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Expert Opinion

Appropriateness of treatments for postpartum and post-abortion uterine vascular anomalies



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ABSTRACT

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Purpose: Secondary postpartum and post-abortion hemorrhage due to uterine vascular anomalies can range from mild to life threatening episodes. Although clinicians have access to various treatment options, no studies have systematically evaluated their appropriateness across diverse clinical scenarios. This study aimed to assess the appropriateness of treatments for secondary postpartum and post-abortion hemorrhage using hypothetical scenarios that integrate different clinical presentations and imaging findings of uterine vascular anomalies.

Materials and methods: Applying the RAND/UCLA method, a panel of 14 French experts in gynecology and diagnostic and interventional radiology rated the appropriateness of various treatments for secondary postpartum/post-abortion hemorrhage. In addition, they rated questions regarding terminology and the diagnostic utility of color Doppler ultrasound and MRI.

Results: Of 290 clinical scenarios, 36 (12.4%) were rated as appropriate and 137 (47.2%) as inappropriate. Embolization with gelfoam alone, or followed by curettage or operative hysteroscopy was considered appropriate for various bleeding presentations in patients with extensive enhanced myometrial vascularity (EMV) adjacent to hypervascular Retained Products of Conception (RPOC). Embolization with gelfoam followed by curettage or operative hysteroscopy was deemed appropriate for patients with limited EMV and RPOC. In cases where EMV was present without RPOC, embolization with gelfoam was considered appropriate for abundant or recurrent bleeding leading to anemia.

Conclusion: These recommendations, which integrate clinical presentations, imaging evidence and patient pregnancy plan, offer valuable decision-making support for gynaecologists and radiologists in the managing of post-partum and post-abortion uterine vascular anomalies.

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Introduction

In recent decades, the number of reported cases of uterine arteriovenous malformations (AVMs) following abortion, curettage or pregnancy has increased considerably in parallel with advancements in Doppler ultrasound imaging. Uterine AVMs are considered a major cause of postpartum and post-abortion bleeding, which can vary from heavy, life-threatening episodes to mild, barely perceptible events that may be intermittent or continuous.

The true incidence of AVMs remains uncertain. Interestingly, pathological analysis suggest that the majority of postpartum and post-abortion hemorrhages are caused by the subinvolution of placental bed vessels rather than AVMs [1]. Since postpartum and post-abortion hemorrhages may not be triggered by uterine AVMs, various authors have adopted different terminologies that would better represent this disorder. Timor-Tritsch et al. [2] proposed the term “enhanced myometrial vascularity” (EMV), which does not consider the involvement of the endometrium. Timmerman et al [3] classified uterine vascular abnormalities into two categories: “true uterine AVMs”, characterized by the presence of arteriovenous shunts, and “non-AVMs”, which lack such shunts. However, this classification erroneously supports the misconception that all AVMs are congenital malformations [4], and overlooks the physiological presence of arteriovenous shunts in the trophoblastic tissue [5]. Bazerries et al. [6] introduced the term “retained products of conception with marked vascularities” (hypervascula RPOC) which does not consider the involvement of the myometrium [1]. The term “uterine vascular anomalies” (UVA) encompasses both endometrial and myometrial components, although there is currently no consensus on the terminology that better corresponds to these vascular anomalies.

While postpartum/post-abortion hemorrhage can be treated by different approaches, minimally invasive percutaneous treatments has been increasingly used in the last years [7]. There is still need for expert recommendations that combines gynecologists and radiologists' expertise.

This study aimed to establish a supervised approach to facilitate therapeutic decision-making for patients with late post-partum or post-abortion hemorrhage (that occurs from 24 h up to 12 weeks post-delivery).

Materials and methods

An expert panel was convened and consisted of 9 radiologists and 5 gynecologists from different French hospitals and one institution in the UK (Supplementary Table 1). For second and third rounds of ratings and discussions, the expert panel was composed of 13 members. The whole survey process was supervised by one outside radiologist acting as a moderator (Supplementary Table 1). The RAND/UCLA Appropriateness Method was applied as detailed in the RAND/UCLA Appropriateness Method User's Manual [8].

