Temporary Uterine Artery Embolization Followed by Hysteroscopy to Treat a Case of Acquired Uterine Arteriovenous Malformation (UAVM): Case Report with Systematic Literature Review

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Abstract

Objective: This paper provides information about conservative surgery to correct uterine arteriovenous malformations (UAVMs). The main objectives are to review the current literature on this subject and to share our very interesting and challenging case of UAVM. Our innovative surgical approach consisted in a combined method with temporary uterine artery embolization (UAE) plus hysteroscopic treatment.

Materials and Methods: A search of MEDLINE, EMBASE, Web of Sciences, Scopus, ClinicalTrial.gov, OVID and Cochrane Library was performed. Any type of study has been considered including case reports. We identify articles published from the inception to July 2019. Three hundred sixty-three articles were identified: 286 articles were excluded for any reason. Overall, 77 articles were incorporated for further assessment.
Results: Four surgical techniques have been employed to treat 125 cases of UAVMs: uterine artery embolization (UAE) (69.9%), dilatation and curettage (D&C) (10.4%), operative hysteroscopy (14.4%), uterine artery ligation (4%). Two patients (1.6%) underwent combined approach. Failed procedures which required a new treatment were twenty-one (16.8%). Forty-five pregnancies after surgical conservative management of UAVMs were reported.

Conclusion: UAVM is a rare condition. In literature, there is no gold standard of treatment. For young women who wish to preserve fertility, a conservative surgical management should be recommended. As in our case, using a resorbable agent to perform UAE permitted a normal restoration of the flow in the uterine artery after the hysteroscopic resection.

Keywords: Fertility; Hysteroscopy; Uterine arteriovenous malformation; Uterine artery embolization

1. Introduction
A uterine arteriovenous malformation (UAVM) is a vascular abnormal connection between arteries and veins of the uterus, which creates enlarged, tangled vessels with a fast and turbulent flow [1]. This abnormal structure results in a direct connection between arteries and veins, while they are normally linked by capillaries. UAVMs are considered as rare, and the real incidence is unknown: less than 1000 cases are described in literature [2-4]. UAVM can be congenital or acquired. The acquired form often follows a spontaneous abortion with subsequent dilation and curettage, an interruption of pregnancy, an endometrial carcinoma, or a gestational trophoblastic disease [5-6]. Generally, women present with severe and life-threatening vaginal bleeding despite the onset of medical therapy [7]. Explorative laparotomy or total hysterectomy were once the only possible way to diagnose UAVM, upon pathological examination. After that, angiography became the gold standard for diagnosis. Lately, ultrasonography with color Doppler has been widely used to obtain a reliable diagnosis [8-10]. Treatments for these conditions are far from being standardized and range between expectation management mainly based on medical therapy, to invasive approaches, such as conservative surgery (uterine arterial embolization, dilatation and curettage, operative hysteroscopy, uterine arteries ligation) or demolitive surgery (hysterectomy) [11]. The treatment of choice depends on various factors such as pregnancy desire and patients’ haemodynamic parameters [12]. There have been several reports of pregnancy after conservative management of UAVMs, that seems to be feasible and reassuring on selected patients [13, 14]. In this paper, we report a successful case of a UAVM conservative management with combined temporary UAE plus hysteroscopic resection and we perform a retrospective systematic review of the available literature with regard to the conservative surgical treatment of acquired UAVMs and the fertility outcomes.

2. Methods
2.1 Search strategy
The data research was conducted using the following databases MEDLINE, EMBASE, Web of Sciences, Scopus, ClinicalTrial.gov, OVID and Cochrane Library querying for all articles related to temporary uterine artery embolization, hysteroscopy and UAVM. We used a combination of the following Medical Subjects Heading (MeSH): ((uterine) OR pelvic) AND arteriovenous AND (malformation OR fistula OR...
cirsoid aneurysm) AND (curettage OR D and C OR surgical treatment OR hysteroscopy OR uterine artery embolization) AND (bleeding OR hemorrhage). A systematic review was therefore performed following the Preferred Reporting Items for Systematic reviews and Meta-Analyses “PRISMA” guidelines [15]. We have selected articles published from inception to June 2019. We screened those record titles and abstracts retrieved from our searches. All full-text manuscript reference lists were analyzed in order to find additional eligible studies. This process was performed collaboratively by 2 authors (IR, SM).

2.2 Eligibility criteria
Studies with patients with acquired UAVMs were considered for the inclusion. Case reports were included in the selection. No language restrictions were initially applied. To avoid duplication, studies describing the same study population were included only once. The inclusion criteria were as follows: papers referring to acquired UAVMs treated by conservative surgical management (UAE, D & C, hysteroscopy, uterine ligature). Papers with congenital non acquired AVMs were excluded from the review as well as article not in English language, conference papers, reviews, and studies with information overlapping another publication. Also, we excluded studies reporting medical treatments and/or demolitive surgery (hysterectomy) as first line treatment.

