

ORIGINAL ARTICLE

Ultrasound-guided hysteroscopy (UGHys) for the management of high-risk retained products of conception: a retrospective case series

Ultrasound-guided hysteroscopy in high-bleeding-risk RPOC

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DOI: 10.36129/jog.2026.264

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ABSTRACT

Objective. Retained Products of Conception (RPOC) can be highly vascularized, increasing the risk of severe or life-threatening hemorrhage during surgery. Identification of high-risk cases is crucial to minimize complications. The aim of this study was to assess single-step Ultrasound-Guided Hysteroscopy (UGHys), a minimally invasive technique combining ultrasound and hysteroscopic guidance for highly vascularized RPOC.

Materials and Methods. We conducted a retrospective study at Careggi Hospital in 2024 on the obstetric population hospitalized for delivery or miscarriage to identify cases of

RPOC. Transvaginal ultrasound (TVUS) with Doppler, performed according to International Endometrial Tumor Analysis (IETA) criteria, was used to stratify patients by bleeding risk. Low-risk cases were managed conservatively with TVUS follow-up, whereas high-risk cases underwent UGHys removal. The primary outcome was procedural success, defined as complete removal without bleeding.

Results. Among 3944 screened patients, 62 surgical RPOC were included (1,57%), of whom 6 (9.67%) were classified as high-risk. Mean gestational age at termination was higher in the high-risk group (9.67 ± 2.84 vs. 6.94 ± 1.79 weeks; $p= 0.034$), a difference that was also clinically relevant. All high-risk cases were successfully treated with UGHys. No intra- or postoperative complications occurred, all patients were discharged the same day, and no repeat hysteroscopy was required.

Conclusions. UGHys appears to be a safe and effective single-step technique for managing highly vascularized RPOC, achieving complete removal avoiding complications and preserving fertility. RPOC following pregnancies beyond nine weeks or with prolonged persistence are more likely to show high vascularity and therefore warrant careful assessment.

Key words

Retained products of conception; residual trophoblastic tissue; operative hysteroscopy; enhanced myometrial vascularity; doppler ultrasound

Introduction

Retained products of conception (RPOC) is defined as placental or trophoblastic tissue retained in the uterine cavity after a pregnancy. RPOC can be highly vascularized, resembling an arteriovenous malformation (AVM) [1-3]. Accurate identification of a highly vascularized RPOC is crucial, as an improper surgical approach could result in life-

threatening hemorrhage. RPOC can complicate pregnancies, regardless of gestational age, type of delivery, spontaneous or induced abortion [4-7].

Currently, there are no established diagnostic criteria or standardized therapeutic protocols for the management of highly vascularized RPOC. Transvaginal ultrasound (TVUS) plays a key role in diagnosis and the presence of an endometrial tissue, thickened endometrium, irregular myometrial-endometrial interface, complex endometrial fluid or an echogenic focus without apparent mass are sonographic findings that may indicate RPOC [8-11]. Recently, an ultrasonographic endometrial thickness of >15mm, measured two weeks after primary treatment, has been proposed as a diagnostic criterion for RPOC after abortion [12]. Additionally, the use of color Doppler imaging is crucial for diagnosis. An echogenic, well-vascularized intracavitary lesion detected after a miscarriage or delivery, is suggestive of retained tissue [13]. Furthermore, Kamaya et al., classified RPOC using color Doppler into three types, ranging from type 0 (no vascularization) to type 3, where the endometrial vascularity is greater than that in the myometrium [1]. Other authors have also referred to these vascularized areas as “marked vascularity” (MV) or “enhanced myometrial vascularity” (EMV) [14-16].

In the last two decades, hysteroscopy has proven to be an effective treatment for RPOC and to be superior to dilation and curettage (D&C) for its removal due to the achievement of a higher rate of complete treatment, reduction of the incidence of intruterine adhesions (IUAs) and improving pregnancy rates [4, 17-20]. Office hysteroscopy is feasible for patients with RPOCs < 30mm and absent or minimal vascularization on Doppler TVUS [21].