Before the first round of ratings, a summary of the study and a glossary of relevant terms were presented to the panel members (Table 1). MRI images of EMV and RPOC are shown in Fig. 1. Post-traumatic false aneurysm of uterine arteries and gestational trophoblastic disease were excluded from this study.

The clinical scenarios included different bleeding presentations, distinct diagnostic imaging features and pregnancy desire.

The appropriateness method consisted of nine steps:

1. Literature review: Bibliography was searched in Medline (Embase/Pubmed) for articles published between 1978 and May 2023. The following keywords were used: “Uterine arteriovenous malformation”, “Uterine arteriovenous malformation + embolization” and “Uterine vascular malformation”. Case reports were excluded from the analysis.
2. Template development: The survey was created using RedCap free software (Vanderbilt University's Nashville, Tennessee 37240 615-

322-7311). Questions and clinical scenarios were validated by expert radiologists and gynecologists before distribution.

3. Panel selection: The panel was composed of members from a focus group on uterine vascular anomalies, created in 2023.
4. Survey distribution and analysis: The survey was distributed to the panelists via email in February 2023. The responses were collected and analyzed two months later. Each item was classified as follows: appropriate (median between 7 and 9), neutral (median between 3 and 6), inappropriate (median between 1 and 3) and disagreement (at least 5 participants rated the item as appropriate and 5 rated it as inappropriate).
5. First meeting: A virtual meeting was held to discuss points of disagreement.
6. Survey reformulation, distribution, and analysis: The survey was revised and redistributed. One panelist was absent during the second and third rating rounds; consequently disagreement was determined when at least 4 participants rated an item as appropriate and 4 rated it as inappropriate.
7. Second meeting: Virtual discussion triggered the formulation of new questions.
8. Rating of additional questions and final meeting: Panelists reconvened virtually in April 2024.
9. Data reporting: A final version of the recommendations was proposed.

Fig. 2B shows the process used to develop the clinical scenarios for evaluating the appropriateness of treatments.

Results

After reviewing 290 treatment indications, 36 (12,4%) were rated as appropriate, 117 (40,3%) as uncertain, and 137 (47,2%) as inappropriate. A summary of the survey responses is presented in Table 2.

To determine a suitable term for this pathology, three options were proposed during the first round. All were considered appropriate, but the term with the higher median was “post-partum/post-abortion Uterine Vascular Anomaly” (post-partum/post-abortion UVA) (Table 2A).

Consensus was reached about the appropriateness of using color Doppler US to describe RPOC characteristics such as vascularity and size as well as the EMV features such as the myometrial extension (including its relationship with the uterine serosa and extra uterine involvement), peak systolic value, and resistance index (Table 2B). Color Doppler US was also considered appropriate for postoperative follow-up.

MRI was considered appropriate for assessing early venous return,

Table 1
Glossary of relevant terminologies.

Terminology	Definition
Enhanced myometrial vascularity (EMV)	EMV is defined as the presence of an area of marked flow of the myometrium in color Doppler imaging [11].
Extensive EMV	EMV spreads out in the myometrium exceeding the limits of the RPOC.
Limited EMV	EMV is localized near to the RPOC.
Retained Products of Conception (RPOC)	Persistence of trophoblastic or placental content after delivery. It is defined histologically by the presence of chorionic villi. RPOC is trophoblastic echogenic mass presenting with minimum, moderate, or more often, marked vascularity [12].
Hypervascula RPOC	Marked endometrial vascularity greater than that of normal myometrium in the same image section.
Abundant bleeding	One or few episodes of genital bleeding more abundant than menstruation.
Recurrent bleeding	Several episodes of genital bleeding less abundant than menstruation.
Anemia	Hemoglobin concentration ≤ 7 g/dL.
Hemodynamic complication	Dysfunction of blood circulation and pressure.