2.3 Data extraction
From each eligible paper, we extracted and tabulated the following clinical data: author’s name and year; age; gravidity and parity; symptoms at the diagnosis, previous uterine surgical treatments; surgical management, time of follow-up, rate of failed procedures and pregnancy outcomes. Since most of the papers were case reports, we did not conduct a meta-analysis of these studies. The flow chart of the search strategy and the selection process is shown in Figure 1.

Figure 1: Study selection process.
3. Results
Our electronic database search revealed 363 articles of which 135 were excluded because they were after all, not relevant for the review, 19 records for linguistic reasons, 38 records because they included congenital AVMs, 46 records because they included demolitive surgery, 34 records because they included pharmacological management as first line treatment and 14 records because the same patients were included in latest records. Overall, 77 articles were incorporated for further assessment reporting 125 patients diagnosed with UAVM. The summary of all the papers is outlined in Table 1.

3.1 Patients characteristics
All patients were symptomatic and presented with acute abnormal vaginal bleeding, which was defined as severe. Mean age at diagnosis was 29.38 years, standard deviation (SD) was +/- 6.81 years (range 16-51). Among considered population, mean gravity and parity at the moment of the AVM diagnosis was respectively 2.34 years, SD +/- 1.68 years (range 0-8) and 1.02 years, SD +/- 1.10 years (range 0-5). Ninety-two patients (73.6%) presented with vaginal bleeding post interruption of pregnancy or spontaneous miscarriage. Twelve patients were (9.6%) diagnosed shortly after vaginal delivery and 4 (3.2%) after cesarean delivery; 1 patient (0.8%) presented after a diagnosis of chorioamnionitis. For 16 (12.8%) patients the cause of the UAVM remained unknown. Among all patients ninety-four patients (74%) underwent D&C before the occurrence of the UMAV.

3.2 Management and failed procedures
In terms of management, our search of current literature identified 85 patients that primarily underwent uterine artery embolization (69.6%) and this was the most common treatment option. Eighteen (14.4%) patients were treated with operative hysteroscopy. Five (4%) patients primarily had laparoscopic uterine artery ligation. Thirteen (10.4%) patients underwent D&C. Combined management was the treatment of choice for 2 (1.6%) patients. Of them, one (0.8 %) underwent UAE plus D&C, one (0.8%) had UAE plus operative hysteroscopy.

3.3 Failed procedures
Overall, failed procedures were 21 (16.8%): UAE was insufficient in 17 cases (19.5%). Among these patients fifteen (12%) required a second procedure and six (4.8%) had total abdominal hysterectomy performed due to uncontrolled bleeding (all among the UAE group). Of the patients treated by D&C and uterine ligation, 3 (2.4%) and 1 (0.8%), respectively, had a recurrence and required a second procedure. Two patients treated with combined method had no complications, and the procedures were successful.