The main unresolved issue concerns determining the most effective approach to treating women at high-risk of bleeding, particularly in cases where Doppler TVUS reveals highly vascularized RPOC resembling an AVM, a condition variably described in the literature as “type 3 vascularization”, “EMV” or “MV”.

A two-step hysteroscopy procedure has been proposed for the management of complex RPOCs (i.e. highly vascularized). In those studies, operative hysteroscopies were performed on patients who had preoperative TVUS done by external providers, with or without the use of color Doppler flow. As a result, proper selection of women truly at high-risk of bleeding was not guaranteed [4, 22]. Recently, Dewilde et al. proposed an algorithm for the management of cases with enhanced myometrial vascularity [23].

In these patients, the goal is not only to achieve complete removal of RPOC while minimizing the risk of excessive bleeding, and preserve the structural and functional integrity of the uterine cavity and endometrium, so optimizing future pregnancy outcomes. To achieve this, we propose a single-step hysteroscopy combined with ultrasound for the management of highly vascularized RPOC.

Materials and Methods

The present retrospective, single-center study, recruited patients diagnosed with RPOC from January 1st to December 31st, 2024, at the Department of Obstetrics and Gynecology of Careggi hospital in Florence. 3103 vaginal or cesarean deliveries, 325 medical and 69 surgical abortions, 307 medical and 140 surgical terminations of pregnancy were recorded, resulting in a total of 3944 patients. All data were obtained from existing patient files and electronic medical records, consistent with the retrospective study design. In our routine clinical practice, a gynecological examination with TVUS is performed one month after cesarean or vaginal delivery and two weeks after spontaneous or induced abortion. In case of RPOC diagnosis, patients were managed according to the protocol outlined in the flowchart shown in Figure 1.

Patients diagnosed with RPOC underwent TVUS examination using a Voluson S10 Expert (GE Healthcare, Milwaukee, WI) equipped with a 2.9 to 9.7 MHz endocavitary probe. All

sonographic and color Doppler second-look examinations were conducted by two investigators (M.E.C. and M.G.). The examination began with the assessment of uterine position and measurements. Following the visualization of the ovaries, the uterine cavity was evaluated using the terms and definitions established by the International Endometrial Tumor Analysis (IETA) group [24]. RPOC vascularity were assessed using the color Doppler box, which included the endometrium and the surrounding myometrium, with frequencies at least 5.0 MHz and pulse repetition frequency between 0.3 and 0.9 kHz. Amount of blood was scored (CS1-CS4) using the International Ovarian Tumor Analyses (IOTA), as applied to ovarian masses [25]. No specific peak systolic velocity cut-off was applied to identify highly vascularized RPOC, although velocities exceeding 60 cm/s were considered highly suspicious. The typical TVUS appearance of RPOC was described according to the recommendations of the IETA group. Therefore, a characteristic RPOC was considered as an endometrial lesion arising from the endometrium, with non-uniform echogenicity (mixed echogenicity, with greater hyperechogenic component), irregular edges and interrupted endometrial-myometrial junction. Color Doppler assessment, using a pulse repetition frequency 0.6-0.9 kHz, had to include the endometrium and the underlying myometrium. The presence of a dominant vessel crossing the interrupted endometrial-myometrial junction was a typical finding (Figure 2). No specific endometrial thickness cut-off has been shown to reliably distinguish the presence or absence of RPOC.

Patients with minimal or no vascularization (color score 1 or 2) were classified as low risk for bleeding. RPOCs measuring <30mm, with CS 1 or 2 on Doppler TVUS and without bleeding, were primarily managed conservatively with TVUS follow-up until complete resolution. Cases of increased vascularization (CS3-4) had a second-look TVUS performed by a senior sonographer to confirm the suspicion of highly-risk RPOC, quantifying the size and displaying anastomotic vessels using color Doppler score.

