CASE SERIES

Angioembolization of Uterine Arteriovenous Fistula: A Case Series

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ABSTRACT

Uterine Arteriovenous Fistulas (AVFs) are rare but clinically significant vascular abnormalities that can lead to severe, sometimes life-threatening, vaginal bleeding, particularly in women of reproductive age. Prompt diagnosis and treatment are essential to prevent serious morbidity. Radiologic imaging is the mainstay of diagnosis, revealing increased and abnormal uterine vascularity. Three principal treatment approaches are available: (i) Medical management, including hormonal therapy, methotrexate, or uterotonics; (ii) Interventional radiology, particularly Uterine Artery Embolization (UAE); and (iii) Surgical management, most notably hysterectomy. Clinical presentation often includes irregular or profuse per-vaginal bleeding, which may result in hemodynamic instability, necessitating transfusion or emergency intervention. Given the condition's prevalence among women wishing to preserve fertility, minimally invasive options like UAE are preferred. Angiography serves as both a diagnostic and therapeutic tool, aiding in the localization and embolization of AVFs. This paper presents ten cases of uterine AVFs diagnosed through imaging and managed with UAE, followed by an analysis of clinical outcomes and implications for fertility preservation.

Keywords: *Uterine AVF, uterine AVM, embolization, interventional radiology, abnormal uterine bleeding, fertility preservation.*

INTRODUCTION

Uterine arteriovenous malformations (AVMs) represent rare vascular disorders involving abnormal, high-flow communications between the arterial and venous systems within the uterus. First documented in the early 20th century by Dubreil and Loubat, they were initially described as "cirsoid aneurysms"—a term reflecting the convoluted nature of these vessels [1-4]. These lesions are classified as either congenital or acquired, with the acquired forms accounting for most cases in contemporary practice. Histologically, AVMs bypass the capillary bed, forming fistulous links between arterial and venous structures in the myometrium, giving rise to rapid, unregulated blood flow [2].

The classic presentation is heavy or irregular uterine bleeding, often unresponsive to standard gynecologic management and sometimes necessitating emergency care. Suspicion should be heightened in the context of obstetric hemorrhage that fails to respond to conventional interventions [5]. Additional manifestations may include chronic pelvic pain, anemia, fatigue, menorrhagia, or incidental detection during imaging performed for other indications [6, 7]. Due to its low incidence and variable presentation, uterine AVM is often misdiagnosed, leading to inappropriate interventions such as dilatation and curettage (D&C), which can cause catastrophic hemorrhage.

AVMs are categorized into congenital and acquired types [1, 3, 4, 8]. Congenital AVMs stem from abnormal vascular development during embryogenesis, often presenting in adolescence or early adulthood. They usually have multiple feeding arteries and draining veins and may be associated with genetic abnormalities, such as RASA-1 mutations located on chromosome 5q13-22 [1, 4, 9].

Acquired AVMs, on the other hand, are more common and frequently result from uterine trauma—typically following procedures such as curettage, cesarean sections, or myomectomy. They can also occur in association with conditions like gestational trophoblastic disease, endometrial cancer, and pelvic infections [7, 10-13]. Their actual incidence remains difficult to ascertain but may reach up to 0.63% after pregnancy-related interventions [2-4]. Their presentation often overlaps with other uterine pathologies like retained products of conception or placental site subinvolution [5, 14], underscoring the importance of precise diagnosis.

This case series presents a comprehensive overview and emphasizes the diagnostic modalities and therapeutic outcomes of UAE in patients with acquired uterine AVMs/AVFs, with special attention to fertility preservation.

Imaging plays a pivotal role in the diagnosis and management of uterine AVMs. Initial evaluation typically includes transvaginal or transabdominal ultrasound with color Doppler, which is widely accessible and cost-effective. On B-mode imaging, AVMs may appear as ill-defined, hypoechoic, or heterogeneous lesions with serpiginous vascular channels in the myometrium.

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Color Doppler imaging is crucial, revealing a characteristic mosaic flow pattern, indicative of turbulent blood flow. Spectral Doppler further confirms the presence of low-resistance, high-velocity flow (RI 0.27-0.75, PSV 25-110 cm/s) [15]. In the setting of suspected AVM, these findings are essential for raising clinical suspicion.

MRI provides additional anatomical detail, especially useful in complex or equivocal cases. T1- and T2-weighted images typically reveal multiple flow voids representing abnormal vasculature within the uterus or parametrium [16]. MRI is also valuable in excluding alternative diagnoses and defining lesion extent.

