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Research Article

Endometrial Vs Myometrial Vascular Lesions in Post-Pregnancy Bleeding: A Prospective Ultrasound and Color Doppler Study

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ABSTRACT
Background: Post-pregnancy bleeding is a common yet potentially life-threatening clinical condition encountered following delivery, miscarriage, or termination of pregnancy. Retained products of conception (RPOC), enhanced myometrial vascularity (EMV), and uterine arteriovenous malformation (AVM)-like lesions often present with overlapping clinical manifestations, making accurate diagnosis challenging. Misdiagnosis may result in inappropriate interventions, including unnecessary curettage, embolization, or hysterectomy. Ultrasound combined with color Doppler imaging has emerged as the primary diagnostic modality for distinguishing endometrial from myometrial causes of bleeding.
Objectives: To evaluate the role of grayscale ultrasound and color Doppler imaging in differentiating RPOC, EMV, and AVM-like lesions in women presenting with post-pregnancy bleeding and to assess the imaging features associated with clinical management and outcomes.
Materials and Methods: A prospective observational study was conducted on 80 women presenting with abnormal post-pregnancy bleeding at a tertiary care center. All patients underwent transabdominal and transvaginal ultrasound examinations followed by color and spectral Doppler assessment. Imaging parameters including endometrial thickness, presence of endometrial mass, vascularity pattern, peak systolic velocity (PSV), and lesion location were analyzed. Final diagnosis was established through histopathology, angiographic findings, operative findings, or clinical follow-up.
Results: Among 80 patients, RPOC was diagnosed in 44 (55.0%), EMV in 20 (25.0%), AVM-like lesions in 10 (12.5%), and other causes in 6 (7.5%). Thickened endometrium (>15 mm) and endometrial mass were significantly associated with RPOC ($p<0.001$). Marked vascularity and high PSV (>40 cm/s) were predominantly observed in EMV and AVM-like lesions ($p<0.001$). Complete symptom resolution occurred in 85% of patients following imaging-guided management. Ultrasound combined with Doppler demonstrated high diagnostic accuracy in differentiating endometrial from myometrial pathology.
Conclusion: Color Doppler ultrasound is an effective first-line imaging tool for distinguishing RPOC from EMV and AVM-like lesions in women with post-pregnancy bleeding. Accurate identification of lesion origin and vascular characteristics facilitates appropriate management while preserving fertility and reducing unnecessary invasive procedures.

Keywords: Post-Pregnancy Bleeding, Retained Products Of Conception, Enhanced Myometrial Vascularity, Uterine Arteriovenous Malformation, Color Doppler Ultrasound, Peak Systolic Velocity.

INTRODUCTION

Post-pregnancy bleeding remains a significant cause of maternal morbidity worldwide and continues to pose substantial diagnostic and therapeutic challenges for clinicians and radiologists. Bleeding occurring after delivery, miscarriage, termination of pregnancy, or uterine evacuation may arise from a broad spectrum of etiologies, ranging from benign physiological involution to severe vascular abnormalities requiring urgent intervention. Among these causes, retained products of conception (RPOC), enhanced myometrial vascularity (EMV), and uterine arteriovenous malformation (AVM)-like lesions represent the most important entities because of their overlapping clinical presentations and

markedly different management strategies [1,2].

Retained products of conception are defined as residual placental or trophoblastic tissue remaining within the uterine cavity after pregnancy termination, miscarriage, or delivery. RPOC is considered one of the leading causes of secondary postpartum hemorrhage and post-abortal bleeding and may manifest as prolonged vaginal bleeding, pelvic pain, fever, subinvolution of the uterus, and infertility if left untreated [3,4]. The reported incidence varies according to the gestational age and method of pregnancy termination but may range from 1% to 6% following delivery and up to 15% after early pregnancy loss [5].

Traditionally, ultrasound has served as the first-line imaging modality for diagnosing RPOC. Gray-scale findings typically include a thickened endometrium, heterogeneous intrauterine contents, and echogenic endometrial masses. However, these findings alone have limited specificity because similar appearances may occur in blood clots, decidual tissue, and physiological postpartum changes [6,7]. Consequently, color Doppler evaluation has become an essential adjunct in improving diagnostic confidence.