EMV extension, and to identify feeder arteries and aneurysm before embolization. However, MRI was considered inappropriate if it delayed treatment in patients with abundant bleeding. Unlike color Doppler US, MRI was also considered inappropriate to follow the postoperative progression of uterine vascular anomalies (Table 2B).

It was deemed appropriate to monitor patients with EMV but no evidence of RPOC and no bleeding symptoms for more than three months using Doppler US and hemoglobin dosage. However, in general, it was deemed inappropriate to rely solely on monitoring (color Doppler US and hemoglobin dosage) in cases of abundant or recurrent bleeding causing anemia whether patients presented with extensive EMV plus RPOC, limited EMV plus RPOC or EMV alone (Table 2C, Sections 1.1, 2.1, and 3.1, respectively).

Uterine Artery Embolization (UAE) with gelfoam followed by curettage or operative hysteroscopy was considered appropriate for patients with abundant or recurrent bleeding with anemia and limited or extensive EMV plus RPOC but was deemed inappropriate for patients with EMV alone (Table 2C, Sections 1.5, 2.5, and 3.5, respectively). For patients with EMV alone and abundant or recurrent bleeding with anemia, embolization with gelfoam was considered appropriate, without subsequent curettage or operative hysteroscopy (Table 2C, Section 3.3).

Furthermore, UAE with liquid embolic agents or microspheres was deemed appropriate for patients with EMV alone and recurrent bleeding after UVA surgery or embolization, only if they expressed no pregnancy plans (Table 2C, Section 3.4).

A substantial proportion of scenarios were rated uncertain (neutral or disagreement) for patients presenting limited EMV with RPOC (57 %, 55/96), and extensive EMV plus RPOC (43 %, 40/96). Only 23 % (22/96) of the scenarios were rated uncertain in patients with EMV alone.

Total hysterectomy was considered inappropriate for nearly all scenarios (Table 2C, Sections 1.6, 2.6, 3.6, and Section 4). However, it was considered appropriate in cases of recurrent bleeding after UVA surgical or embolization with no evidence of technical failure, and only if patient expressed no desire for future pregnancies.

We propose a simplified decision-making algorithm for gynecologists and radiologists, as shown in Fig. 2.

Discussion

The uterine vascular anomalies (UVAs) were earlier visualized by angiography and more recently through US and MRI [3]. This study confirms that US is appropriate for characterizing postpartum/post-abortion UVA due to its widespread availability and effectiveness in