High-risk RPOC was defined according to IETA criteria as follows:

1. persistence of trophoblastic tissue on follow-up scans, regardless of quantity;
2. presence of still “active” tissue, characterized by marked vascularity on color Doppler
3. identification of one or more dominant invasive vessels crossing the endo-myometrial junction and penetrating into the myometrium.

Study registration and ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by the Regional Ethical Committee (CEAVC 10189, amendment 16 May 2018, 2018-017, CINECA 10189). Written informed consent was obtained from all participants.

Statistical analysis

Patient characteristics were analyzed using Fisher’s exact test or Chi-squared test, as appropriate (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The difference between groups was assessed using an independent samples t-test with unequal variances (Welch’s t-test), A p-value <0.05 was considered statistically significant. Because this was a retrospective study, all eligible cases within the study period were included to maximize statistical power; therefore, no a priori power calculation was performed.

Ultrasound-Guided Hysteroscopy (UGHys) for high-risk retained products of conception

High-risk RPOC cases were managed with operative hysteroscopy under ultrasound guidance (UGHys), a minimally invasive approach that is recommended and routinely

implemented in our institution as part of standard clinical practice, in operation room under general anesthesia.

A TVUS was repeated before starting hysteroscopy, with an empty bladder to confirm the presence of high-risk RPOC and the exact site of the dominant vessel (point of adhesion of the retained tissue). The ultrasound machine was positioned to the right of the patient. Subsequently, the bladder was filled with 120mL of saline solution to facilitate transabdominal ultrasound window during hysteroscopic procedure. The hysteroscopy procedure was conducted under ultrasound guidance with strictly communication between the hysteroscopist and the sonographer. During cervical dilatation with Hegar instruments, ultrasound guidance helped avoiding high-risk RPOC to prevent bleeding. A 26Fr resectoscope with an angled loop is introduced and used in a “cold” (non-activated) mode to grasp and remove the retained tissue from the opposite side of the trophoblastic adhesion zone, functioning similarly to a curette (Figure 3). In the area of adhesions and high-risk of bleeding, ultrasound identified endometrial-myometrial junction interruption with vascular invasion. The surgeon carefully removed the tissue to minimize the risk of hemorrhage. In cases of bulky RPOC or mild bleeding, where the hysteroscopic visualization was compromised, ultrasound guidance was essential for accurately directing the resectoscope loop toward the retained tissue. Bleeding naturally resolved after complete removal of RPOC. In presence of vessel hemorrhage ultrasound guided hysteroscopist to identify the source of bleeding for selected coagulation (Figure 4). The complete removal of RPOC was confirmed by hysteroscopic visualization of empty uterine cavity and absence of retained tissue by TVUS.

The operative room was equipped for major bleeding including intrauterine balloon catheters. RPOC tissue was sent for pathological examination. TVUS at 15 days postoperatively, confirmed the absence of intrauterine remnants and assessed the

improvement of sonographic findings, particularly the partial restoration of the endometrial-myometrial junction.

Results

A total of 62 (1.57% of cases) RPOC surgical procedures were performed, 42 hysteroscopies and 20 D&C. The 62 patients were stratified into two risk groups: low-bleeding-risk (56 patients, 90.33%) and high-bleeding-risk (6 patients, 9.67%).

The main demographic and ultrasonographic characteristics of the patients are reported in Table 1.