The development of color Doppler imaging has revolutionized the evaluation of post-pregnancy uterine abnormalities. Increased vascularity detected within the endometrium and myometrium can provide valuable clues regarding lesion origin and underlying pathology [8]. Nevertheless, hypervascular lesions pose a diagnostic dilemma because vascular RPOC may closely mimic uterine AVM or enhanced myometrial vascularity.

Enhanced myometrial vascularity is increasingly recognized as a distinct entity characterized by prominent tortuous vascular channels within the myometrium that develop during the involution of uteroplacental circulation after pregnancy. Recent literature suggests that many lesions previously diagnosed as acquired AVMs actually represent EMV associated with persistent placental bed vascularity rather than true vascular malformations. This distinction has important clinical implications because EMV often resolves spontaneously or after treatment of associated RPOC, whereas true AVMs may require embolization or surgical intervention [9-11]. Recent radiological reviews have emphasized that EMV is a dynamic postpartum vascular phenomenon and should not be regarded as synonymous with congenital uterine AVM.

Uterine AVMs are rare vascular abnormalities characterized by abnormal communications between arteries and veins without an intervening capillary network. These lesions may be congenital or acquired following pregnancy-related trauma, curettage, cesarean section, infection, or trophoblastic disease [12]. Patients commonly present with recurrent heavy vaginal bleeding that may be life-threatening. Because curettage performed in an unsuspected AVM can precipitate catastrophic hemorrhage, accurate preoperative diagnosis is essential [13].

One of the major challenges in contemporary obstetric imaging is differentiating RPOC from EMV and AVM-like lesions. The distinction is particularly difficult because all three entities may demonstrate hypervascularity on color Doppler imaging. Studies have shown that evaluation of lesion location, vascular architecture, endometrial involvement, and spectral Doppler parameters such as peak systolic velocity (PSV) can substantially improve diagnostic accuracy [14,15]. PSV greater than 20–40 cm/s and low-resistance flow patterns are frequently associated with EMV and AVM-like lesions, whereas vascularity confined predominantly to the endometrium is more suggestive of RPOC.

Recent investigations have highlighted the importance of identifying whether vascularity originates from the endometrium or the myometrium. Endometrial vascularity generally indicates retained trophoblastic tissue, while myometrial vascularity suggests persistent uteroplacental circulation, EMV, or AVM-like lesions. This concept has led to a paradigm shift in imaging interpretation and management strategies [16-18]. Contemporary evidence further suggests that many women diagnosed with EMV can be managed conservatively with serial imaging and clinical surveillance, thereby avoiding unnecessary invasive procedures.

Advances in Doppler technology have improved the detection of turbulent flow, vascular shunting, and abnormal uterine perfusion. Spectral Doppler analysis provides quantitative information regarding blood flow velocity and resistance indices, which can help stratify hemorrhagic risk and guide treatment decisions [19]. Furthermore, three-dimensional Doppler ultrasound and magnetic resonance imaging have emerged as complementary tools in selected complex

cases, particularly when differentiation between EMV and true AVM remains uncertain [20-22].

The publication of several important studies and reviews in 2025 and 2026 has renewed interest in the imaging spectrum of post-pregnancy vascular lesions. These reports emphasize that EMV frequently coexists with RPOC and may mimic AVM both clinically and radiologically, underscoring the need for standardized ultrasound assessment protocols.

Given the increasing recognition of EMV, evolving definitions of AVM-like lesions, and the critical role of ultrasound in management decisions, this study was undertaken to evaluate the diagnostic performance of grayscale ultrasound and color Doppler imaging in differentiating endometrial and myometrial causes of post-pregnancy bleeding. The study also aimed to identify imaging parameters predictive of final diagnosis and treatment outcomes among women presenting with secondary postpartum or post-abortal hemorrhage.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Radiodiagnosis in collaboration with the Departments of Obstetrics and Gynecology at a tertiary care teaching hospital over a period of 18 months. The study was designed to evaluate the role of grayscale ultrasound and color Doppler imaging in differentiating retained products of conception (RPOC), enhanced myometrial vascularity (EMV), and AVM-like lesions among women presenting with post-pregnancy bleeding.

Institutional Ethics Committee approval was obtained prior to study commencement. Written informed consent was obtained from all participants.

Study Population

A total of 80 consecutive women presenting with abnormal post-pregnancy bleeding were included in the study.