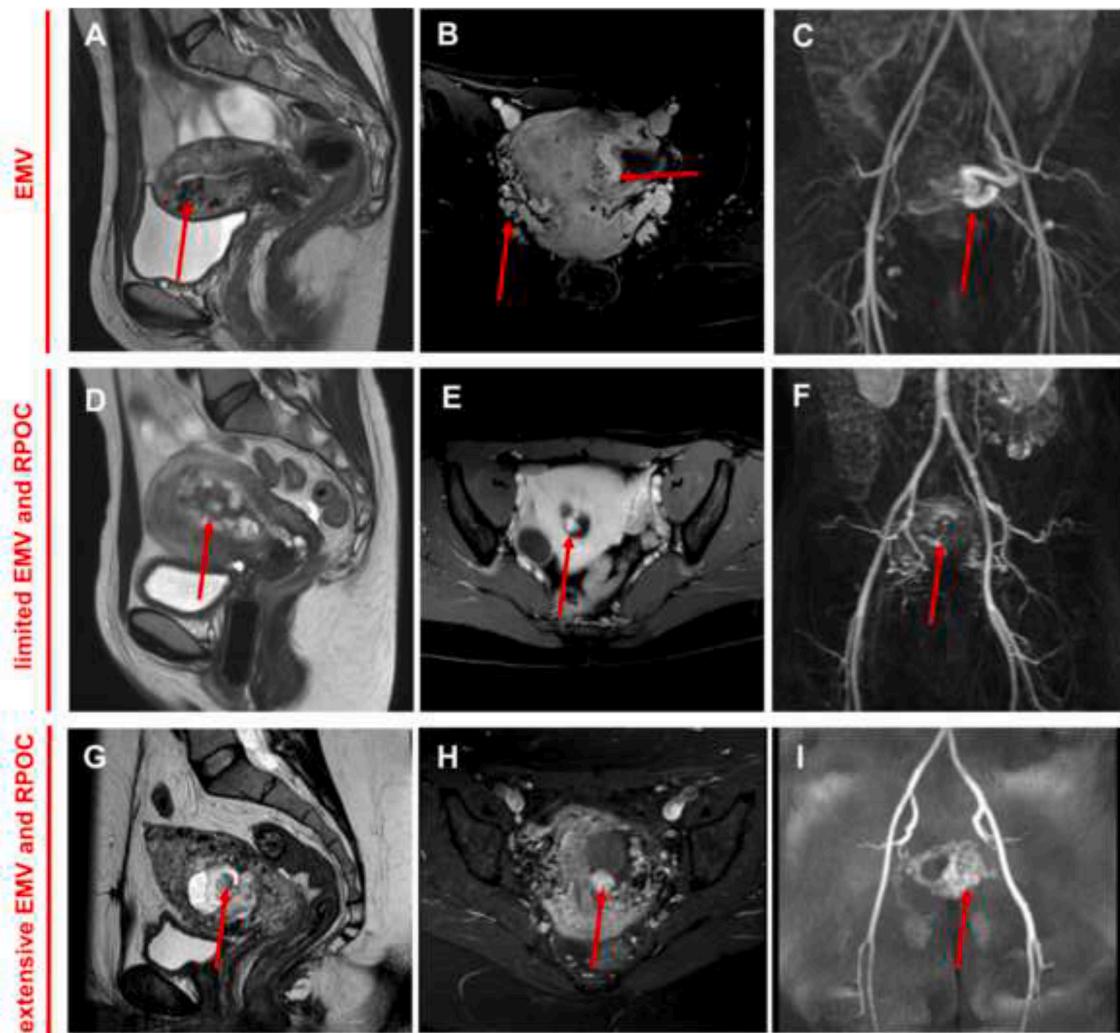


Fig. 1. EMV (A–C), limited EMV and RPOC (D–F) and extensive EMV and RPOC (G–I). T2 MRI in sagittal plane showing (red arrows): (A) an EMV alone and (D and E) a RPOC. Axial plane showing (red arrows): (B) an intramyometrial and periuterine hypervascularization in T2 Dixon MRI and (E and H) hypervascular RPOC in T1 gradient-echo fat-saturated. Dynamic angiMRI showing (red arrows): (C) hypervascularization from the left uterine artery, (F) limited hypervascularization from the right uterine artery and (I) extensive hypervascularization from the right and left uterine arteries.

life-threatening situations. Conversely, MRI is inappropriate in such contexts but can complement US by identifying feeder arteries, early venous return or, aneurysms before embolization. Moreover, unlike US, MRI is inappropriate for monitoring UVA progression post-treatment. This is in agreement with recent recommendations where US is proposed as first line and MRI as second line examination for abnormal uterine bleeding [9].

All clinical scenarios in this study included the patient's pregnancy plan. This variable significantly impacted the appropriateness ratings in scenarios addressing the use of definitive embolic agents. Embolization with liquid agents or microspheres was deemed inappropriate for patients planning to conceive and in most cases it was uncertain for those with no pregnancy plans (Table 2C, Section 1.4, 2.4, and 3.4).

In France, there is no consensus on techniques for removing RPOCs. Curettage and operative hysteroscopy were included as therapeutic options in various sections (Table 2C, Sections 1.2, 1.5, 2.2, 2.5, 3.2, and 3.5), despite evidence that curettage is more likely to cause synechiae than hysteroscopy or aspiration [10]. This concern may have influenced the responses of gynecologists, who emphasized the risk of post-curettage synechiae formation.