Digital subtraction angiography (DSA) is both diagnostic and therapeutic. It confirms the presence of arteriovenous shunting, identifies the feeding arteries and draining veins, and allows real-time embolization. DSA remains the gold standard in both diagnosis and intervention.

The choice of therapy for uterine AVMs depends on bleeding severity, patient stability, fertility goals, and lesion characteristics. While hormonal or cytotoxic medications may provide symptom control in select cases, embolization has become the standard for rapid and definitive management [3].

The UAE is favored due to its minimally invasive nature, rapid recovery time, and fertility preservation potential. Embolic agents commonly include PVA particles (250-710 microns), gel foam, Histoacryl glue, or metallic coils. UAE offers a high rate of success in symptom control and AVM obliteration while avoiding the need for hysterectomy.

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We report ten cases of uterine AVMs **(Table 1)** managed with UAE between the ages of 25 to 43. Presenting symptoms were most often post-abortion or postpartum bleeding. Imaging confirmed the diagnosis in all cases, and DSA-guided UAE was performed with excellent technical success.

Case 1

A 43-year-old female presented with torrential bleeding post-D&C. Ultrasound showed increased vascularity,

Table 1: Summary of 10 cases.

Case	Age	Presentation	DSA Findings	Embolized Arteries	Agent Used	Diagnosis-Embolization Interval	Follow-Up Findings	Fertility Outcome	Pregnancy Outcome
1	43	PV bleeding post D&C	Dilated venous channels, venous varices	Bilateral uterine	PVA	1 day	Decreased vascularity in 14 days	2 children	No congenital anomaly
2	34	PPH post MTP	High-flow lesion, right dominant	Bilateral uterine	355-500 µm PVA	5 hrs	Normal US at 2 years	Not known	—
3	32	Miscarriage at 3 months, heavy bleeding	Abnormal vessels in cornual regions	Bilateral uterine	355-500 µm PVA + Gel foam	2 days	Resolved heterogeneous area on US	Conceived twice	Normal anomaly scan, outcome unknown
4	27	Bleeding post D&C	Fundal vascularity	Bilateral uterine	355-500 µm PVA	7 days	Not available	Not known	—
5	28	Bleeding post miscarriage	Large uterine AVM	Bilateral uterine	355-500 µm PVA	11 hrs	Conceived twice within 4 years	2 children	No congenital disease
6	33	Suspected scar pregnancy	Uterine blush from both sides	Bilateral uterine	250-355 µm PVA	28 days	Resolution after 1 year	Not known	—
7	39	DUB, prior C-sections, surgeries	AVM from uterine + left ovarian artery	Bilateral uterine + left ovarian	PVA, Histocryl glue, coil	12 days	Resolution after 2 years	Not known	—
8	36	Menorrhagia post D&E	Bunch of vessels from uterine arteries	Bilateral uterine	355-500 µm PVA	8 days	Vascularity at scar resolved	Conceived spontaneously in 1 year	Healthy baby girl
9	29	PPH at 6 weeks postnatal	Serpiginous vessels from both uterine arteries	Bilateral uterine	355-500 µm PVA	4 hrs	Resolution seen in serial US	Conceived 3 years later	Miscarriage, others not known
10	25	Post-miscarriage sepsis	AVM from left uterine artery	Left uterine	355-500 + 710-1000 µm PVA	4 days	Not available	Not known	-