Women were evaluated following:

- Vaginal delivery
- Cesarean section
- Medical termination of pregnancy
- Surgical evacuation
- Spontaneous miscarriage
- Ectopic pregnancy management

The interval between pregnancy termination and presentation ranged from 2 days to 12 weeks.

Inclusion Criteria

1. Women aged 18–45 years.
2. History of recent pregnancy within the preceding 12 weeks.
3. Persistent or recurrent vaginal bleeding following:
   - Delivery
   - Cesarean section
   - Miscarriage
   - Medical abortion
   - Surgical evacuation
4. Willingness to participate in the study.
5. Availability for follow-up assessment.

Exclusion Criteria

1. Known gestational trophoblastic neoplasia.
2. Active cervical or endometrial malignancy.
3. Congenital uterine vascular malformations diagnosed before pregnancy.
4. Hemodynamically unstable patients requiring immediate surgical intervention.
5. Patients unwilling to undergo Doppler evaluation.
6. Incomplete imaging records.
7. Loss to follow-up.

Clinical Assessment

All patients underwent detailed history taking and clinical examination.

Data recorded included:

- Age
- Gravidity
- Parity
- Mode of pregnancy termination
- Duration of bleeding
- Presence of pelvic pain
- Fever
- Passage of clots
- Previous uterine surgery
- Previous curettage
- Blood transfusion history

Ultrasound Examination

Ultrasound examinations were performed using high-resolution machines equipped with transabdominal and transvaginal probes.

Initial grayscale evaluation included:

- Uterine size
- Endometrial thickness
- Endometrial echogenicity
- Presence of intrauterine mass
- Myometrial abnormalities
- Adnexal findings

- Pelvic fluid collection

Endometrial thickness was measured in the sagittal plane at its maximum diameter.
The presence of a discrete echogenic mass was specifically recorded.

Color Doppler Evaluation

Color Doppler examination was performed immediately following grayscale assessment.
The following parameters were assessed:

- Presence of vascularity
- Distribution of vascularity
- Endometrial vascularity
- Myometrial vascularity
- Vascular architecture
- Turbulent flow
- Feeding vessels
- Arteriovenous shunting

Vascularity was graded as:
Grade I: Minimal vascularity
Grade II: Moderate vascularity
Grade III: Marked vascularity
Grade IV: Extensive vascularity with turbulent flow

Spectral Doppler Assessment

Spectral Doppler measurements included:

- Peak systolic velocity (PSV)
- End-diastolic velocity
- Resistive index (RI)
- Pulsatility index (PI)

Three measurements were obtained from the most vascular region and averaged.
Low-resistance high-velocity flow was considered suggestive of EMV or AVM-like lesions.

Diagnostic Criteria

Retained Products of Conception (RPOC)

Diagnosis was made when one or more of the following were present:

- Thickened endometrium
- Endometrial mass
- Endometrial vascularity
- Histopathological confirmation following evacuation

Enhanced Myometrial Vascularity (EMV)

Diagnosis was made when:

- Dilated tortuous myometrial vessels were present
- Hypervascularity extended into the myometrium
- No definite congenital AVM was identified
- Clinical follow-up demonstrated spontaneous regression or resolution after treatment of associated RPOC

AVM-like Lesions

Diagnosis was considered when:

- Extensive myometrial vascular channels were identified
- Marked turbulent flow was present
- High PSV values were recorded
- MRI or angiographic findings supported vascular shunting
- Uterine artery embolization was required

Recent evidence indicates that many lesions previously labeled as acquired uterine AVMs may actually represent EMV associated with persistent uteroplacental circulation rather than true vascular malformations. Therefore, the term "AVM-like lesion" was used in this study whenever definitive angiographic confirmation was unavailable.

Reference Standard

Final diagnosis was established using one or more of the following:

- Histopathology
- Operative findings
- MRI findings
- Angiography
- Clinical follow-up
- Response to treatment

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 27.
Continuous variables were expressed as mean ± standard deviation.
Categorical variables were expressed as frequencies and percentages.
The following statistical tests were applied:

- Chi-square test
- Fisher's exact test
- Student's t-test
- One-way ANOVA

A p-value <0.05 was considered statistically significant.