The gynecologists in this study recommend discontinuing the use of curettage in favor of aspiration or hysteroscopy for RPOC resection.

Uterine artery embolization (UAE) with gelfoam or UAE with gelfoam followed by aspiration or operative hysteroscopy was the appropriate approach for most clinical scenarios. UAE with gelfoam was appropriate for extensive EMV adjacent to RPOC or EMV alone but it was uncertain for limited EMV adjacent to RPOC. A possible explanation is that an alternative treatment could be proposed in this scenario since aspiration or hysteroscopy and resection without embolization is at low risk of bleeding for limited EMVs but with a higher risk of bleeding for extensive EMVs; although this is not reflected in the panelists' answer (Table 2C, Section 2.2).

Patient treatment by embolization using gelfoam, followed by curettage or operative hysteroscopy, was considered appropriate in most cases involving extensive EMV and RPOC but inappropriate for all clinical scenarios involving EMV alone where hysteroscopy or curettage is unnecessary.

Uncertainty (neutral or disagreement) was observed in 51 % (49/96) of the clinical scenarios involving limited EMV and RPOC and 41.66 %

(40/96) of scenarios involving extensive EMV and RPOC. This highlights the complexity of the medical decisions, where a "wait and see" approach could entail the risk of a lack of spontaneous involution of the EMV and RPOC, while a proactive approach could be iatrogenic and inappropriate. Different issues arose during this study and are summarized in Supplementary Table 2. One topic addressed the timing of invasive intervention. Panelists considered that in cases where no pregnancy is desired, patients with recurrent bleeding and anemia could be monitored with US and hemoglobin levels for a longer period to allow for spontaneous expulsion of RPOCs.

There was also discussions about the influence of pregnancy plans on therapeutic decisions. Some panelists advocated for a proactive approach (e.g. embolization and/or hysteroscopy) in patients with pregnancy plans, as bleeding can impede fertilization. Others advocated that hysteroscopy, aspiration or embolization could lead to intrauterine synechiae, which impairs fertility. In many clinical scenarios, Gelfoam embolization is preferred to microspheres or liquid embolic agents, because Gelfoam is the only absorbable embolic agent, that is completely resorbed within 4 to 6 weeks and therefore has a low risk of endometrial and ovarian ischaemic complications, thus preserving fertility.

In the case of recurrent bleeding after UVA surgery or embolization without evidence of technical failure there is no consensus except in the case of treatment with liquid embolic or microspheres in the absence of pregnancy desire. If pregnancy is desired, embolization can be repeated with Gelfoam or switched to microspheres or liquid embolic agents if greater efficacy is required, especially in the case of haemodynamic complications. In the absence of consensus, these decisions must be discussed with the patient and between the interventional radiology and gynecology teams.

Collaboration and rapid communication between radiologists and gynecologists are crucial for managing these patients effectively. This collaboration is well-established in the south-eastern France (the PACA-Corse-Monaco perinatal network; <https://www.reseauperinatmed.fr/>). Unfortunately, embolization is not equally accessible across French hospitals, a factor that should be considered in future recommendations.

All panelists agreed that hysterectomy could be envisaged in cases of aspiration/hysteroscopy and/or embolization failure, but only in patients with no future pregnancy plan. Nonetheless, we have not

