Transarterial Embolization: Alternative Treatment of Early and Late Postpartum Hemorrhage at a Single Tertiary Center

Satit Rojwatcharapibarn, M.D.*, Somrach Thamtorawat, M.D.*, Kritdipha Ningunha, M.D.*, Chandran Nadarajan, M.D., Ji Hoon Shin, M.D.*****

**Department of Radiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand, **Department of Radiology, School of Medical Sciences, Health Campus, University Sains Malaysia, Kelantan, Malaysia, ***Department of Radiology and Research Institute of Radiology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea.*

ABSTRACT

Objective: To evaluate the efficacy of uterine artery embolization (UAE) in the treatment of postpartum hemorrhage (PPH).

Methods: All women who underwent UAE for the treatment of PPH between August 2008 and February 2016 were included. The patients were divided into early and late PPH defined by the onset of bleeding. All UAE procedures were performed by experienced interventional radiologists. Electronic medical records and radiological images were reviewed for data collection. Statistically significant associations between angiographic findings and the onset of PPH were evaluated.

Results: Total twenty-one women were enrolled in the study. The mean age of the patients was 30.1 years (range 16-42 years).Total 23 UAE procedures were performed in 21 women. Major clinical presentation was vaginal bleeding in 19 patients (90.5%) and hypovolemic shock was found in 10 patients (47.6%). Eight patients (38.1%) were in early PPH group and thirteen patients (61.9%) were in late PPH group. Five women underwent hysterectomy before UAE. Active contrast extravasation was a common finding associated with early PPH (50%) while pseudoaneurysms were commonly found in late PPH (53.8%) (p=0.016). The overall technical and clinical success rate were 100%. However, two women required repeated UAE after gelatin sponge embolization for active extravasation due to re-bleeding. No immediate complication of UAE was found in our study.

Conclusion: UAE is a safe and effective treatment for both early and late PPH. Various embolic materials can be used but permanent embolic material is preferable in patient with extravasation.

Keywords: Postpartum hemorrhage; embolization; pseudoaneurysm (Siriraj Med J 2018;70: 198-203)

INTRODUCTION

Postpartum hemorrhage (PPH) is an important obstetric complication that causes maternal morbidity and mortality. PPH is defined as bleeding from the genital tract exceeding 500 ml for vaginal delivery or greater than 1000 ml for cesarean section, which can occur within the first 24 hours following delivery (early PPH) or after 24 hours (late PPH).[1-3] The common causes of PPH include uterine atony, retained placenta, coagulopathy, genital tract injury, and endometritis.

The treatments of PPH comprise of supportive and definitive management which includes giving intravenous fluid and blood components, uterine compression, uterotonic agent administration, and finally, hysterectomy in patients not responding to conservative treatment.[4-7] Transarterial embolization for treatment of PPH began to play a role in the current scenario due to it being a less invasive procedure with high success rate and significantly low complication rate.[2,8-10]

The purpose of this study was to analyze and report the efficacy of uterine arterial embolization (UAE) in the treatment of PPH at a single tertiary-care hospital.

Correspondence to: Somrach Thamtorawat
E-mail: somrach.tha@mahidol.edu
Received 9 April 2018 Revised 26 April 2018 Accepted 1 May 2018
doi:10.14456/smj.2018.33

MATERIALS AND METHODS

Patient Selection

This retrospective study was conducted with the approval of the institutional review board of our institution with waiver of patient's informed consent (Si 344/2016). All women who underwent UAE for the treatment of PPH from August 2008 until February 2016 were included in this study.

A total of 21 women underwent UAE for the treatment of PPH in our institution during the study period. The patient characteristics were shown in Table 1. The mean age of the patients was 30.1 years (range 16-42 years); twelve patients were primiparous, and nine patients were multiparous. Three patients had unassisted vaginal deliveries, one patient had instrumented vaginal delivery, and 17 patients underwent cesarean section.

UAE Techniques

All of these patients were referred to the interventional radiology unit for UAE after all of the usual obstetric treatments of PPH were exhausted without gaining expected outcome. The usual obstetric treatments in our center depend on the cause of PPH, and it includes intravenous uterotonic agent injection, aggressive uterine massage, manual extraction of the retained placenta, and repair of genital lacerations.