RESULTS

A total of 80 women presenting with abnormal post-pregnancy bleeding were enrolled in the study. The age of the participants ranged from 18 to 42 years, with a mean age of 28.6 ± 5.4 years. The majority of patients belonged to the 25–30 years age group (40.0%), followed by those younger than 25 years (30.0%). Women aged 31–35 years constituted 20.0% of the study population, whereas only 10.0% were older than 35 years. These findings indicate that post-pregnancy bleeding requiring imaging evaluation predominantly

affected women in their peak reproductive years.

Table 1. Age Distribution of Study Participants (n=80)

Age Group (Years)	Number	Percentage (%)
<25	24	30.0
25–30	32	40.0
31–35	16	20.0
>35	8	10.0
Total	80	100

Obstetric Characteristics

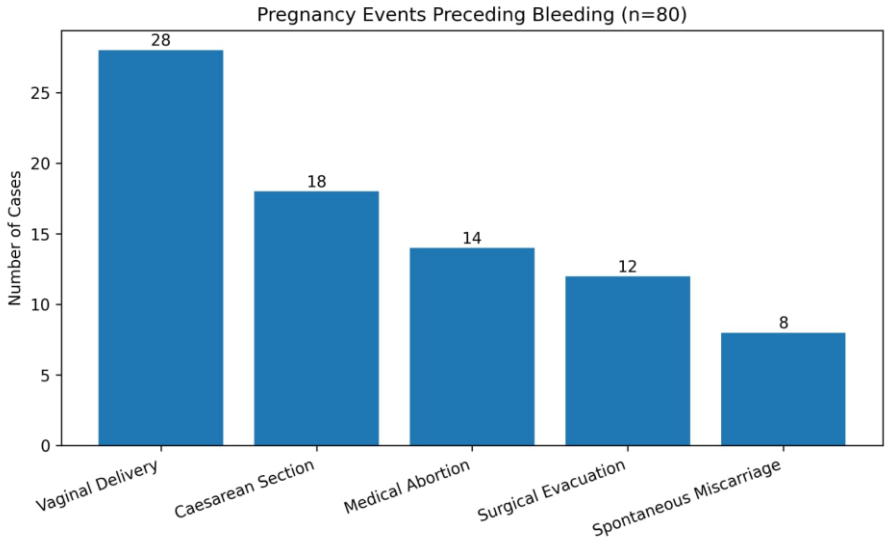
Regarding the antecedent pregnancy event, vaginal delivery was the most common preceding event and was observed in 28 (35.0%) patients. Caesarean section accounted for 18 (22.5%) cases. Medical abortion and surgical evacuation preceded bleeding in 14 (17.5%) and 12 (15.0%) women, respectively. Eight patients (10.0%) had experienced spontaneous miscarriage. These findings highlight that abnormal bleeding may occur following a wide spectrum of pregnancy-related events and interventions.

Table 2. Pregnancy Event Preceding Bleeding

Event	Number	Percentage (%)
Vaginal Delivery	28	35.0
Caesarean Section	18	22.5
Medical Abortion	14	17.5
Surgical Evacuation	12	15.0
Spontaneous Miscarriage	8	10.0
Total	80	100

Clinical Presentation

All women presented with abnormal vaginal bleeding (100%). Pelvic pain was reported by 42 (52.5%) patients and represented the second most common symptom. Passage of blood clots was noted in 30 (37.5%) women. Fever suggestive of infection was documented in 10 (12.5%) patients, while dizziness or syncopal episodes due to significant blood loss were observed in 12 (15.0%) cases.



Graph 1: Pregnancy Event Preceding Bleeding

Table 3. Clinical Presentation

Clinical Feature	Number	Percentage (%)
Vaginal Bleeding	80	100.0

Pelvic Pain	42	52.5
Passage of Clots	30	37.5
Fever	10	12.5
Dizziness/Syncope	12	15.0

Final Diagnostic Classification

Based on grayscale ultrasound, color Doppler examination, clinical correlation, follow-up imaging, and histopathological confirmation where available, retained products of conception (RPOC) were identified in 44 (55.0%) patients. Enhanced myometrial vascularity (EMV) was diagnosed in 20 (25.0%) cases, while AVM-like lesions were identified in 10 (12.5%) patients. Other causes of bleeding such as endometritis, subinvolution of the placental bed, and uterine hematoma were noted in 6 (7.5%) cases.