3.4 Fertility outcomes
Follow-up data were available for 89 (71.2%) patients, with a mean follow-up of 22 months with SD +/- 11 (range 5-36). Follow-up data is described in table 2. Forty-five (50.6%) conceptions were observed, considering a positive blood beta-hcg. Delivery rate was 82.2% (37 patients). Four (10%) patients had a miscarriage. Four patients were lost to follow-up after positive b-hcg. Twenty-six patients had a term vaginal delivery. Six patients had a term caesarean section. Six patients reported obstetric complications such as pre-eclampsia, IUGR and pPROM. Twenty-eight patients with positive blood beta-hcg were reported after UAE.
| Year | Author | Article Type | N° | Pt N° | Age | G | P | A | Cause |
|------|--------|--------------|----|------|-----|---|---|---|-------|
| 1982 | Forssman[1] | case report | 1 |      | 20 | 2 | 0 | 1 | D&C |
| 1986 | Brown[2] | case report | 1 |      | 21 | 2 | 0 | 1 | D&C |
| 1986 | Markoff[3] | case report | 1 |      | 27 | 5 | 1 | 1 | D&C |
| 1987 | Poppe[4] | case report | 1 |      | 25 | 0 | 0 | 0 | NS |
| 1994 | Ginsberg[5] | case report | 1 |      | 42 | 2 | 1 | 1 | D&C |
| 1994 | Manolitsas[6] | case report | 1 |      | 21 | 3 | 1 | 1 | D&C |
| 1995 | Chow[7] | case report | 1 |      | 20 | 2 | 0 | 1 | D&C |
| 1996 | Gaens[8] | case report | 1 |      | 27 | 6 | 1 | 1 | D&C |
| 1997 | Palmeri[9] | case report | 1 |      | 16 | 1 | 0 | 1 | D&C |
| 1997 | Hoffman[10] | case report | 1 |      | 24 | 2 | 0 | 1 | D&C |
| 1997 | Arredondo-Soberon[11] | case report | 1 |      | 33 | 3 | 0 | 1 | NS |
| 2001 | Elia[12] | case report | 1 |      | 29 | 6 | 3 | 1 | D&C |
| 2002 | Kwon[13] | case report | 1 |      | 26 | 2 | 1 | 1 | D&C |
| 2003 | Gopal[14] | case report | 1 |      | 42 | 6 | 0 | 1 | D&C |
| 2003 | Takeuchi[15] | case report | 1 |      | 29 | 3 | 0 | 1 | D&C |
| 2003 | Chia[16] | case report | 1 |      | 37 | 3 | 2 | 1 | D&C |
| 2003 | Clarke[17] | case report | 1 |      | 29 | 4 | 1 | 1 | D&C |
| 2003 | Kelly[18] | case report | 1 |      | 36 | 1 | 1 | 0 | D&C |
| 2003 | Pope[19] | case report | 1 |      | 19 | 2 | 1 | 1 | D&C |
| 2003 | Chan[20] | case report | 1 |      | 33 | 3 | 2 | 1 | D&C |
| 2003 | Chen[21] | case report | 1 |      | 51 | 3 | 2 | 1 | D&C |
| 2004 | Winsor[22] | case report | 1 |      | 30 | 1 | 0 | 1 | D&C |
| 2004 | Batch[23] | case report | 1 |      | 28 | 1 | 1 | 0 | VD |
| 2004 | Irikoma[24] | case report | 1 |      | 28 | 1 | 0 | 1 | D&C |
| 2004 | Neto[25] | case report | 1 |      | 21 | 1 | 0 | 1 | D&C |
| 2004 | Aziz[26] | case report | 1 |      | 30 | 1 | 0 | 1 | D&C |
| 2004 | Amagada[27] | case report | 1 |      | 17 | 1 | 0 | 1 | D&C |
| 2004 | Nikolopoulos[28] | case report | 1 |      | 39 | 1 | 0 | 1 | D&C |
| 2005 | Ahn[29] | case report | 1 |      | 37 | 3 | 1 | 1 | D&C |
| 2005 | Ghir[30] | case report | 1 |      | 29 | 1 | 1 | 0 | VD |
| 2006 | Mccormick[31] | case report | 1 |      | 21 | 0 | 0 | 0 | NS |
| No. | Year | Author(s)          | Study Type | Case Count | D&C Count | Other Counts |
|-----|------|--------------------|------------|------------|-----------|--------------|
| 32  | 2006 | Yahi-Mountasser[32]| case report | 1          | 31        | 7 3 1 D&C   |
| 33  | 2006 | Morikawa[33]      | case report | 1          | 39        | 8 3 1 D&C   |
| 34  | 2006 | Phoon[34]         | case report | 1          | 31        | 1 0 1 D&C   |
| 35  | 2006 | Delotte[35]       | case report | 1          | 33        | 2 1 1 D&C   |
| 36  | 2007 | Lin[36]           | case report | 1          | 28        | 4 3 1 D&C   |
| 37  | 2007 | Halperin[37]      | case series | 3          |           | 1 27 2 1 1 D&C |
|     |      |                    |            |            |          | 2 24 3 0 1 D&C|
|     |      |                    |            |            |          | 3 28 4 1 1 D&C|
| 38  | 2007 | Rangarajan[38]    | case report | 1          | 22        | 2 0 1 D&C   |
| 39  | 2008 | Bae[39]           | case report | 1          | 35        | NS NS NS NS  |