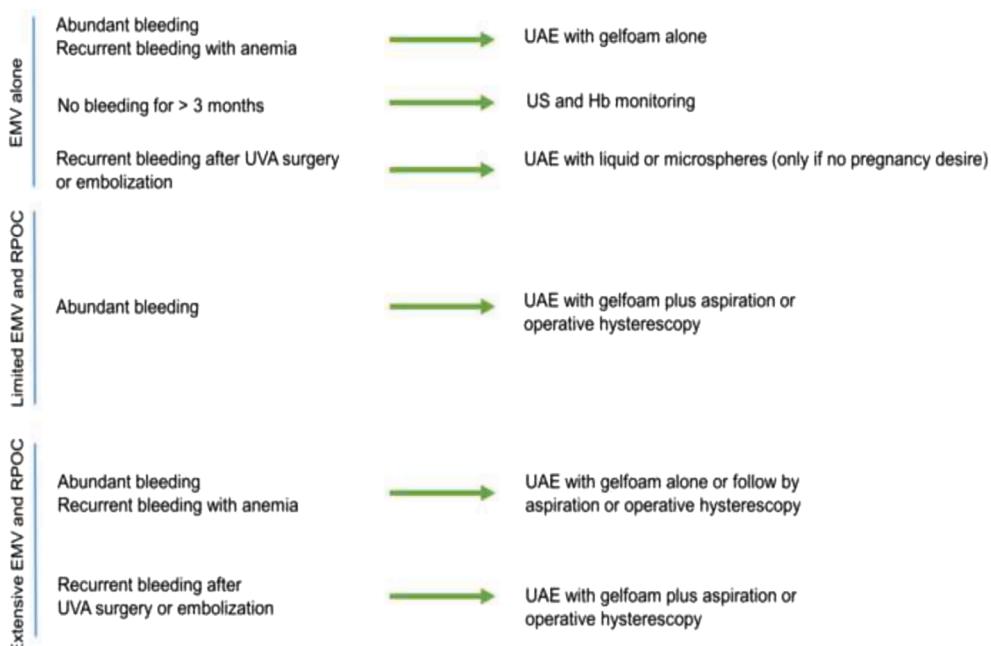


Fig. 2. Decision making in case of imaging evidence of an EMV alone, a limited EMV and hypervascul RPOC and an extensive EMV and hypervascul RPOC.

Table 2
Summary results.

Green	Appropriate (median of 7-9)
Orange	Neutral (median of 3-6)
Red	Inappropriate (median of 1-3)
Blue	Disagreement First rating: disagreement (at least 5 rated appropriate and 5 rated inappropriate)* Second and third rating: disagreement (at least 4 rated appropriate and 4 rated inappropriate*)

* distinguished by bold numbers

A. What is the most appropriate term to describe what is known as arteriovenous malformation or uterine AVM-like?

Acquired uterine vascular anomaly? **6.5**

Post-partum/post-abortion uterine vascular anomaly? **7**

Uterine vascular anomaly associated with a RPOC? **6.5**

B. Use of color Doppler US and MRI for the management of suspected uterine vascular anomalies

Is it appropriate to perform color Doppler to

describe the vascularity of the RPOC (vascular or avascular)?	describe the size of the RPOC?	describe the extension of the EMV?*	describe the peak systolic value of the EMV arteries?	describe the resistance index of the EMV arteries?	to follow an uterine vascular abnormality after embolization or curettage or operative hysteroscopy until its complete disappearance?
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8.5	9	9	7	7	9
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*whether is localized near to the RPOC or whether it spreads out in the myometrium exceeding the limits of the RPOC?

Is it appropriate to perform MRI

if it delays de patient's treatment in a situation of abundant bleeding?	to describe the early venous return?	to describe the extension of the EMV?*	to identify the feeder arteries before embolization?	to identify an aneurysm before embolization?	to plan the resection of the RPOC	to differentiate an RPOC from a blood clot?	to follow an uterine vascular abnormality after embolization or curettage or operative hysteroscopy until its complete disappearance?
1	9	8	7	7	5	7	3

*localized near the RPOC or spreads out in the myometrium exceeding the limits of the RPOC

C. Section 1: Clinical scenarios for rating the appropriateness of treatments for patients with extensive EMV and hypervasculair RPOC

(continued on next page)

Table 2 (continued)