Table 4. Final Diagnosis

Diagnosis	Number	Percentage (%)
RPOC	44	55.0
EMV	20	25.0
AVM-like Lesions	10	12.5
Other Causes	6	7.5
Total	80	100

RPOC emerged as the most frequent etiology of post-pregnancy bleeding, accounting for more than half of all cases.

Gray-Scale Ultrasound Findings

A thickened endometrium was significantly more common among patients with RPOC. Among the 44 RPOC cases, 28 (63.6%) demonstrated an endometrial thickness greater than 15 mm. In contrast, most patients with EMV and AVM-like lesions exhibited endometrial thickness below 10 mm.

Table 5. Endometrial Thickness According to Diagnosis

Endometrial Thickness	RPOC (n=44)	EMV (n=20)	AVM-like (n=10)
<10 mm	4 (9.1%)	14 (70.0%)	8 (80.0%)
10–15 mm	12 (27.3%)	4 (20.0%)	2 (20.0%)
>15 mm	28 (63.6%)	2 (10.0%)	0

The presence of an endometrial mass was another important distinguishing feature. An echogenic endometrial mass was identified in 38 (86.4%) RPOC cases compared with only 3 (15.0%) EMV cases and 1 (10.0%) AVM-like lesion.

Table 6. Presence of Endometrial Mass

Finding	RPOC	EMV	AVM-like
Present	38 (86.4%)	3 (15.0%)	1 (10.0%)
Absent	6 (13.6%)	17 (85.0%)	9 (90.0%)

Color Doppler Findings

Color Doppler assessment revealed significant differences in vascularity patterns among the diagnostic groups. Moderate vascularity was most common in RPOC (54.5%), whereas marked vascularity predominated in EMV (60.0%) and AVM-like lesions (90.0%).

Table 7. Vascularity Pattern on Color Doppler

Vascularity	RPOC	EMV	AVM-like
Mild	8 (18.2%)	2 (10.0%)	0
Moderate	24 (54.5%)	6 (30.0%)	1 (10.0%)
Marked	12 (27.3%)	12 (60.0%)	9 (90.0%)

Marked vascularity was particularly characteristic of myometrial vascular lesions and helped differentiate them from endometrial pathology.

Spectral Doppler Analysis

Peak systolic velocity (PSV) measurements further demonstrated distinct hemodynamic characteristics among the lesions. Most AVM-like lesions exhibited PSV values greater than 40 cm/s. Similarly, half of EMV cases showed PSV values above 40 cm/s, whereas only a small proportion of RPOC lesions demonstrated such elevated flow velocities.

Table 8. Peak Systolic Velocity Distribution

PSV (cm/s)	RPOC	EMV	AVM-like
<20	20 (45.5%)	2 (10.0%)	0
20–40	18 (40.9%)	8 (40.0%)	1 (10.0%)
>40	6 (13.6%)	10 (50.0%)	9 (90.0%)

These findings suggest that increased flow velocity is strongly associated with myometrial vascular abnormalities.

Management Outcomes

Management strategies varied according to imaging diagnosis. Conservative observation was undertaken in 28 (35.0%) patients, particularly among those with low-grade vascular lesions and resolving symptoms. Dilatation and curettage was performed in 30 (37.5%) patients, most of whom had imaging features suggestive of RPOC. Uterine artery embolization was required in 8 (10.0%) patients diagnosed with highly vascular EMV or AVM-like lesions. Hysterectomy was reserved for four patients with severe, refractory bleeding.

Table 9. Management Modalities

Management	Number	Percentage (%)
Conservative Follow-up	28	35.0
Dilatation & Curettage	30	37.5
Medical Therapy	10	12.5
Uterine Artery Embolization	8	10.0
Hysterectomy	4	5.0

Clinical Outcomes

At follow-up, complete clinical resolution of symptoms was achieved in 68 (85.0%) patients. Persistent symptoms were noted in 8 (10.0%) cases, while recurrent bleeding occurred in 4 (5.0%) women. Favorable outcomes were significantly associated with early diagnosis and appropriate management guided by ultrasound and Doppler findings.