The UAE for the treatment of PPH was performed in an interventional radiology unit. UAE was routinely performed in our center through a 5-Fr vascular sheath (Terumo, Somerset, NJ) placed via the right common femoral artery access site. A 5-Fr diagnostic catheter (Cobra C2, Terumo, Somerset, NJ) with a 0.035 guidewire (Terumo, Somerset, NJ) were used to catheterize the internal iliac artery, and then, angiography was performed. Superselection into uterine arteries was done by using a 2.7-Fr Progreat microcatheter (Terumo, Somerset, NJ), and angiography was performed. After satisfactory microcatheter position was confirmed within the required branch of the uterine artery via angiography, transarterial embolization was performed. Various kinds of embolic materials were used according to vascular pathology, angiographic findings, position of microcatheter and patient condition. The endpoint of embolization was the absence of a contrast extravasation or pseudoaneurysm in case of the angiographic findings positive of those vascular pathology. In the case of hyperemia of uterus without vascular pathology, stasis of flow in the uterine artery was the endpoint in post embolization angiography. Embolization technique in case of prior hysterectomy and uterine ligation was same as those who had not undergone hysterectomy.

Data analysis and statistics

PPH was categorized into two groups according to the onset of hemorrhage, early PPH was defined as hemorrhage within the first 24 hours after delivery. Late PPH was defined as hemorrhage occurring after 24 hours of delivery.

TABLE 1. Patient demographics and characteristics

Characteristics	N (%)
Age, mean ± SD (range)	30.1 ± 7.6 (16-42)
Hematocrit level, mean ± SD (range)	27.1 ± 8.4 (9-38)
Parity	
Primiparous	12 (57.1)
Multiparous	9 (42.9)
Mode of delivery	
Cesarean section	17 (81.0)
Vaginal delivery	4 (19.0)
Onset of PPH	
Early	8 (38.1)
Late	13 (61.9)
Clinical presentation	
Bleeding per vagina	19 (90.5)
Intraabdominal bleeding	2 (9.5)
Hypovolemic shock	10 (47.6)

Abbreviation: PPH = postpartum hemorrhage

For each patient, the hospital medical records and radiological images were reviewed. Demographic data collection included the indication for the procedure, patient's age, parity, obstetric history, mode of delivery, the timing of PPH in relation to time of the delivery, pre-procedural hematocrit level, and type of transfusion requirement before UAE. Specific UAE procedural data collection included the type of embolic material used, pre- and post-embolization angiographic findings, and associated procedural complications.

Technical success was defined as successful catheterization of pathologic arteries with embolization to stasis of a specific vascular lesion (i.e., extravasation, pseudoaneurysm or hyperemia).

Clinical success was defined as an improvement of the patient's condition and obviation of repeated UAE or surgical management post-UAE.

Using Fisher exact tests, statistically significant associations between subject characteristics (early vs late PPH) and angiographic findings were evaluated. Statistical analysis was performed with SPSS statistical package version 18.0. A *p*-value of lower than 0.05 was taken as statistically significant finding.

RESULTS

In total 23 UAE procedures were performed in 21 women. Major clinical presentation was vaginal bleeding in 19 patients (90.5%) and hypovolemic shock was found in 10 patients (47.6%). Eight patients (38.1%) underwent UAE for early PPH. Among these patients, uterine atony was diagnosed in 5 patients (62.5%). Four patients experienced disseminated intravascular coagulation, and one patient was affected by HELLP syndrome. Five patients in this group underwent subtotal hysterectomy before UAE as the first line management of PPH from uterine atony and placenta accreta.

The mean hematocrit level measured immediately before embolization was 27.1±8.4% (range 9-38%) regardless of whether they had been transfused or not. Sixteen women were transfused with packed red blood cells, ten with fresh frozen plasma, and six with platelet transfusions prior to the procedure.

Association between angiographic findings and onset of PPH was shown in Table 2. Four patients (50%) with early PPH had active contrast extravasation on pre-embolization angiography. Hyperemia and pseudoaneurysm were found in three (37.5%) and one (12.5%) patients, respectively (Figs 1, 2).

TABLE 2. Association between angiographic findings and onset of PPH

Onset of PPH	Angiographic findings, N (%)			
	Extravasation	Pseudoaneurysm only	Hyperemia only	P-value
Early	4 (50.0)	1 (12.5)	3 (37.5)	0.016
Late	0 (0.0)	7 (53.8)	6 (46.2)	