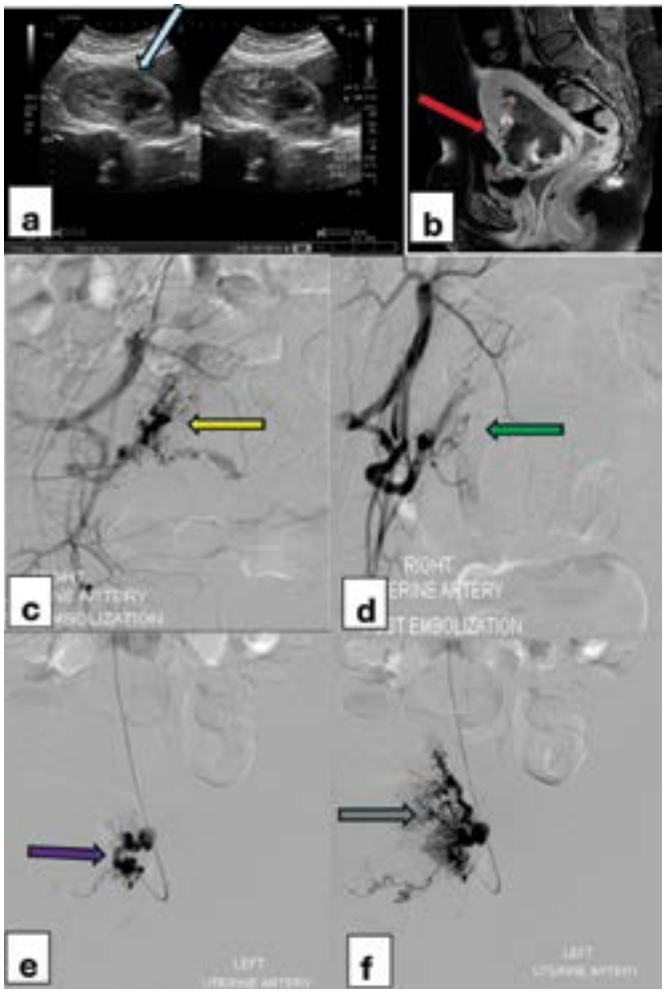

Fig. (1): (a) Greyscale ultrasound image with heterogeneous area along anterior myometrium (White arrow) with cystic spaces. Cystic spaces are filled with colour on Doppler imaging leaving the centre avascular area. Findings represent uterine AV malformation with thrombosed vessels/hematoma in the centre. **(b)** Post contrast Sagittal MRI image showing dilated tortuous vessels (Red arrow) in the anterior wall of the uterus representing an AV malformation, non-enhancing area posterior to it represents hematoma/thrombosed pseudo-aneurysm. **(c)** & **(f)** Pre-embolization run of right and left uterine arteries (Yellow and grey arrows), shows abnormal bunch of vessels, dilated venous channels with formation of venous varices. **(d)** & **(e)** Post procedural angiogram of right and left uterine arteries (Green and Purple arrows), revealed complete embolization of vascular malformation.

and MRI confirmed AVM with venous varices **(Fig. 1a** & **b)**. DSA revealed bilateral uterine artery feeders **(Fig. 1c** & **f)**. Embolization was completed with PVA particles **(Fig. 1d** & **e)**. Follow-up imaging showed complete resolution. The patient later delivered two full-term, healthy children.

Case 2

A 34-year-old female experienced severe postpartum bleeding three days after a miscarriage. Serial ultrasounds showed unchanged increased myometrial vascularity **(Fig. 2a** & **b)**. Angiography demonstrated