| 40  | 2008 | Bagga[40]         | case report | 1          | 24        | 2 1 1 D&C   |
| 41  | 2008 | Dar[41]           | case report | 1          | 28        | 1 1 0       |
| 42  | 2008 | Bamberg[42]       | case report | 1          | 31        | 0 0 0       |
| 43  | 2008 | Singh[43]         | case report | 1          | 21        | 2 1 1 D&C   |
| 44  | 2008 | Maldonado[44]     | case report | 1          | 21        | 1           |
| 45  | 2009 | Griffin[45]       | case report | 1          | 25        | 1 1 0       |
| 46  | 2009 | Taylor[46]        | case report | 1          | 37        | 3 1 1 D&C   |
| 47  | 2009 | Vilos[47]         | case report | 1          | 19        | 1 0 1 D&C   |
| 48  | 2009 | Wijesekera[48]    | case report | 1          | 27        | 1 0 1 D&C   |
| 49  | 2010 | Guo[49]           | case report | 1          | 18        | 0 0 0       |
| 50  | 2010 | Kim[50]           | case series | 2          |           | 35 4 2 1 D&C |
|     |      |                    |            |            |          | 20 1 0 1 D&C|
| 51  | 2010 | Wani[51]          | case report | 1          | 37        |           |
| 52  | 2010 | Przybojewski[52]  | case report | 1          | 21        |           |
| 53  | 2011 | Shaban[53]        | case report | 2          |           | 1 30 1 1 D&C |
|     |      |                    |            |            |          | 2 45 4 0 1 D&C|
| 54  | 2011 | Vaknin[54]        | observational | 16         |           | 1 27 2 1 1 D&C |
|     |      |                    |            |            |          | 2 24 3 0 1 D&C|
|     |      |                    |            |            |          | 3 27 1 1 0 CS |
|     |      |                    |            |            |          | 4 28 4 1 1 D&C|
|   |   |   |   |   |
|---|---|---|---|---|
|   |   |   |   |   |
| 5 | 35 | 6 | 5 | 1 D&C |
| 6 | 20 | 3 | 1 | 0 CS   |
| 7 | 36 | 5 | 4 | 0 VD   |
| 8 | 36 | 5 | 2 | 1 D&C |
| 9 | 20 | 2 | 0 | 1 D&C |
| 10 | 29 | 6 | 3 | 1 D&C |
| 11 | 32 | 1 | 1 | 0 CS   |
| 12 | 31 | 4 | 3 | 1 D&C |
| 13 | 29 | 3 | 2 | 0 CS   |
| 14 | 41 | 4 | 3 | 1 D&C |
| 15 | 39 | 8 | 3 | 1 D&C |
| 16 | 31 | 1 | 0 | 1 D&C |
| 55 | 2012 | Scioscia\(^{55}\) | case report | 1 / 36 | 1 | 0 | 1 | D&C |
| 56 | 2012 | Clarke\(^{56}\) | case report | 1 | 23 | 1 | 0 | 1 | D&C |
| 57 | 2012 | Levy-Zaubermann\(^{57}\) | case report | 1 | 29 | 3 | 2 | 0 | D&C |
| 58 | 2013 | Chittawar\(^{58}\) | case report | 1 | 36 | 3 | 2 | 0 | D&C |
| 59 | 2013 | Sharma\(^{59}\) | case report | 1 | 25 | 2 | 1 | 1 | VD |
| 60 | 2014 | Woodhams\(^{60}\) | case series | 2 | 1 | 33 | 1 | D&C |
|   |   |   |   |   | 2 | 30 | 1 | 1 | 0 Chorioamniotitis |
| 61 | 2015 | Aslan\(^{61}\) | case report | 1 | 27 | 2 | 1 | 1 | D&C |
| 62 | 2015 | Vilos\(^{62}\) | case series | 5 | 1 | 19 | 1 | 0 | 1 D&C |
|   |   |   |   |   | 2 | 32 | 3 | 1 | 1 D&C |
|   |   |   |   |   | 3 | 30 | 1 | 0 | 1 D&C |
|   |   |   |   |   | 4 | 18 | 1 | 1 | 0 VD |
|   |   |   |   |   | 5 | 32 | 2 | 2 |   |
| 63 | 2015 | Tullius\(^{63}\) | case report | 1 | 37 |   |   | D&C |
| 64 | 2016 | Calzolari\(^{64}\) | retrospective | 11 | 1 | 18 | 1 | 0 | 1 D&C |
|   |   |   |   |   | 2 | 28 | 2 | 0 | 1 D&C |
|   |   |   |   |   | 3 | 37 | 2 | 1 | 1 D&C |
|   |   |   |   |   | 4 | 23 | 2 | 1 | 1 D&C |
|   |   |   |   |   | 5 | 44 | 2 | 1 | 1 D&C |
|   |   |   |   |   | 6 | 26 | 2 | 1 | 1 D&C |
|   | Year | Title | Type | Case Count |
|---|------|-------|------|------------|
|7 | 2017 | Bandura | case series | 14 |
|8 | 2017 | Lehrman | case report | 1 |
|9 | 2017 | Evans | case report | 1 |
|10 | 2017 | Ho | case report | 3 |
|11 | 2018 | Wee | case report | 1 |
|12 | 2018 | El agwany | case report | 1 |
|13 | 2018 | Bettaiah | case report | 1 |
|14 | 2018 | Schwartz | case report | 1 |
|15 | 2018 | Kaouther | case report | 1 |
|16 | 2019 | Guida | case report | 1 |
|17 | 2019 | Da joung | case report | 1 |
|18 | 2019 | Kim | case report | 1 |