The majority of RPOC cases occurred after medical termination of pregnancy (39 cases, 62.9%), followed by vaginal delivery (17 cases, 27.4%), cesarean section (5 cases, 8.1%) and surgical termination of pregnancy (1 case, 1.6%) (Table 2). No cases of high-bleeding-risk RPOC were observed following cesarean delivery or surgical termination of pregnancy. The interval between the delivery and the surgical intervention was 9.78 weeks (SD \pm 11.1) in the low-risk group and 8.14 weeks (SD \pm 1.6) in the high-risk group. Conversely, the interval between early pregnancy loss and surgery was 4.27 weeks (SD \pm 3.0) in the low-risk group and 11.57 weeks (SD \pm 7.9) in the high-risk group. The high-risk group showed a significantly higher mean gestational age at the time of first-trimester pregnancy termination compared to the low-risk group (9.67 weeks vs. 6.94 weeks; $p= 0.034$).

Regarding symptoms, vaginal bleeding was the most frequently reported, occurring in 3 of the 6 patients in the high-bleeding-risk group (50%) and in 18 of the 56 patients in the low-bleeding-risk group (32.1%, $p= 0.034$). Notably, two of the six high-risk patients presented to the emergency department due to bleeding.

The six high-bleeding-risk RPOCs were managed using UGHys procedure. One patient had the uterine cavity completely filled and obscured by the retained placental tissue. Two

patients were bleeding at the time of hysteroscopy so the visualization of the uterine cavity and the retained tissue was limited. After the complete removal of the retained tissue, no major bleeding was observed and the Foley catheter was never required. Intraoperative blood loss was measured in all cases and ranged from 20 to 120 mL, as recorded in the graduated collection bag. The fluid deficit during the procedure was also monitored and never exceeded 400mL.

All patients classified as high-risk of bleeding, had histological analysis response of chorionic villi associated with a decidual flap, along with necrotic-ischemic or inflammatory-hemorrhagic changes. The mean size of placental remnants was 33,3mm (range: 19-55mm). Notably, none of the patients classified in the high-risk group had documented coagulation disorders.

All patients were admitted and discharged on the same day. None required a second hysteroscopic procedure for complete removal of retained tissue. The ultrasound control at fifteen days after the procedure confirm complete removal of the retained tissue in all cases and a partial restore endo-myometrial junction.

Discussion

Main findings

A key challenge in the diagnosis and management of RPOC patients concerns the accurate interpretation of ultrasound findings, particularly the assessment of color Doppler. As an intrauterine lesion, RPOC should be describe with the terms and definitions of the International Endometrial Tumor Analysis (IETA) terminology [24]. Therefore, a characteristic retained products of conception should be described as an endometrial lesion arising from the endometrium, with non-uniform echogenicity (mixed echogenicity, with greater hyperechogenic component), irregular edges and interrupted underlying endometrial-myometrial junction. Color Doppler assessment, using a pulse repetition

frequency 0.6-0.9 kHz, should include both the endometrium and the underlying myometrium. The most critical clinical indicator and sonographic pattern is bleeding and/or persistence of an endometrial lesion over time, that remains attached to and infiltrates the underlying myometrium. Accurate use of TVUS and Doppler requires specific skills, therefore, all cases of suspected or highly vascularized RPOCs should be referred for a second-level evaluation by an experienced sonographer.

Our analysis identified a statistically significant higher risk of developing highly vascularized RPOC in later gestational ages compared to earlier gestational ages (mean gestational age: 9,67 weeks vs. 6,94 weeks; p value 0,034), an association that has not been previously reported in the scientific literature. This increased risk may be linked to the physiologic remodeling of maternal spiral arteries, which regulate uteroplacental blood inflow into the intervillous space. Prior to 8 weeks of gestation, these arteries remain largely occluded by trophoblast plugs and from tortuous, non-perfused networks, resulting in limited placental perfusion. Beginning around 9 weeks, recanalization of the spiral arteries initiates from the placental periphery – a process typically completed by 12 weeks – leading to progressive increases in vascularization and blood flow within the placental bed [26, 27]. Therefore, caution is recommended when managing RPOC after first-trimester termination beyond 9 weeks' gestation.

