ORIGINAL REPORT

Selective embolization to treat obstetric hemorrhage☆

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KEYWORDS
Obstetric labor complications; Postpartum hemorrhage; Uterine artery embolization; Angiography; Fertility

Abstract
Objective: To describe cases of obstetric hemorrhage that have called for selective intraarterial embolization and the different embolization techniques used. To assess the clinical outcomes and postprocedural fertility.
Material and methods: We studied 27 women with obstetric hemorrhage. In 24 patients, embolization was performed by catheterizing both uterine arteries and in 2 patients only one uterine artery was catheterized (pseudoaneurysm). The materials used for embolization consisted of Spongostan in 17/27, particles in 9/27, and coils in 1/27. Clinical follow-up included an analysis of early and late complications and of postprocedural fertility.
Results: Hemorrhage was classified as primary (25/27) or secondary (2/27).
The cause of bleeding was vaginal delivery (20), cesarean sections (5), abortion (1), and cervical ectopic pregnancy (1).
The initial technical success rate was 100% and the clinical success rate was 92.6% (25 of the 27 patients).
Bleeding ceased and the outcome was satisfactory in 25 patients. During clinical follow-up ranging from one to seven years, 23 patients had normal menstruation and 6 patients completed 7 full-term pregnancies.
Conclusion: Intra-arterial embolization for obstetric hemorrhage leads to good outcomes and few complications and it preserves fertility.
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PALABRAS CLAVE
Complicaciones del trabajo del parto; Hemorragia posparto; Embolización arterial uterina; Arteriografía; Fertilidad

Embolización selectiva como tratamiento de la hemorragia obstétrica

Resumen
Objetivo: Describir los casos de hemorragias obstétricas que han precisado embolización selectiva intraarterial, referir las diferentes técnicas de embolización empleadas, valorar los resultados clínicos y la fertilidad posterior.

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Selective embolization to treat obstetric hemorrhage

Introduction

Management of Obstetric Hemorrhage (OH) is one of the most important challenges in today’s daily clinical practice since it is one of the most common causes of maternal mortality. Despite its incidence varying from one country to the other the World Health Organization (WHO) estimates that the overall annual maternal deaths are close to 24%.1

The loss of blood is considered excessive in a vaginal delivery if it is over 500 ml or beyond 1000 ml after cesarean delivery or when there is a fall in the concentration of hemoglobin in blood in the peri-delivery period over 4 g/dl.2

OH is usually sudden and associated with coagulopathies and this is why its early diagnosis and management are very important. Recently minimally invasive treatments like the ones that interventional radiology offers are also very important in the decision making process.3-5

The goal of this study is to describe the cases of OH needing selective intra-arterial embolization and the different embolization modalities used and the assessment of clinical outcomes and further fertility.

Materials and method

Patients

The data of 27 women of around 26 years of age–average 28 (range 18–33) were gathered retrospectively. They had suffered obstetric hemorrhage with hemodynamic compromise for the last 12 years. The indication of embolization came from the Ginecologic and Anesthesia Services. Both patients and families had been informed on the proceeding and signed the written informed consent. The approval by the hospital ethical committee was not necessary for this study.

Hemorrhages were considered primary when they occurred during the first 24 h after delivery and secondary when they occurred beyond 24 h after delivery.4

Proceedings

Embolizations were urgently carried out in a Philips Allura-Xper Vascular Radiology room (DA Best, The Netherlands) in the presence of an anesthesiologist. In 2 of the hospitals there was an emergency team trained in these modalities.

All patients underwent an arteriography with a conventional 5 F pigtail catheter in the lumbar aorta using a common uni- or bilateral femoral approach through a 5 F vascular inducer. The study showed the anatomy of pelvic arteries, any bleeding spots or bedsheet bleedings in cases of uterine atony.

Embolization proceeding in bedsheet bleeding without contrast extravasation

Due to the suspicion of uterine atony nurses prepared the Spongostan® Film 20 × 7 cm × 0.05 cm (Nycomed. Ferrosan, Medical devices A/S Soeborg, Denmark) by cutting the film in fragments of 1 mm of diameter and mixing them with serum and contrast (1:2). With the help of two 5 cc syringes and 1 key they were able to go from one syringe to the next until reaching a certain "seminole" consistency to appropriately occlude the vessels and avoid catheter obstruction.