|   | Year | Title | Type | Case Count |
|---|------|-------|------|------------|
|7 | 2017 | Bandura | case series | 14 |
|8 | 2017 | Lehrman | case report | 1 |
|9 | 2017 | Evans | case report | 1 |
|10 | 2017 | Ho | case report | 3 |
|11 | 2018 | Wee | case report | 1 |
|12 | 2018 | El agwany | case report | 1 |
|13 | 2018 | Bettaiah | case report | 1 |
|14 | 2018 | Schwartz | case report | 1 |
|15 | 2018 | Kaouther | case report | 1 |
|16 | 2019 | Guida | case report | 1 |
|17 | 2019 | Da joung | case report | 1 |
|18 | 2019 | Kim | case report | 1 |
### Table 1: Demographics.

| №  | Diagnostic Method       | Treatment | Successful | Complications | Follow Up | Conservative | Pregnancy | Outcome               |
|----|-------------------------|-----------|------------|---------------|-----------|--------------|-----------|-----------------------|
| 1  | Angiography             | UAE       | YES        | NO            | 22        | YES          | YES       | Elective CS at term   |
| 2  | US/Angiography          | UAE       | YES        | Rec (1m)      | 12        | YES          | NS        |                       |
| 3  | Angiography             | UAE       | YES        | Rec (1m)      | 12        | YES          | NS        |                       |
| 4  | Angiography             | UAE       | YES        | Rec (1m)      | 6         | YES          | YES       | VD at 35W             |
| 5  | US/Angiography          | UAE       | YES        | NO            | 6         | YES          | NS        |                       |
| 6  | US/Angiography/Hysteroscopy | UAE     | YES        | NO            | 10        | YES          | NS        |                       |
| 7  | Angiography             | UAE       | YES        | NO            | 6         | YES          | YES       | TVD                   |
| 8  | Angiography             | UAE       | YES        | NO            | 3         | YES          | YES       | NS                    |
| 9  | US/Angiography          | UAE       | PARTIAL    | Rec (12m), TV excision. | 12        | YES          |           |                       |
| 10 | US/Angiography          | UAE       | NO         | HYSTERECTOMY  | NS        | NO           |           |                       |
| 11 | US/Angiography          | UAE       | YES        | NO            | 12        | YES          | YES       | TVD                   |
| 12 | US/Angiography/MRI      | UAE       | YES        | NO            | 5         | YES          | NS        | TVD                   |
| 13 | US/MRI                  | UAE       | YES        | NO            |           | NS           | YES       | YES                   |
| 14 | US/Angiography/MRI      | UAE       | YES        | NO            | 8         | YES          | YES       | IVF/TWI pregnancy/TCS |
| 15 | US                      | UAE/danazol | PARTIAL    | NO            | 16        | YES          | NS        |                       |
| 16 | US/Angiography          | UAE       | YES        | NO            | 14        | YES          | NO        |                       |
| 17 | US                      | UAE       | YES        | NO            | NO        | YES          |           |                       |
| 18 | US/Angiography          | UAE       | YES        | NO            | 1W        | YES          | NS        |                       |
|   | Procedure                                      | Location | YES | NO | NS |   |   |
|---|------------------------------------------------|----------|-----|----|----|---|---|
|19 | US/Angiography                                | UAE      | YES | NO |    | 2 | YES|
|20 | US/Angiography                                | UAE      | YES | NO |    | NS| YES|
|21 | US/Angiography/Ligation of UA                 | Ligation of UA | YES | NO | 14 | YES| NO|
|22 | US/Angiography/MRI                            | UAE      | YES | NO |    |   |   |
|23 | US/Angiography/MRI                            | UAE      | YES | NO | 3  | YES| NO|
|24 | US/Angiography/MRI                            | UAE      | YES | NO |    | NS| YES|
|25 | US/Angiography                                | UAE      | YES | NO |    | NS| YES|