Another notable observation concerns the interval between early pregnancy termination and subsequent surgery. The interval between the end of early pregnancy and surgery differed between the low- and high-risk groups, suggesting that prolonged persistence of the lesion may represent a significant risk factor for the development of increased vascularization. The presence of retained tissue beyond 9 weeks' gestation – thus following the onset of spiral artery remodeling – is associated with inevitable villous necrosis over time. As hypothesized by Borell, this necrosis may contribute to the

formation of a fistulous circuit, resulting in arterial-to-venous shunting and ultimately to the development of a highly vascularized RPOC [28].

Expectant management is not recommended in high-risk RPOC patients, particularly in patients experiencing vaginal bleeding (observed in 50% of our cohort). A prolonged follow-up - extended over several months- increase patient anxiety, the risk of infection, delay of conception and follow-up drop-out; in fact, expectant management of patients with highly vascularized RPOCs remains questionable due to its high failure rate [29, 30].

In high-bleeding-risk RPOC, the integrated approach offered by Ultrasound-Guided Hysteroscopy (UGHys) enhances procedural safety. Compared with conventional blind dilation and curettage (D&C), UGHys provides direct visualization of the uterine cavity and real-time ultrasound monitoring, reducing the risk of uterine perforation—particularly relevant in postpartum uteri, which are structurally softened and more vulnerable to injury. Ultrasound guidance also improves the accuracy of resectoscope navigation, allows identification of the bleeding vessel with color Doppler, and facilitates the complete removal of placental remnants, even in bulky or actively bleeding RPOC with limited endoscopic visibility. Manual vacuum aspiration (MVA) is also considered a method for managing RPOC; however, as a blind technique, it may be less suitable in highly vascularized or bleeding cases. These aspects make UGHys a safer and more controlled option than both blind D&C and MVA in high-risk cases. An additional strength of our study is the educational value of ultrasound guidance during operative hysteroscopy. Real-time imaging can support trainees, including residents in obstetrics and gynecology, by improving their understanding of uterine anatomy, vascular patterns, and procedural steps. This aligns with the growing role of digital visual resources in gynecologic training and may enhance learning effectiveness and procedural safety [31]. UGHys is a safe procedure that avoids emergency procedures such as D&C, embolization or hysterectomy. It preserves

the morphological and functional integrity of the uterus, thereby its potential to support future pregnancies.

Strengths and Limitations

The main strength of our study lies in the systematic application of International Endometrial Tumor Analysis (IETA) terminology to describe RPOC ultrasound features, together with standardized Doppler assessment. Moreover, we provide new evidence linking later gestational age and prolonged persistence of retained tissue with a higher risk of developing highly vascularized RPOC. Long-term follow-up was not part of the study design, as per the hospital-approved protocol; however, at the 15–30-day ultrasound control, an intact uterine cavity and cessation of bleeding were documented in all cases. The main limitations are its retrospective, single-center design and the limited number of high-risk cases, which reduces the statistical strength of subgroup analyses.

Conclusion

To our knowledge, this is the first study recommending the use of International Endometrial Tumor Analysis (IETA) terminology to describe RPOC on TVUS and suggesting that later gestational age and prolonged lesion persistence are significant risk factors for developing highly vascularized RPOC. UGHys appears to be a safe and effective treatment option in these patients, with the potential to preserve reproductive outcomes.

Compliance with Ethical Standards

Authors contribution: M.G.: Conceptualization, Visualization, Writing-Original draft and Editing. E.W.: Investigation, Data Curation. E.G.: Formal analysis, Data Curation. M.F.: Methodology, Validation. F.P.: Supervision. M.E.C.: Conceptualization, Project administration, Writing-Reviewing.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure of Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Approval: This study was approved by the Regional Ethical Committee (CEAVC 10189, amendment 16 May 2018, 2018-017, CINECA 10189).

Data sharing: The data that support the findings of this study are available on request from the corresponding author. Due to confidentiality and their extraction from the ArchiMed management system, only encrypted datasets can be shared.