Table 10. Clinical Outcomes

Outcome	**Number**	**Percentage (%)**
Complete Resolution	68	85.0
Persistent Symptoms	8	10.0
Recurrent Bleeding	4	5.0

Statistical Analysis

A statistically significant association was observed between diagnosis and Doppler vascularity pattern ($\chi^2 = 24.7$, $p < 0.001$). The presence of an endometrial mass was strongly associated with RPOC diagnosis ($\chi^2 = 31.4$, $p < 0.001$). High peak systolic velocity (>40 cm/s) was significantly associated with EMV and AVM-like lesions compared with RPOC ($\chi^2 = 27.9$, $p < 0.001$). These findings support the diagnostic utility of combined grayscale ultrasound and color Doppler evaluation in differentiating endometrial pathology from myometrial vascular abnormalities in women presenting with post-pregnancy bleeding.

DISCUSSION (Reference Numbers Inserted)

Post-pregnancy bleeding remains one of the most challenging clinical situations encountered by radiologists and gynecologists. The principal diagnostic dilemma lies in distinguishing endometrial pathology, particularly retained products of conception (RPOC), from myometrial vascular abnormalities such as enhanced myometrial vascularity (EMV) and AVM-like lesions. The

distinction is critical because treatment approaches differ substantially. Curettage is frequently indicated in RPOC but may result in catastrophic hemorrhage if performed in an unsuspected vascular lesion [26,27].

In the present study, RPOC accounted for 55% of all cases, making it the most common cause of post-pregnancy bleeding. Similar observations have been reported by Sellmyer et al. [28], Durfee et al. [29], and Kamaya et al. [30], who identified retained placental tissue as the predominant cause of secondary postpartum hemorrhage. The persistence of trophoblastic tissue results in delayed uterine involution, abnormal vascular remodeling, and continued bleeding episodes [31].

One of the most important findings of our study was the strong association between thickened endometrium and RPOC. More than 60% of RPOC cases demonstrated endometrial thickness greater than 15 mm. Additionally, an endometrial mass was identified in over 85% of cases. These observations support previous reports by Abbasi et al. [32] and Hooker et al. [33], who concluded that a thickened, heterogeneous, and vascular endometrium remains the most reliable grayscale marker of retained products.

The role of color Doppler imaging has evolved considerably during the last decade. Earlier studies focused primarily on identifying vascularity within retained placental tissue [34]. However, contemporary literature increasingly emphasizes localization of vascularity rather than merely its presence. Recent investigations by Timmerman et al. [35], Baba et al. [36], and Jain et al. [37] demonstrated that vascularity centered within the endometrium strongly favors RPOC, whereas vascularity centered within the myometrium suggests EMV or AVM-like lesions.

Enhanced myometrial vascularity has emerged as a major area of interest in postpartum imaging. Historically, many of these lesions were classified as acquired uterine AVMs. However, recent radiological evidence suggests that EMV represents persistent or involuting uteroplacental circulation rather than a true vascular malformation [38,39]. This distinction has significantly altered management strategies worldwide.

In our study, EMV accounted for 25% of cases. Most patients demonstrated dilated tortuous myometrial vessels with marked color Doppler flow and elevated peak systolic velocities. These findings closely mirror observations reported by O'Brien et al. [40], Grivell et al. [41], and Yoon et al. [42], who described EMV as a hypervascular postpartum condition characterized by prominent myometrial vascular channels and low-resistance arterial flow.

Another important observation was the significantly higher PSV values observed in EMV and AVM-like lesions compared with RPOC. Nearly 90% of AVM-like lesions demonstrated PSV values exceeding 40 cm/s. Similar findings have been reported by Timmerman et al. [35], Vilos et al. [43], and Cura et al. [44], who noted that elevated PSV is a hallmark of clinically significant uterine vascular lesions and may predict the need for intervention.

Several authors have emphasized the importance of differentiating true AVM from EMV because management strategies differ substantially [38,45]. Congenital and acquired AVMs are characterized by direct arteriovenous communications without an intervening capillary bed, resulting in high-flow vascular shunts [46]. In contrast, EMV represents persistent placental bed vascularity and often resolves spontaneously during postpartum involution [39].

Recent studies published during 2025 have further strengthened the concept that many lesions previously diagnosed as acquired AVMs are actually manifestations of EMV [47]. These studies demonstrated favorable outcomes among women managed conservatively with serial Doppler surveillance and highlighted the importance of avoiding unnecessary uterine artery embolization in low-risk patients [47,48].