|26 | US/Angiography                                | UAE      | YES | NO |    | 6W| YES|
|27 | US/Angiography                                | UAE      | YES | NO | 24 | YES| TCD|
|28 | US/Angiography/Hysteroscopy/LP S             | Laparoscopic excision | YES | NO | 14 | YES| TCD|
|29 | US/Angiography/MRI                            | UAE      | NO  | Hystectomy | 12 | NO|   |
|30 | US/Angiography                                | UAE      | YES | NO |    | 4 | YES|
|31 | US/MRI                                        | UAE      | YES | NO |    | NS| YES|
|32 | US/Angiography/MRI                            | UAE      | YES | NO | 4  | YES| NO|
|33 | US/Angiography                                | UAE      | YES | NO | 12 | YES| NO|
|34 | US/Angiography                                | UAE      | YES | NO | 12 | YES| NO|
|35 | US/Angiography                                | UAE      | YES | NO | 20 | YES| TCD|
|36 | US/Angiography                                | UAE      | YES | NO | 8  | YES| NS|
|37 | US/Angiography                                | Ligation of UA | YES | NO | NS | YES| NS|
|38 | US/Angiography                                | UAE      | YES | NO |    | NS| YES|
|39 | US/Angiography                                | UAE      | YES | NO | 29 | YES| NO|
|40 | US/Angiography                                | UAE      | NO  | Hystectomy | 6  | NO|   |
|   | Procedure                  | Technique | YES | NO |   |   |   |
|---|----------------------------|-----------|-----|----|---|---|---|
| 41| US/Angiography             | suction/cur| YES | NO | 42| YES | NO |
| 42| US/Angiography             | UAE       | YES | NO | 24| yes | NO |
| 43| US/MRI                     | UAE       | YES | NO | 1 | YES | NO |
| 44| US/Angiography/MRI         | UAE       | YES | NO | NS| YES | NS |
| 45| US/Angiography/Hysteroscopy| UAE       | NO  | Hysterectomy | NS| NO |
| 46| US/Hysteroscopy            | UAE       | YES | NO | NS| YES | NS |
| 47| US/Angiography             | UAE       | YES | NO | 11| YES | YES | TVD |
| 48| US/Angiography             | UAE       | YES | NO | NS| YES | NS |
| 49| US/Angiography             | UAE       | NO  | Hysterectomy | NS| NO |
| 50| US/Angiography             | UAE       | YES | NO | 36| YES | YES | TCS |
|   | US/Angiography             | UAE       | YES | NO | 12| YES | NO |
| 51| CT scan                    | UAE       | YES | NO | NS| YES | NO |
| 52| US/MRI                     | UAE       | PARTIAL | Rec (1Y), Surg excision(2Y) | 36| YES | NS |
| 53| US/Angiography             | UAE/Progesterone | YES | NO | 30| YES |
|   | US/RM                      | UAE       | YES | MODERATE PEWIC PAIN | 12| YES | YES | NORMAL PREGNANCY |
| 54| US                         | Arterialigation | PARTIAL | NO | YES | NO |
|   | US                         | UAE       | YES | NO | YES | NO |
|   | US                         | UAE       | YES | NO | YES | YES | TVD |
|   | US                         | UAE       | YES | NO | YES | NO |
|   | US                         | UAE/Hysteroscopy | YES | NO | YES | YES | TVD |
|   | US                         | Observation | YES | NO | YES | YES | TVD |
|   | US                         | D&C       | YES | NO | YES | NO |
|   | US                         | UAE       | YES | NO | YES | NO |
|   | US                         | Observation/MTX | YES | NO | YES | YES | TVD |
|   | US | Hysteroscopy/Guided D&C | YES | NO | YES | NO |
|---|---|-------------------------|-----|----|-----|----|
| 55 | US | Hysteroscopy | YES | NO | YES | NS |
| 56 | US | UAE | PARTIAL | NO | NO | NS |
| 57 | Angiography | UAE | PARTIAL | LPS iliac artery occlusion | 1 | YES |
| 58 | Hysteroscopy/Angiography | UAE | YES | NO | YES | NS |
| 59 | US/Angiography | UAE | YES | NO | NO | NO |
| 60 | US/CT | UAE | YES | NO | 6 | YES |
| 61 | US/MRI | UAE | YES | NO | ns | NO |
| 62 | US | UAE | YES | NO | 12 | YES |
| 63 | US | UAE | PARTIAL | re-embolization | 24 | YES |
| 64 | US | UAE | PARTIAL | re-embolization | 14 | YES |
| 65 | US | UAE | PARTIAL | re-embolization | 36 | YES |
| 66 | US | UAE | PARTIAL | re-embolization | 9 | YES |