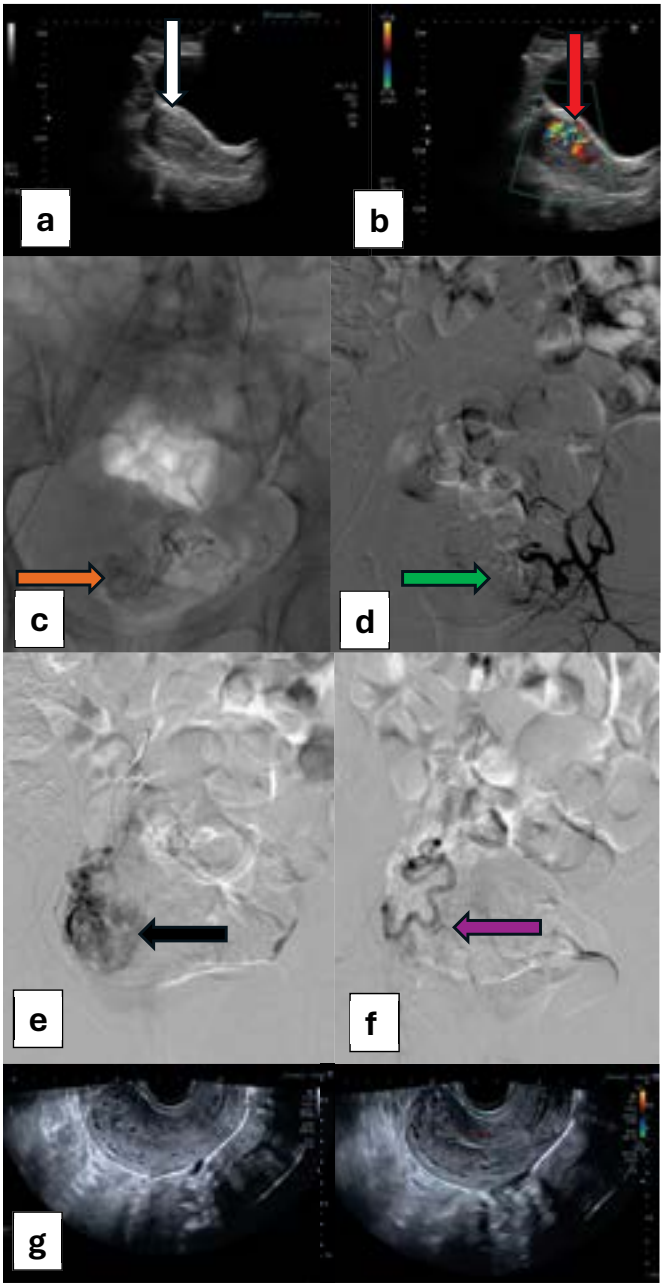

Fig. (2): a) On transabdominal grey scale ultrasound, anterior wall of uterus appeared non-homogeneous with a few tiny cystic spaces (White arrow). **b)** These cystic spaces showed significant vascularity of mosaic pattern on colour doppler (Red arrow). **c)** Left uterine artery pre-embolization angiogram run shows abnormal bunch of vessels (Orange arrow). **d)** Left uterine artery post embolization run shows resolution of abnormal vascularity (Green arrow). **e & f)** Right pre and post-embolization runs show the high flow vascular malformation predominantly supplied by the right uterine artery (Black arrow) which was embolized by PVA particles (Purple arrow). **g)** Follow up ultrasound 2 years after the initial ultrasound shows no residual abnormal vascularity.

a high-flow lesion supplied predominantly by the right uterine artery **(Fig. 2c** & **e)**. Bilateral UAE using 355-500 micron PVA particles was successful **(Fig. 2d** & **f)**. Follow-up ultrasound showed resolved vascularity, though fertility outcome is undocumented.