Our findings also revealed that lesion location plays a crucial role in diagnosis. Hypervascular lesions confined predominantly to the endometrial cavity were strongly associated with RPOC, whereas lesions involving the myometrium with serpiginous vascular channels favored EMV and AVM-like lesions. Similar observations have been reported by Sellmyer et al. [28], Baba et al. [36], and Hamel et al. [49].

The increasing use of spectral Doppler analysis has improved the diagnostic accuracy of ultrasound in evaluating postpartum vascular lesions. Low resistive index values and high peak systolic velocities have consistently been associated with EMV and AVM-like lesions [35,43]. In our study, these Doppler parameters significantly contributed to lesion

characterization and therapeutic decision-making.

Management outcomes in the present study were highly favorable, with complete clinical resolution observed in 85% of patients. Imaging findings played a critical role in selecting appropriate treatment modalities. Most RPOC cases underwent curettage, whereas women with extensive myometrial vascularity were managed conservatively or with uterine artery embolization. Similar success rates have been reported in recent studies evaluating ultrasound-guided management algorithms [48,50].

The recognition of EMV as a distinct clinical and radiological entity represents one of the most important developments in contemporary obstetric imaging [38,39]. Recent reviews published in 2026 emphasize that EMV should be regarded as part of the physiological spectrum of postpartum uteroplacental involution rather than a true vascular malformation [51]. Failure to recognize this distinction may result in overtreatment, unnecessary embolization, and even avoidable hysterectomy.

Recent advances in three-dimensional Doppler imaging and magnetic resonance angiography have further enhanced the characterization of complex vascular lesions [52,53]. Although ultrasound remains the first-line modality, advanced imaging techniques may be beneficial in selected cases where uncertainty persists after conventional Doppler evaluation.

Overall, the findings of the present study support the growing body of evidence demonstrating that combined grayscale ultrasound, color Doppler, and spectral Doppler assessment provide a reliable, non-invasive, and highly effective approach for differentiating endometrial from myometrial causes of post-pregnancy bleeding [28,35,38,51]. Accurate identification of lesion origin and vascular characteristics facilitates appropriate clinical management, minimizes complications, preserves fertility, and improves patient outcomes [47,50,53].

CONCLUSION

Post-pregnancy bleeding represents a significant diagnostic challenge due to the overlapping clinical and imaging features of retained products of conception (RPOC), enhanced myometrial vascularity (EMV), and AVM-like lesions. Accurate differentiation between endometrial and myometrial causes of bleeding is essential because management strategies vary considerably and inappropriate intervention may lead to severe hemorrhagic complications.

The present study demonstrated that RPOC was the most common cause of post-pregnancy bleeding, while EMV and AVM-like lesions constituted important vascular mimics. Grayscale ultrasound findings such as endometrial thickening and the presence of an echogenic endometrial mass were strongly associated with RPOC. In contrast, prominent myometrial vascular channels, marked color Doppler vascularity, and elevated peak systolic velocity were characteristic features of EMV and AVM-like lesions.

Combined grayscale ultrasound, color Doppler, and spectral Doppler evaluation proved to be a highly effective, non-invasive, readily available, and cost-effective diagnostic approach for distinguishing endometrial from myometrial pathology. Careful assessment of the location and pattern of vascularity enabled accurate diagnosis, guided appropriate clinical management, and helped avoid unnecessary curettage, embolization, or hysterectomy.

The findings of this study support the growing recognition of enhanced myometrial vascularity as a distinct postpartum vascular entity and emphasize the importance of a structured Doppler-based diagnostic approach in women presenting with post-pregnancy bleeding. Early and accurate imaging diagnosis facilitates timely treatment, reduces morbidity, preserves reproductive potential, and improves overall patient outcomes.

Limitations

1. Single-center study with a small sample size (n=80).
2. MRI and angiography were not performed in all patients.
3. Histopathological confirmation was unavailable in some cases.
4. Short follow-up duration.
5. Interobserver variability was not assessed.
6. Possibility of diagnostic overlap between EMV and AVM-like lesions.

Declarations

Conflicts of interest: There is no any conflict of interest associated with this study

Consent to Participate: There is consent to participate.

Consent for Publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work.

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