1.1) Is it appropriate to monitor by US and Hb dosage? ¹	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ²
Pregnancy desire	1	1	2	2	5	3	3	8
No pregnancy desire	1	1	3	2	5	5	8	5

¹patients monitored by US and Hemoglobin (Hb) without further treatment.²no evidence of technical failure

1.2) Is it appropriate to perform curettage or operative hysteroscopy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	2	2	2	3	5	5	5	6
No pregnancy desire	1	2	2	2	2	3	1	6

¹no evidence of technical failure

1.3) Is it appropriate to perform UAE* with gelfoam alone?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	6	8	7	7	5	7	5	4
No pregnancy desire	8	8	8	7	7	8	2	6

^{*}UAE: uterine artery embolization¹no evidence of technical failure

1.4) Is it appropriate to perform embolization with definitive liquid or microspheres?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	3	2	3	1	2	1	7
No pregnancy desire	4	7	6	6	6	5	1	7

¹no evidence of technical failure

(continued on next page)

Table 2 (continued)

1.5) Is it appropriate to perform embolization with gelfoam plus curettage or operative hysteroscopy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	9	8	8	7	7	7	7	7
No pregnancy desire	8	8.5	8	8	6	6	3	7

¹no evidence of technical failure

1.6) Is it appropriate to perform hysterectomy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	1	1	1	1	1	1	1
No pregnancy desire	7	2	1	2	1	1	1	6

¹no evidence of technical failure**Section 2:** Clinical scenarios for rating the appropriateness of treatments for patients with limited EMV and hypervascula RPOC.

2.1) Is it appropriate to simply monitor by US and Hb dosage? ¹	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ²
Pregnancy desire	1	1	2	2	6	4	8	5
No pregnancy desire	1	1	2	2	5	4	8	6

¹patients monitored by US and Hemoglobin without further treatment.²no evidence of technical failure

2.2) Is it appropriate to perform curettage or operative hysteroscopy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	2	5	5	5	7	7	7	5
No pregnancy desire	2	5	5	5	5	7	5	6

¹no evidence of technical failure*(continued on next page)*

Table 2 (continued)

2.3) Is it appropriate to perform embolisation with gelfoam?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	5	6	6	6	5	5	1	5
No pregnancy desire	6	6	6	5	5	5	2	4

¹no evidence of technical failure

2.4) Is it appropriate to perform embolization with definitive liquid or microspheres?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	1	1	1	1	1	2	4
No pregnancy desire	5	5	5	5	3	2	1	7

¹no evidence of technical failure

2.5) Is it appropriate to perform embolization with gelfoam plus curettage or operative hysteroscopy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	7	7	7	6	1	5	2	6
No pregnancy desire	8	7	7	6	4	4	1	3

¹no evidence of technical failure

2.6) Is it appropriate to perform hysterectomy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	1	1	1	1	1	1	1
No pregnancy desire	5	2	1	2	1	1	1	4

¹no evidence of technical failure

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Table 2 (continued)**Section 3:** Clinical scenarios for rating the appropriateness of treatments for patients with evidence of EMV but no RPOC.

3.1) Is it appropriate to simply monitor by US and Hb dosage? ¹	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ²
Pregnancy desire	1	1	2	2	7	3	8	5
No pregnancy desire	1	1.5	2	2	7	2	6	5

¹patients monitored by US and Hemoglobin without further treatment.²no evidence of technical failure

3.2) Is it appropriate to perform curettage or operative hysteroscopy alone?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	1	1	1	1	1	1	1
No pregnancy desire	1	1	1	1	1	1	1	1

¹no evidence of technical failure

3.3) Is it appropriate to perform embolisation with gelfoam?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	9	9	8	8	7	7	3	5
No pregnancy desire	9	9	8	8	6	7	1	5

¹no evidence of technical failure

3.4) Is it appropriate to perform embolization with definitive liquid or microspheres?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	3	3	3	3	3	2	1	5
No pregnancy desire	5	6	6	6	5	5	1	7

¹no evidence of technical failure

(continued on next page)