TVD, no complications
Cerclage, PPROM at 34w
pre-eclampsia, VD at 34w, recurrence of AVM
IUGR, VD at 36w
TVD, no complications
|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 63 | US | UAE | YES | NO | 3 | YES | NO |
| 64 | US | Hysteroscopy | YES | NO | 24 | YES | NO |
|   | US | Hysteroscopy | YES | NO | 6 | YES | NO |
|   | US | Hysteroscopy | YES | NO | 24 | YES | YES |
|   | US | Hysteroscopy | YES | NO | 22 | YES | YES |
|   | US | Hysteroscopy | YES | NO | 20 | YES | NO |
|   | US | Hysteroscopy | YES | NO | 26 | YES | NO |
|   | US | Hysteroscopy | YES | NO | 28 | YES | YES |
|   | US | Hysteroscopy | YES | NO | 30 | YES | NO |
|   | US | Hysteroscopy | YES | NO | 29 | YES | YES |
|   | US | Hysteroscopy | YES | NO | 4 | YES | YES |
|   | US | Hysteroscopy | YES | NO | 14 | YES | NO |
| 65 | US | Glue injection/Hysteroscopy | YES | NO | 55 | YES | YES |
|   | US | Glue injection/D&C | YES | NO | 55 | YES | YES |
|   | US | Glue injection/Hysteroscopy | YES | NO | 55 | YES | YES |
|   | US | Glue injection/Hysteroscopy | YES | NO | 55 | YES | YES |
|   | US | Glue injection/D&C | NO | Recurrence | 55 | YES | NO |
| US | Glue injection/Hysteroscopy | YES | NO | 55 | YES | YES | Miscarriage |
|----|----------------------------|-----|----|----|-----|-----|-------------|
| US | Glue injection/D&C         | NO  | Recurrence | 55 | YES | YES | Miscarriage |
| US | Glue injection/D&C         | YES | NO | 55 | YES | NO  |             |
| US | Glue injection/D&C         | YES | NO | 55 | YES | YES | Twin pregnancy, term CS |
| US | Glue injection/D&C         | YES | NO | 55 | YES | NO  |             |
| US | Glue injection/D&C         | YES | NO | 55 | YES | YES | TVD         |
| US | Glue injection/D&C         | YES | NO | 55 | YES | YES | TVD         |
| US | Glue injection/D&C         | NO  | Recurrence | 55 | YES | NO  |             |
| 66 | UAE | PARTIAL | Rec (2m)/transvag excision | 17 | YES | NO  |             |
| 67 | US/Angiography | UAE | YES | NO | 17 | YES | NO  |             |
| 68 | US/Angiography | UAE | YES | anovulatory cycles (3m) | 36 | YES (TWICE) | YES | (1st preg) TVD/(2nd preg) IUGR+P Haemorrhage |
Table 2: Diagnosis, management and obstetric outcomes.

