besides, authors also found a reduction in bleeding at 12 months and that was equivalent in both groups.[15] These consistent findings suggest that gelfoam UAE alone or with other embolic agents can be considered a beneficial and effective procedure to reduce the symptoms such as pain, bleeding, and reduction in volume of myomas.[15]

Similar findings have been reported by another prospective report by Katsumori et al on 96 women, followed for about 5 years, suggest a symptomatic relief for about 90% of women following gelfoam UAE.[9] Furthermore, a study by Camacho et al., 2019 suggests a similar clinical and technical success rate following UAE with gelfoam for AVM. The authors included 18 patients and reported a technical and clinical success rate for about 95% and 94% of patients, respectively.[16] A similar high technical and clinical success rate is also reported by Wang et al and Ganguli et al who introduced this procedure on 42 and 66 patients, respectively.[17,18]

In aligns to this study Yadavali R et al[19] also reported that on the comparison of Gelfoam with Embospheres, at six moths both showed the enhanced QOL and improvement in symptoms, with more reduction in volume of uterus in the Embospheres group. These consistent findings can be explained by the fact that selective uterine artery embolization may work by occluding flow of blood by inducing blood clot formation. This concept of temporarily occluding the uterine arteries may be due to apoptotic mechanisms for myomas that may be required to reduce their volume.[20,21] It is likely that gelfoam may result in a similar apoptosis in myomas by inducing hypoxia at the tissue levels instead of exclusive ischemia that is caused following UAE with particles leading to tissue necrosis. Ischemia results in rapid ATP exhaustion and glucose consumption, apoptosis inhibition with subsequent death of cells due to necrosis.[21] These cells are featured by electron-lucent cytoplasm and swelling of mitochondria with lost cell membrane integrity. Cell death takes place following ATP-depleting conditions.[20]

In addition, gelfoam has an added benefit of normalizing menstrual blood loss instead of causing extreme reduction that has been observed following UAE with particles. This perhaps may provide an additional benefit for women who desire to preserve their fertility. Despite the small sample size, the present study has several important clinical implications, as the findings propose that the UAE with gelfoam can lead to improved clinical outcomes, particularly among women of childbearing age in resource-limited settings.

Although this study did not assess patient satisfaction or quality of life, it is plausible that these factors may have improved alongside the alleviation of clinical symptoms. Given the positive outcomes observed, gelfoam UAE could be considered a viable treatment option for women in developing countries with diverse backgrounds, offering a less invasive alternative to hysterectomy or myomectomy for managing fibroids. However, long-term follow-up is necessary to evaluate sustained outcomes and potential side effects. Since gelfoam dissolves within days, it is speculated that this temporary occlusion method may contribute to permanent uterine artery occlusion. This characteristic also allows for the possibility of re-embolization in

cases of recurrent or new myomas, thus preserving fertility and potentially improving pregnancy outcomes.

Additionally, gelfoam UAE may serve as a preventive intervention for small, asymptomatic myomas before they enlarge, providing women with a broader range of treatment options. This study possesses other limitations like the limited small sample size and lack of a control group restricted comparisons with other treatments. Additionally, the study was conducted in a single tertiary care hospital, limiting generalizability.

The retrospective design and variable follow-up durations further hindered establishing a clear temporal relationship between gelfoam UAE and clinical outcomes. To strengthen the evidence, future large-scale randomized controlled trials with standardized follow-ups are needed to assess the long-term efficacy and impact of gelfoam UAE on patient outcomes and quality of life.

Conclusion

Study revealed that the gelfoam uterine artery embolization is a safe and effective treatment option for women with myomas, with high technical and clinical success rate. Additionally, this method appears to improve clinical symptoms while minimizing potential harm to endometrial anatomy. Therefore, gelfoam UAE can be considered a viable approach for managing symptomatic uterine arteriovenous shunting. However, based on certain study limitations and retrospective design, further longitudinal studies are recommended to validate the findings.