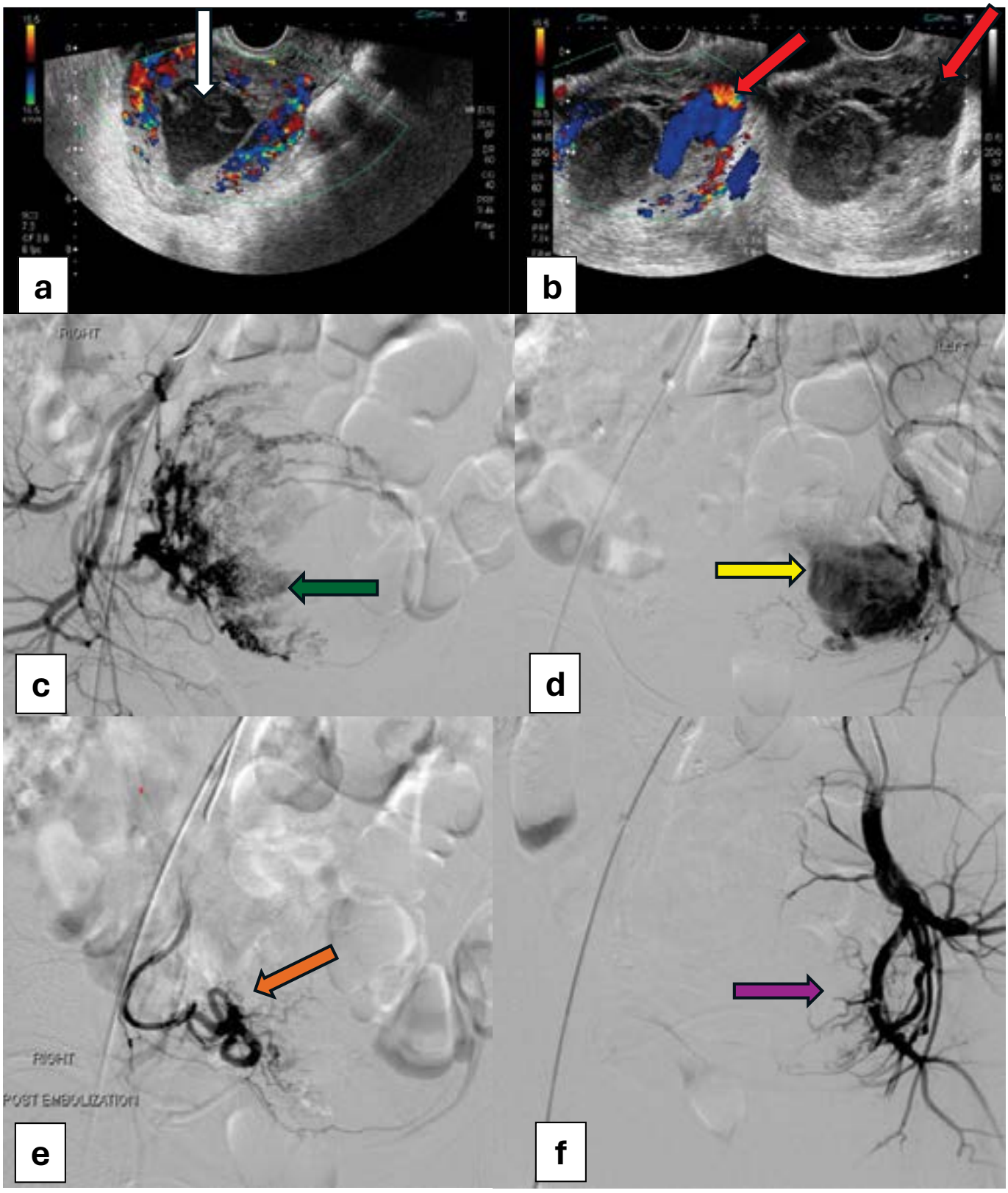

Fig. (3): (a) Transvaginal grey and colour doppler images that show endometrial canal has an irregular gestational sac with internal haemorrhage (White arrow) with increased vascularity of myometrium. **(b)** An anechoic area is seen along the left lateral wall of myometrium showing turbulent flow on colour Doppler (Red arrow), suggesting AV malformation. **(c)** & **(d)** Right and left uterine artery pre angioembolization runs show large AVM supplied by the feeders from both uterine arteries and left ovarian artery (Green and Yellow arrows). **(e)** & **(f)** Right and left uterine artery post angioembolization runs show complete embolization of the vascular malformation (Orange and purple arrows).

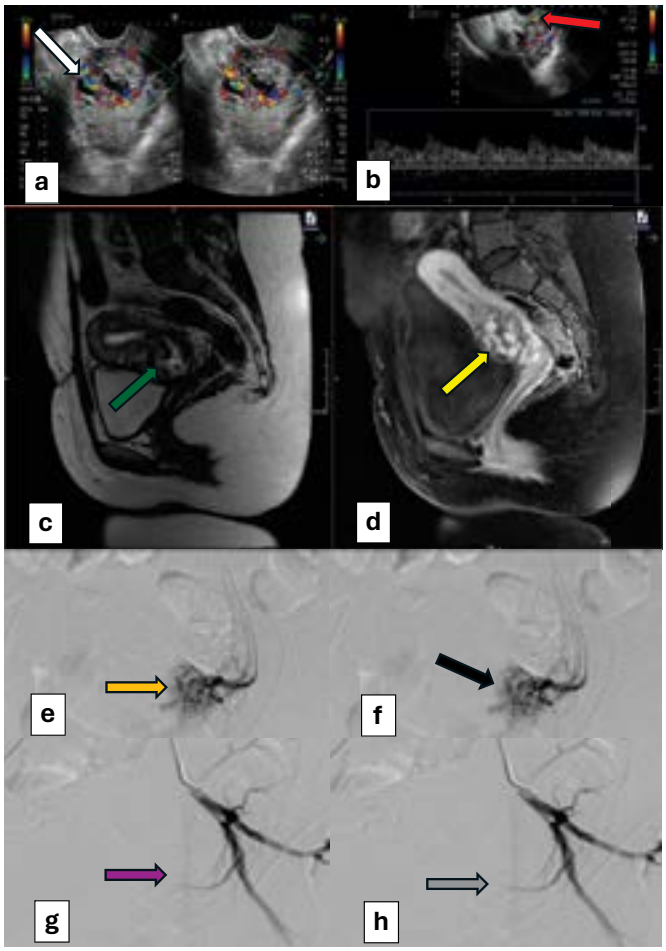

Fig. (4): (a) & **(b)** Colour doppler sonogram shows cystic mass with mosaic pattern of peripheral vascularity at previous caesarean section site (White and Red arrows). Doppler examination shows low resistance high velocity flow. **(c)** & **(d)** T2 sagittal and T1 post contrast sagittal images show a heterogeneous bulging mass with serpentine signal voids involving the lower uterine cavity and anterior myometrium with patchy post contrast enhancement at site of LSCS scar, suggestive of uterine AVM. **(e)** & **(f)** Right and left uterine artery pre-embolization runs show abnormal blush of vessels (Orange and black arrows). **(g)** & **(h)** Right and left uterine artery post-embolization runs show complete resolution of abnormal blush. (Purple and grey arrows).