Embolization occurred in both uterine arteries using a conventional Cobra2-type visceral catheter. First the contralateral internal iliac artery was selectively catheterized via arterial approach and then via uterine artery embolizing with the Spongostan® until occluding intrauterine vessels. Without changing the site of puncture and thanks to the wire placed in the internal iliac artery a conventional Simmons-type catheter was used pre-forming it so it could be introduced into the ipsilateral internal iliac artery through the site of puncture to be able to undergo the same embolization proceeding. The technical success was achieved when intrauterine branches were occluded with no need of control aortography.

Embolization proceeding in bleeding due to vascular damage

If the pelvic arteriography showed evidence of bleeding the artery was selectively catheterized using a Progreat® 2,5 F micro-catheter (Terumo Europe NV, Leuven Belgium) to advance as much as possible while embolization was performed with more permanent materials like coils (Hydrocoil® 18 Azur, Terumo Europe NV, Leuven Belgium) or embolizing particles like Contour® PVA (Boston Scientific Scimed, MN, USA), Bead Block® micro-spheres (Terumo

Material y métodos: Se estudiaron 27 mujeres con hemorragia obstétrica. La embolización se realizó cateterizando ambas arterias uterinas en 24 pacientes y solo una arteria uterina en 2 (pseudoaneurismas), en 17/27 se embolizó con Spongostán®, en 9/27 con partículas y un paciente con coils. Se realizó un seguimiento clínico de las pacientes analizando la aparición de complicaciones inmediatas y tardías, y la posterior fertilidad.

Resultados: Las hemorragias fueron primarias (25/27) y secundarias (2/27).

Las causas fueron: partos vaginales (20), cesáreas (5), aborto (1) y embarazo ectópico cervical (1).

El éxito técnico inicial fue del 100% y el éxito clínico del 92.6% (25/27) de las pacientes, El resultado fue satisfactorio en 25 pacientes cesando la hemorragia. Se realizó seguimiento clínico entre 1 y 7 años tras la embolización, en 23 pacientes se constataron menstruaciones normales y se produjeron 7 embarazos a término en 6 pacientes.

Conclusión: La embolización intraarterial en la hemorragia obstétrica ofrece buenos resultados, pocas complicaciones y preserva la fertilidad.

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Europe NV, Leuven Belgium) or Embocenz Microspheres® (Celanova Biosciences, Georgi, USA) of very different sizes depending on the bleeding vessel until its complete occlusion.

In patients having clotting disorders the arterial introducers were kept with a cleaning by physiological serum to be later removed after clotting was normal. After the proceeding all patients were referred to the ICU.

Analysis

Technical success was defined as the complete occlusion of the bleeding artery or arteries after embolization and clinical success was defined as the hemorrhage’s cease in such patient accompanied by her hemodynamical normalization.

The hemorrhage’s cease, the technical and clinical successes and the appearance of complications were all studied. The appearance of post-embolization syndrome–fever, pelvic pain and nausea was assessed as well.

The Ginecologic and Anesthesia Services did a study on fertility assessing the normality of menstruations, the desire to get pregnant, further pregnancies and delivered pregnancy.

Results

Among the 27 women of the study 25 patients suffered from primary or immediate hemorrhages and 2 from secondary hemorrhages. In 20 patients the hemorrhage was due to vaginal delivery (19 uterine atonies, 1 cervix tear), in 5 patients the hemorrhage occurred after cesarean delivery (2 arterial tears, 2 uterine atonies and 1 pseudo-aneurysm), in another patient it was due to pseudo-aneurysm following an abortion and in 1 patient the hemorrhage occurred after a hysterectomy due to hemorrhage after curettage of a cervical ectopic pregnancy 3 months after pregnancy. The most common cause was uterine atony and the team of gynecologists suspected it in 18 out of 20 cases.