Acknowledgements: We thank the entire staff of the Maternal and Child Department of the Azienda Ospedaliero-Universitaria Careggi, whose dedicated work ensures high-quality care for women. We also extend our gratitude to all the residents working within the department for their constant commitment and support in daily clinical practice.

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Table 1. Demographic and sonographic data of patients with RPOC

	RPOC low-risk (n=56)	RPOC high-risk (n=6)	P value=
Age (yrs, mean)	35,4 (range 27-47)	33,3 (range 22-40)	0,33
BMI (mean)	23,1 (range 18-32)	23,5 (range 21-27)	0,55
Smoke (n° of patients)	7 (12,5%)	3 (50%)	0,045
N. previous pregnancies	2,78 (SD± 1,44)	2,33 (SD± 1,75)	0,54
N. previous deliveries	1,28 (SD± 0,97)	0,83 (SD± 0,75)	0,23
Conception by ART (n° of patients)	5 (8,9%)	1 (16,66%)	>0,9
Previous cesarean section (n° of patients)	17 (30,3%)	0 (%)	0,18
Previous intrauterine curettage (n° of patients)	23 (41%)	2 (33,33%)	>0,9
Previous myomectomy (n° of patients)	2 (3,5%)	0 (%)	>0,9
Interval between term pregnancy to surgery (weeks)	9,78 (SD± 11,1)	8,14 (SD± 1.6)	0,57
Interval between early pregnancy to surgery (weeks)	4,27 (SD± 3)	11,57 (SD± 7,9)	0,162
RPOC thickness on TVUS (mm)	19,03 (9-47)	24,6 (11-46)	
Color Doppler score (n° of patients)	CS1=36 CS2=18 CS3=2 CS4=/ 	CS1=/ CS2=/ CS3=2 CS4=4	<0.001
RPOC size histopathology (mm)	24,7 (5-60)	33,33 (19-55)	

N = number, BMI = body mass index, ART = assisted reproductive technology

Table 2. Early and Term pregnancy with low and high-risk RPOC

	RPOC low-risk (n=56)	RPOC high-risk (n=6)	Total n° (%)	P value=
Gestational age after term pregnancy (weeks)	38,5 (SD ± 2,6)	39,9 (SD ± 0,4)		0,055
Vaginal delivery	15	2	17 (27,4)	0,7
Cesarean section	5	0	5 (8,1)	0,4
Gestational age after early pregnancy termination (weeks)	6,94 (SD ± 1.79)	9.67 (SD ± 2.84)		0,034
Medical pregnancy termination	35	4	39 (62,9)	0,8
Surgical pregnancy termination	1	0	1 (1,6)	0,7

Figure 1. Protocol for the Management of Retained Products of Conception (RPOC)

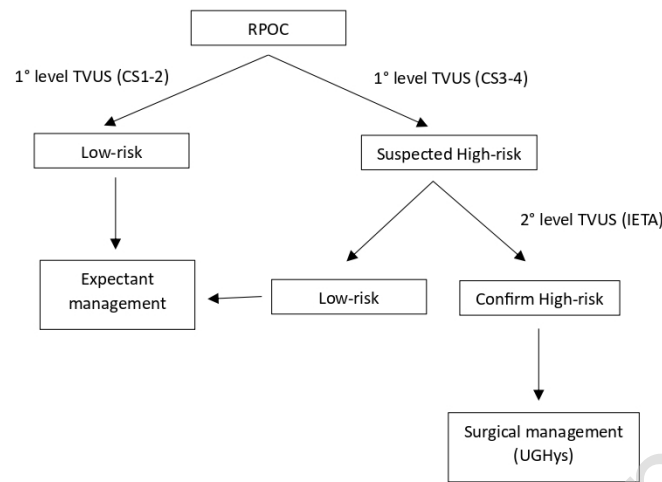


Figure 2. High-risk RPOC case. (a) RPOC with evident interruption of the endometrial-myometrial junction. (b) RPOC on color Doppler imaging showing vascularization with a dominant vessel crossing the disrupted endometrial-myometrial junction.