| Case No. | Imaging Procedure | Location | Vascular Malformation | Recurrence (months) | Pregnancy Outcome | Complications |
|----------|-------------------|----------|-----------------------|---------------------|-------------------|---------------|
| 69       | US/Angiography    | UAE      | YES                   | NO                  | 2                 | NS            |
| 70       | US/MRI            | UAE      | YES                   | NO                  | 1                 | NS            |
| 71       | US/Hysteroscopy   | Lig. UA  | NO                    | 6                   | YES               | NS            |
| 72       | Hysteroscopy      | UAE      | NO                    | HYSTERECTOMY        | NO                | NS            |
| 73       | US/Angiography    | UAE      | YES                   | Re-embolization     | 8                 | YES           | NS            |
| 74       | US/CT             | UAE      | YES                   | NO                  | 5                 | YES           | normal pregnancy |
| 75       | US/Angiography    | UAE/D&C  | YES                   | NO                  | 2                 | YES           | CS at 37w     |
| 76       | US/MRI            | Hysteroscopy | YES                  | NO                  | 12                | YES           | NO            |
| 77       | US/MRI            | UAE      | YES                   | NO                  | 6                 | YES           | NS            |

4. Case Report

A 33-year-old woman (IG 0P) with no relevant clinical history was referred in February 2019 to our gynaecology department after a miscarriage at 21 weeks of gestation, treated by evacuation with aspiration and curettage. After persistent uterine bleeding she started therapy with acetate norethisterone and tranexamic acid. In April 2019 she was admitted to our department due to secondary anemia requiring blood transfusion. The level of haemoglobin concentration decreased from 12.7 gr/dL to 7.2 gr/dL. Transvaginal ultrasonographic evaluation (2D and 3D scan) showed an anteverted uterus of 82x41x57mm and a thickened endometrium of 16mm. The uterine cavity was occupied by a hypervascular region on the posterior uterine wall of 21x16 mm, colour score 4, with a PSV > 100 cm/s (Figure 2). The b-hcg value was negative. Ovaries and cervix were normal. Based on clinical and imaging findings, a uterine arteriovenous malformation (UAVM) was considered. After multidisciplinary agreement, the patient underwent a computed tomography angiography (CTA) that confirmed the presence of a mass located between the endometrium and the myometrium with contrast enhancement (intense captation during arterial
phase and early venous drainage) confirming the suspect of UAVM (Figure 3). The procedure was followed by a right uterine artery embolization with reabsorbable agent (Spongostan) (Figure 4) to decrease the ongoing vaginal bleeding and reduce the possible successive risk of intraoperative blood loss. Access through the right common femoral artery was performed, permitting the selective catheterization of hypogastric artery and of the right uterine artery. Spongostan was used to perform temporary UAE also in order to protect the ovary from permanent ischemic damage. There were no post-operative complications. After 24 hours from the UAE a second transvaginal ultrasound showed absence of hematic flow after the UAE. The uterine cavity was still enlarged by clots and the presence of hyperechoic lesion of mm13x14 (Figure 5). In the same day the patient underwent the hysteroscopic treatment. Hysteroscopy was performed with vaginoscopic approach, with a 5-mm diameter continuous-flow hysteroscope with oval profile, a 30° fore-oblique telescope and a 5 Fr operating channel (Office Continuous Flow Operative Hysteroscopy ‘size 5’; Karl Storz, Tuttlingen, Germany). Saline solution (NaCl 0.9%) was used as distension medium, which was provided through an electronic system of irrigation and aspiration (Endomat; Karl Storz, Tuttlingen, Germany). A stable intrauterine pressure of about 40 mmHg was obtained. The hysteroscopic view showed the uterine cavity filled with haemorrhagic material as well as parenchymatous material. The surgeon decided to undergo hysteroscopic resection using a bipolar 15 Fr resectoscope (bipolar 15Fr office resectoscope; Karl Storz, Tuttlingen, Germany). The procedure was safe and successful (Figure 6). No post-operative complications were reported and resulted in a complete absence of symptoms. One month after surgery a normal menstrual cycle was restored and the ultrasonography showed a restoration of right uterine artery flow (Figure 7).

Figure 2: Hypervascular lesion into the uterine cavity.
Figure 3: Computed tomography angiography (CTA).

Figure 4: Selective embolization of right uterine artery with Spongostan.

Figure 5: US view of hyperechoic lesion after temporary UAE.
5. Discussion

UAVM is a very rare condition but potentially life-threatening. This paper described a case of UAVM treated by temporary UAE plus hysteroscopy and provided a systematic review of current available literature on UAVM conservative surgical management. UAVMs often occur in women who previously underwent D&C, probably because the intrauterine trauma is involved in the pathogenesis of the disease [16]. This review confirmed this trend, as we found 74.4% patients with an acquired UMAV diagnosis after IVG or D&C for spontaneous miscarriage. Until not so long ago, the gold standard treatment was hysterectomy [17]. However, such a demolitive management is no longer acceptable, especially with stable hemodynamic conditions in young women. Among the conservative management, UAE was the most used but literature showed that UAE treatment alone is often not successful [18]. In fact, our series presented 19.5% failed UAE that required either further procedure. Among these patients, 6.9% had heavy recurrence of bleeding that lead to hysterectomy. Only 2 cases of combined surgical strategy were
reported in available literature (UAE plus D&C and UAE plus hysteroscopy) in cases of UAVMs [54,75].
To our knowledge, this case report is the first to describe a combined method with temporary UAE and hysteroscopy. In fact, in our case, the UAE was performed with Spongostan that has an absorption time of only 15 days. This permitted a safe hysteroscopic treatment avoiding in the same time the subsequent ischemic damage. The use of UAE with no resorbable agent reduce definitively the blood flow to the uterus. Despite the presence of collateral vessels the reduction of the flow could create problems in subsequent pregnancies [20]. Moreover, it is still reported an increased incidence of miscarriage and stillbirth in pregnancy after UAVM embolization [20], which could be explained by a reduction of the uterine flow. Using of resorbable agent for the UAE could avoid this consequence. In any case there have been several case studies of pregnancy after conservative management of UAVMs. In fact, our review shows 45 cases of pregnancies, most of them after UAE treatment. Although we performed a systematic review our paper suffers of the lack of RCTs. Most papers are case reports and this does not allow a methodological analysis of the results. After all, we share a rare UAVM management with a combined method (UAE plus hysteroscopy) and for the first time the UAE is performed with a resorbable agent. In the same fashion the systematic review is the first one that report data only about conservative surgery.

6. Conclusions
In conclusion, UAVMs are very rare life-threatening lesions. There is not a gold standard of treatment. Conservative surgery management should be proposed to young women with pregnancy desire in stable hemodynamical conditions. Using a resorbable agent to perform UAE permitted a normal restoration of the flow in the uterine artery after the hysteroscopic resection but it needs RCT to have solid results about surgical and fertility outcomes.

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Nothing to declare

Disclosure
Nothing to declare

Conflict of Interest
The authors declare that they have no conflict of interest.

Ethical Approval
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.

Informed Consent
Informed consent was obtained from all individual participants included in the study.

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