Case 3

A 27-year-old female had persistent bleeding following a miscarriage diagnosed as a subchorionic hematoma. MRI later revealed a focal AVM. UAE with both PVA and gel foam led to resolution. She conceived twice afterward and delivered without complications.

Case 4

A 27-year-old with heavy bleeding post-D&C showed echogenic material with high vascularity on Doppler. MRI confirmed AVM. The UAE with PVA was successful with complete vascular obliteration.

Case 5

A 28-year-old with profuse bleeding post-miscarriage had serpiginous vessels noted on ultrasound. Angiography confirmed a large AVM with bilateral supply. Embolization led to full symptom resolution. She later delivered two children successfully.

Case 6

A 33-year-old referred with a presumptive diagnosis of scar pregnancy had MRI and angiography confirming bilateral AVM. UAE with 250-355 micron PVA particles resolved the lesion. Later follow-up showed no vascularity.

Case 7

A 32-year-old with a history of caesareans and D&Cs presented with unexplained menorrhagia. Imaging showed AVM with feeders from both uterine and left ovarian arteries **(Fig. 3a-d)**. Embolization involved PVA particles, Histoacryl glue, and coil occlusion. Post-procedure DSA showed complete cessation of flow **(Fig. 3e & f)**.

Case 8

A 31-year-old, post-D&C for a non-viable pregnancy, experienced persistent menorrhagia. AVM was diagnosed on colour Doppler and MRI pelvis **(Fig. 4a-d)**. UAE was conducted using 355-500 micron PVA particles **(Fig. 4a-h)**. Two years later, she had a successful pregnancy.

Case 9

A 27-year-old presented with bleeding at six weeks postpartum. MRI revealed an AVM and a myometrial defect. Bilateral UAE was performed using 355-500 micron PVA particles. Follow-up imaging confirmed complete resolution.

Case 10

A 25-year-old with angiographically confirmed AVM showed a large lesion fed by the left uterine artery and draining into pelvic veins. UAE was performed using a combination of 355-1000 micron PVA particles, achieving embolization.

DISCUSSION

Uterine AVMs, though rare, are a critical differential for abnormal uterine bleeding that is unresponsive to conventional measures. Timely imaging and accurate diagnosis are vital to avoid life-threatening haemorrhage. DSA-guided UAE has become the cornerstone of treatment, offering prompt bleeding control, high success rates, and fertility preservation.

Our case series demonstrates that all patients were successfully treated without the need for hysterectomy. Success rates for embolization are consistent with literature reports, where initial success is observed

in 61% of cases and increases to 91% with repeat interventions [1, 17].

Hysterectomy remains a last resort, typically reserved for refractory cases or patients without fertility concerns [2]. Techniques such as balloon occlusion and preoperative embolization have been documented in the literature for complex cases requiring surgery [2, 5, 18]. However, in our cohort, arterial embolization was sufficient.

Though the UAE is generally safe, risks such as uterine synechiae, premature ovarian failure, and early menopause exist, particularly in women under 45 or those undergoing bilateral embolization [1, 21-24]. One retrospective study found 88% of pregnancies post-UAE resulted in cesarean section, with preterm delivery in 25%, and postpartum hemorrhage in 20% [1, 19]. Another reported 33 successful pregnancies out of 56 among 1200 treated women [1, 20]. In a group of 75 women trying to conceive post-bilateral UAE, 15 achieved pregnancy.

These outcomes highlight the importance of individualized treatment planning. Hyper-selective embolization and protective coiling of ovarian collaterals may mitigate adverse reproductive effects [1].

CONCLUSION

UAE is a highly effective, minimally invasive therapy for uterine AVMs, particularly suited for women of reproductive age who desire fertility preservation. When performed in a timely and targeted manner, UAE can rapidly control life-threatening hemorrhage while minimizing complications. Accurate diagnosis through imaging and long-term follow-up are essential to ensuring successful outcomes. Routine imaging is recommended for at least one year following embolization to assess vascular resolution and monitor reproductive health. As awareness and access to interventional radiology grow, the UAE should be regarded as the first-line treatment for symptomatic uterine AVMs.

CONSENT FOR PUBLICATION

Individual patients' consents for publication were not taken as no patients' identifiers are included in the study, as per policy of our institutional review board.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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