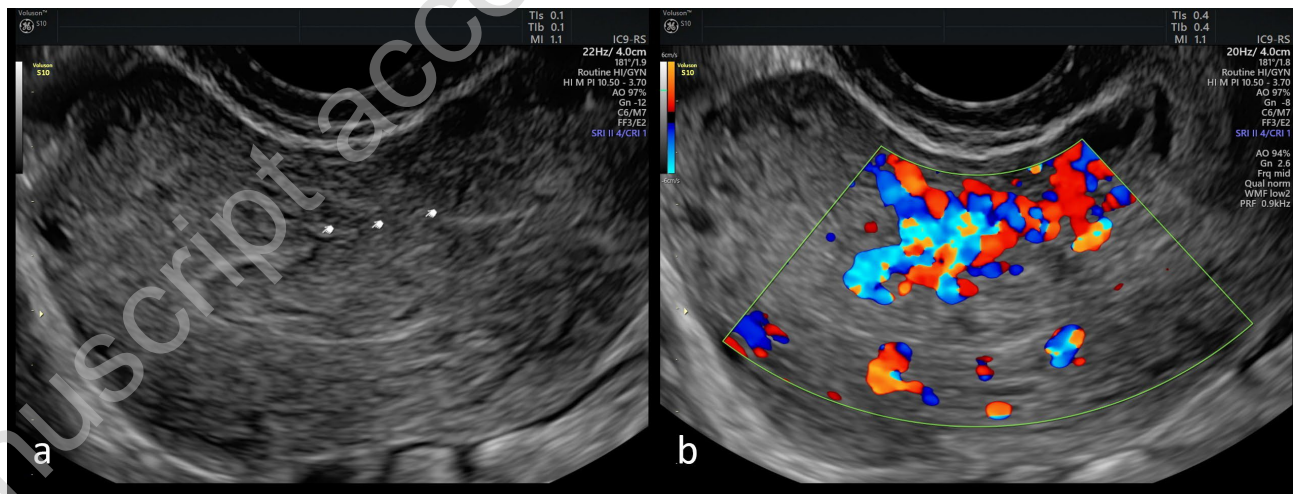


Figure 3. Hysteroscopic vision of a retained products of conception

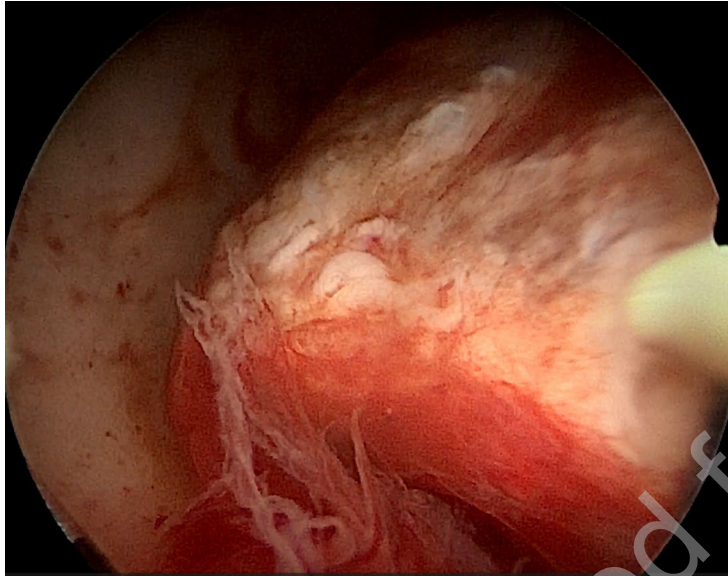


Figure 4. Vessel previously attached to the RPOC, bleeding if touched.