In 25 patients they did a single puncture via right common femoral artery and in 2 patients they used bilateral approach and further catheterization of the contralateral uterine artery due to very critical states which required speed in the proceeding.

Embolization was done selectively catheterizing both uterine arteries in 25 patients (Fig. 1). In 2 cases with pseudo-aneurysm after surgical manipulation only the artery to be treated was catheterized. Seventeen patients were embolized with Spongostan®—all cases were of uterine atonies, 3 patients were embolized using 300–700 µm particles (type Contour® irregular), 3 patients were embolized using 500–700 µm particles Embozene®, 2 patients with BeadBlock Micro-spheres® and 1 patient using 4 mm-coils (Hydrocoil®).

Introducers were not removed after embolization in 11 patients, they were removed once the levels of hemostasis were normal.

Technical success was 100% and clinical success occurred in 92.6% of patients with hemorrhage’s cease after therapy. No post-embolization syndrome occurred. The 2 cases with re-bleeding required hysterectomy (one presented with a significant cervical tear after vaginal delivery and the other with a significant laceration of the left uterine artery (Fig. 2 and Table 1). The stay in the ICU after therapy was 2.4 days (range 1–7). One patient remained in the ICU for 7 days due to hospital pneumonia.

When it comes to fertility evolution could be confirmed in 26 patients (one patient was lost to follow-up). As we have said before 3 patients underwent hysterectomy proceedings. In the remaining 23 patients the normality of menstruations could be confirmed, 12 patients showed desire to get pregnant and there were 7 delivered pregnancies in 6 patients (between 1 and 7 years after embolization), with no issues in delivery or pregnancy. There were no cases of spontaneous miscarriages. One of the patients with a history of cesarean delivery presented with (2 months later) a uterovesical-vaginal fistula which required a total hysterectomy. A comparison between our results and the results of other authors can be seen in Table 2.

Debate

Selective intra-arterial embolization of uterine arteries is an effective alternative in the management of obstetric
Selective embolization to treat obstetric hemorrhage

**Figure 2** (A) Patient with hemorrhage after a cesarean delivery. In the pelvic arteriography the contrast extravasation (arrow) dependent upon a branch of the left artery could be seen. (B) The selective arteriography showed the severity of the lesion with visualization of the contrast jet (arrow) due to the laceration of the vessel.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Summary of cases treated.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong></td>
<td><strong>Proceeding</strong></td>
</tr>
<tr>
<td>21 Atonies</td>
<td>Embolization of both uterine arteries</td>
</tr>
<tr>
<td>2 Uterine Arteries Tears</td>
<td>Embolization of both uterine arteries</td>
</tr>
<tr>
<td>1 Cervical Tear</td>
<td>Embolization of uterine arteries + Embolization of cervical branches</td>
</tr>
<tr>
<td>2 Pseudo Aneurysms</td>
<td>Selective embolization</td>
</tr>
<tr>
<td>1 Cervical Ectopic Pregnancy</td>
<td>Embolization of branches a. Cervical</td>
</tr>
</tbody>
</table>

Obstetric hemorrhages can occur during pregnancy, delivery or post-delivery and are one of the most important causes of mortality in the world (24% of all maternal deaths according to WHO). The classification of primary and secondary hemorrhages is very interesting because most primary hemorrhages are unpredictable and due to uterine atony, traumas during delivery, retained placental tissues or inadequate placenta implantation. Secondary hemorrhages are usually associated with the retention of products of conception or infections. In our series the 2 cases of secondary hemorrhages were due to pseudo-aneurysms that occurred after previous surgical manipulation. The most common cause of obstetric hemorrhage is uterine atony and in our series it is the most common etiology as well. Initial treatment was uterotonic drugs, uterine massage, and when necessary curettage...