Table 2 (continued)

3.5) Is it appropriate to perform embolization with gelfoam plus curettage or operative hysteroscopy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	3	1	1	1	1.5	1	1
No pregnancy desire	1	1	1	1	1	1	1	1

¹no evidence of technical failure

3.6) Is it appropriate to perform hysterectomy?	abundant bleeding and hemodynamic complications	abundant bleeding and anemia	abundant bleeding	recurrent bleeding and anemia	recurrent bleeding for < 3 months	recurrent bleeding for > 3 months	no bleeding for > 3 months	recurrent bleeding after UVA surgery or embolization? ¹
Pregnancy desire	1	1	1	1	1	1	1	1
No pregnancy desire	5	2	2	2	1	1	1	5

¹no evidence of technical failure**Section 4:** Appropriateness of hysterectomy for patients with recurrent bleeding after UVA surgery or embolization failure.

Is it appropriate to perform hysterectomy?	in case of recurrent bleeding after UVA surgery or embolization?*
Pregnancy desire	2
No pregnancy desire	7

*no evidence of technical failure

Section 5: Summary of rating distribution.

	Consensus 52%		Dissensus 47%
	Appropriate	Inappropriate	Uncertain/Neutral
Clinical scenarios (n=290)	36 (12.4%)	117 (40.3%)	137 (47.2%)

1) The number in parenthesis is the median response. 2) 1=Highly Inappropriate, 5=Neutral, 9=Highly Appropriate. 3) Color codes.

considered the woman's desire to preserve the uterus; this parameter should be considered as proposed by Brun et al. [9].

To further validate our study, we invited physicians from the SIFEM (Société d'Imagerie de la femme), the SFICV (Société Française d'Imagerie Cardiaque et Vasculaire Diagnostique et Interventionnelle) and the CNGOF (Collège national des gynécologues et obstétriciens) to evaluate nine recommendations of this survey. The external panel was composed of 11 gynecologists, eight interventional radiologists and six diagnostic radiologists specialized in women's health from public and private hospitals. The clinicians evaluated the validity and clarity of nine conclusions from this study using a scale from 1 to 9, where higher

scores indicated greater validity and clarity (Supplementary Table 3). The median score was 8 or higher for most items.

This study highlights specific clinical situations where expert opinion is needed to improve the care of patients with postpartum/post-abortion hemorrhage.

CRediT authorship contribution statement

Pierre-Antoine Barral: Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **J. Ghelfi:** Validation, Supervision, Investigation. **M. Bravetti:**

Validation, Investigation. **S. Willoteaux**: Validation, Investigation. **A. Agostini**: Validation, Investigation. **K. Janot**: Validation, Investigation. **G. Legendre**: Validation, Investigation. **A. Torre**: Validation, Investigation. **M. Midulla**: Validation, Investigation. **F. Thouveny**: Validation, Investigation. **T. Poclet**: Validation, Investigation. **P. Rousset**: Validation, Investigation. **H. Vernhet-Kovacsik**: Validation, Investigation. **A. Jacquier**: Writing – review & editing, Validation, Supervision, Conceptualization. **H. Marret**: Validation, Investigation. **Laura Miquel**: Writing – review & editing, Validation, Investigation.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Pierre Antoine Barral reports a relationship with Medtronic that includes: consulting or advisory. Kevin Janot reports a relationship with Balt that includes: consulting or advisory. Pascal Rousset reports a relationship with ZIWIG that includes: consulting or advisory. Pascal Rousset reports a relationship with EDAP TMS that includes: consulting or advisory. Pascal Rousset reports a relationship with Medtronic that includes: consulting or advisory. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

These recommendations are validated by the SIFEM (Société d'Imagerie de la femme), the SFICV (Société Française d'Imagerie Cardiaque et Vasculaire Diagnostique et Interventionnelle) and the CNGOF (Collège national des gynécologues et obstétriciens).

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Appendix A. Supplementary data

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