References

1. Yang Q, Ciebiera M, Bariani MV, Ali M, Elkafas H, Boyer TG, Al-Hendy A. Comprehensive review of uterine fibroids: developmental origin, pathogenesis, and treatment. *Endocr Rev.* 2022 Aug 1;43(4):678-719. doi:10.1210/endrev/bnab039.
2. Vannuccini S, Petraglia F, Carmona F, Calaf J, Chapron C. The modern management of uterine fibroids-related abnormal uterine bleeding. *Fertil Steril.* 2024;122:12-30. doi:10.1016/j.fertnstert.2024.04.041.
3. Ludwig PE, Fraser R, Tsung JW, Gagliardi RJ, Lipsitz EC. Pregnancy success and outcomes after uterine fibroid embolization: updated review of published literature. *Br J Radiol.* 2020;93(1105):20190551. doi:10.1259/bjr.20190551.
4. Goodwin SC, Bonilla SM, Sacks D, Reed RA, Spies JB, Landow W, et al. Uterine artery embolization for treatment of leiomyomata: long-term outcomes from the FIBROID Registry. *Obstet Gynecol.* 2008;111(1):22-33. doi:10.1097/01.AOG.0000296526.71749.c9.
5. Glass Lewis M, Ekúndayò OT. Cost and distribution of hysterectomy and uterine artery embolization in the United States: regional/rural/urban disparities. *Med Sci (Basel).* 2017;5(2):10. doi:10.3390/medsci5020010.
6. Pron G, Cohen MM, Soucie J, Garvin G, Vanderburgh L, Bell SD. 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):120-7. doi:10.1016/S0015-0282(02)04538-7.
7. Fleetwood IG, Steinberg GK. Arteriovenous malformations. *Lancet.* 2002;359(9309):863-73. doi:10.1016/S0140-6736(02)07946-1.
8. Hammad R, Nausheen S, Malik M. A case series on uterine arteriovenous malformations: a life-threatening emergency in young women. *Cureus.* 2020;12(7):e9410. doi:10.7759/cureus.9410.
9. Beller U, Rosen RJ, Riddle GJ, Seeger JF, Choi H, Makowski EL. Congenital arteriovenous malformation of the female pelvis: a gynecologic perspective. *Am J Obstet Gynecol.* 1988;159(5):1153-60. doi:10.1016/0002-9378(88)90435-8.
10. Manolitsas T, Hurley V, Gilford E. Uterine arteriovenous malformation—a rare cause of uterine haemorrhage. *Aust N Z J Obstet Gynaecol.* 1994;34(2):197-9. doi:10.1111/j.1479-828X.1994.tb02691.x.
11. Khan S, Sanghavi D, Sanghavi S, Mehta S, Mehta S, Patel P, et al. Acquired uterine arteriovenous malformation following dilatation and curettage treated with bilateral uterine artery embolization: a case report. *Cureus.* 2019;11(3):e4250. doi:10.7759/cureus.4250.
12. Kim T, Shin JH, Kim J, Yoon HK, Ko GY, Gwon DI, et al. Management of bleeding uterine arteriovenous malformation with bilateral uterine artery embolization. *Yonsei Med J.* 2014;55(2):367. doi:10.3349/ymj.2014.55.2.367.
13. Vilos AG, Allaire C, Laberge PY, Leyland N. Uterine artery embolization for uterine arteriovenous malformation in five women desiring fertility: pregnancy outcomes. *Hum Reprod.* 2015;30(7):1599-605. doi:10.1093/humrep/dev097.
14. Vilos AG, Ettler HC, Hollett-Caines J, Abu-Rafea B, Vilos GA. Post-uterine artery embolization pain and clinical outcomes for symptomatic myomas using Gelfoam pledgets alone versus Embospheres plus Gelfoam pledgets: a comparative pilot study. *J Obstet Gynaecol Can.* 2014;36(11):983-9. doi:10.1016/S1701-2163(15)30411-4.
15. Vilos AG, Ettler HC, Hollett-Caines J, Abu-Rafea B, Vilos GA. Uterine artery embolization for symptomatic uterine myomas using Gelfoam pledgets alone vs. Embospheres plus Gelfoam pledgets: a randomized comparison. *Gynecol Surg.* 2016;13:409-14. doi:10.1007/s10397-016-0975-z.
16. Camacho A, Holub Z, Berzaczy D, Barsa P, Sedlmair M, Šrámek V, et al. Uterine artery embolization with Gelfoam for acquired symptomatic uterine arteriovenous shunting. *J Vasc Interv Radiol.* 2019;30(11):1750-8. doi:10.1016/j.jvir.2019.04.002.
17. Wang Z, Chen J, Shi H, Zhou Q, Wang J, Qian L. Efficacy and safety of embolization in iatrogenic traumatic uterine vascular malformations. *Clin Radiol.* 2012;67(6):541-5. doi:10.1016/j.crad.2011.11.002.
18. Ganguli S, Stecker MS, Pyne RF, Baum RA, Fairman RM, Stavropoulos SW, et al. Uterine artery embolization in the treatment of postpartum uterine hemorrhage. *J Vasc Interv Radiol.* 2011;22(2):169-76. doi:10.1016/j.jvir.2010.09.031.
19. Yadavali R, Ananthakrishnan G, Sim M, Monaghan K, McNaught G, Hamoodi I, et al. Randomised trial of two embolic agents for uterine artery embolisation for fibroids: Gelfoam versus Embospheres (RAGE trial). *CVIR Endovasc.* 2019;2:1-8. doi:10.1186/s42155-018-0044-y.
20. Vilos GA, Hollett-Caines J, Burbank F. Uterine artery occlusion: what is the evidence? *Clin Obstet Gynecol.* 2006;49(4):798-810. doi:10.1097/01.grf.0000211950.74583.f5.
21. Vilos GA, Ettler HC, Abu-Rafea B, Hollett-Caines J, Vilos AG. Temporary uterine artery occlusion for treatment of menorrhagia and uterine fibroids using an incisionless Doppler-guided transvaginal clamp: case report. *Hum Reprod.* 2006;21(1):269-71. doi:10.1093/humrep/dei299.