**Table 2** Studies of arterial embolization in obstetric hemorrhages.

<table>
<thead>
<tr>
<th>Author</th>
<th>Number</th>
<th>% clinical success</th>
<th>Major complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelage et al. (1998)</td>
<td>27</td>
<td>92.6</td>
<td>Not been reported</td>
</tr>
<tr>
<td>Deux et al. (2001)</td>
<td>25</td>
<td>88</td>
<td>Not been reported</td>
</tr>
<tr>
<td>Chung et al. (2003)</td>
<td>33</td>
<td>93.9</td>
<td>Not been reported</td>
</tr>
<tr>
<td>Bouilleret et al. (2004)</td>
<td>36</td>
<td>91.7</td>
<td>Not been reported</td>
</tr>
<tr>
<td>Touboul et al. (2008)</td>
<td>102</td>
<td>57.8</td>
<td>2 deaths lumbosacral plexus ischemia and gluteal pain (n = 2)</td>
</tr>
<tr>
<td>Massen et al. (2009)</td>
<td>43</td>
<td>63.8</td>
<td>1 Vesical-vaginal fistula</td>
</tr>
<tr>
<td>Actual study</td>
<td>27</td>
<td>63.8</td>
<td>1 Uterovesical-vaginal fistula</td>
</tr>
</tbody>
</table>
of the uterine cavity. When these proceedings failed treatment through interventional radiology was taken into consideration.

Even though most cases of arterial puncture are done through the unilateral right common femoral artery in 2 patients the bilateral puncture with contralateral catheterization was used due to significant hemodynamic compromise.

As other authors recommend,4,8,9 prior to embolization we consider indispensable to do a non-selective pelvic arteriography with a pigtail catheter that briefly us on the anatomy of uterine arteries, possible collaterals and possible vascular lacerations which would make us act selectively on such vessel.10 One important data is that in over 50% of cases of OH there is no contrast extravasation following the arteriography,5,10 however the fact of not seeing active bleedings does not counterindicate embolization since the bleeding can be intermittent, the artery can be spastic or there can be vasoconstriction due to the administration of vasoactive drugs.

Embolizing both uterine arteries is recommended since unilateral embolization poses a risk of re-patency of collateral branches with reappearance of hemorrhage.11

If we can spot the bleeding catheterization needs to be selective and embolization needs to be as distal as possible. In our group of patients we found 2 pseudoaneurysms which required supraselective embolization with good outcomes.4,12

Choosing the embolizing material is important in cases of uterine atony with a reabsorbible material such as Spongostan12 to preserve arterial perfusion and warrant future fertility leaving more durable embolizing materials like embolizing particles and coils for vascular lesions. We highlight the importance of the right preparation of Spongostan6; this is how we will prevent the occlusion of catheters so that the embolization can be uniform.12 Due to the initial urgency in our series 4 patients with uterine anoties were embolized with particles to save time during preparation. Today and prior to proceeding the nursing team prepares Spongostan6. In any case and as several authors have claimed we should avoid small sized-particles to avoid the risk of ischemic complications.4,13

When it comes to the rates of success in 92.6% of cases the hemorrhage could be stopped; a data consistent with that of other authors shows similar percentages.14–16

Even though the medical literature does not usually study fertility this is one of the most important advantages of this technique. In our series all women with uterine preservation returned to normal menstruation cycles and 6 women had normal deliveries which in turn coincides with what other authors claim,3,17 where patients resumed their menstrual cycles and had deliveries without further complications.

We think that some of the limitations of the study are the small number of patients, the retrospective design of the study, the lack of comparison with another group treated with other proceeding and the diversity of therapies used. We believe it is important to find a common ground when choosing the right embolizing material for each case.

In sum we believe that the selective intra-arterial embolization in cases of obstetric hemorrhages gives good results and few complications while preserving fertility.

Authorship

1. Manager of the integrity of the study: MDFP.
2. Original Idea of the Study: MDFP, CL.
3. Study Design: MDFP, CL, EE.
4. Data Mining: MDFP, CL, EE, JJC.
5. Data Analysis and Interpretation: MDFP, CL, EE, JJC.
7. Reference Search: MDFP, CL, EE.
8. Writing: MDFP, CL.
9. Critical review of the manuscript with intellectually significant notes: MDFP, CL, EE, JJC, MAE, SF.
10. Final Version Approval: MDFP, CL, EE, JJC, MAE, SF.

Conflicts of interests

Authors reported no conflicts of interests.

References

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