Abbreviation: PPH = postpartum hemorrhage

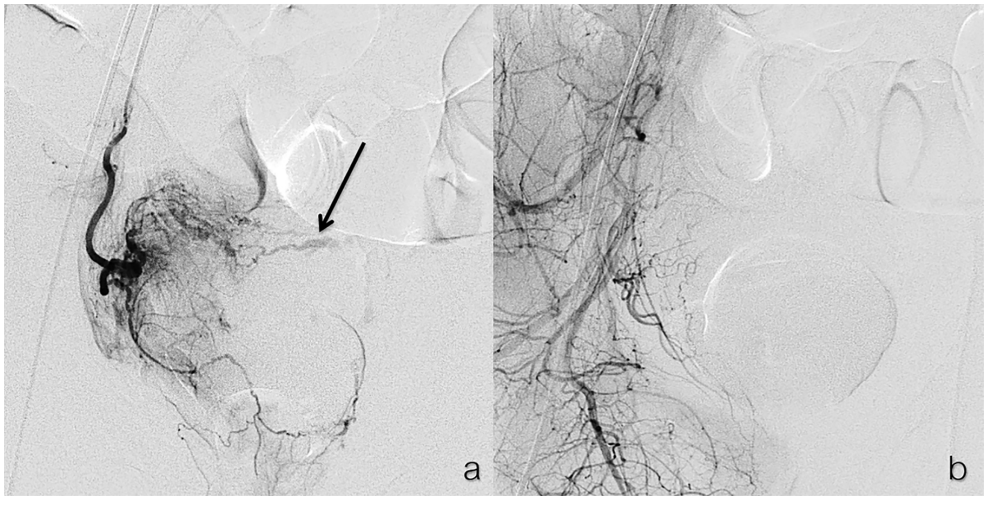


Fig 1. A 28-year-old woman with early PPH after cesarean section. (a) Selective angiography of the right uterine artery demonstrates active contrast extravasation (arrow). (b) Post-embolization angiogram after selective PVA embolization of the right uterine artery shows stasis of blood flow and no visualization of the active contrast extravasation.

Abbreviations: PPH = postpartum hemorrhage, PVA = polyvinyl alcohol

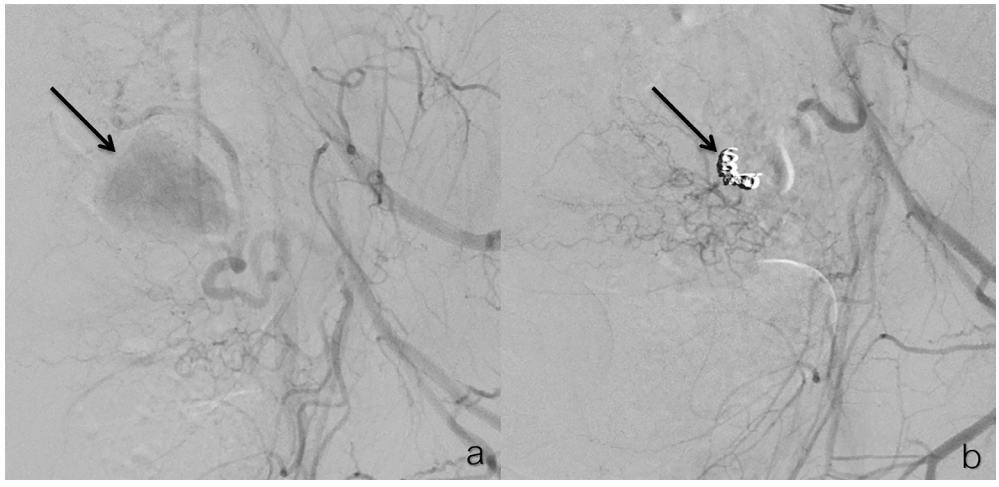


Fig 2. A 24-year-old woman with late PPH after cesarean section. (a) Selective pre-embolization angiography of the left uterine artery demonstrates a large pseudoaneurysm (arrow). (b) Post embolization angiogram after selective coil embolization (arrow) of the left uterine artery shows the non-visualization of the pseudoaneurysm.

Abbreviation: PPH = postpartum hemorrhage

Technical success and clinical success rate of UAE in PPH were 100% and 90.5%, respectively. There were two patients who needed a repeated embolization within 24 hours due to recurrent per vaginal bleeding after the first embolization. Both of them underwent hysterectomy before UAE. One of the patients had a vaginal delivery while another one had a cesarean section. Both patients had active contrast extravasation on the pre-embolization angiography of the first UAE session. They were embolized using gelatin sponge until disappearance of contrast extravasation was noted. However, the repeated angiography showed recurrent contrast extravasation at the previously embolized site in both patients. Coil and NBCA embolizations were done during the repeated embolizations (Fig 3). In the other two patients with active contrast extravasation, polyvinyl alcohol (PVA) and NBCA were used for embolization.

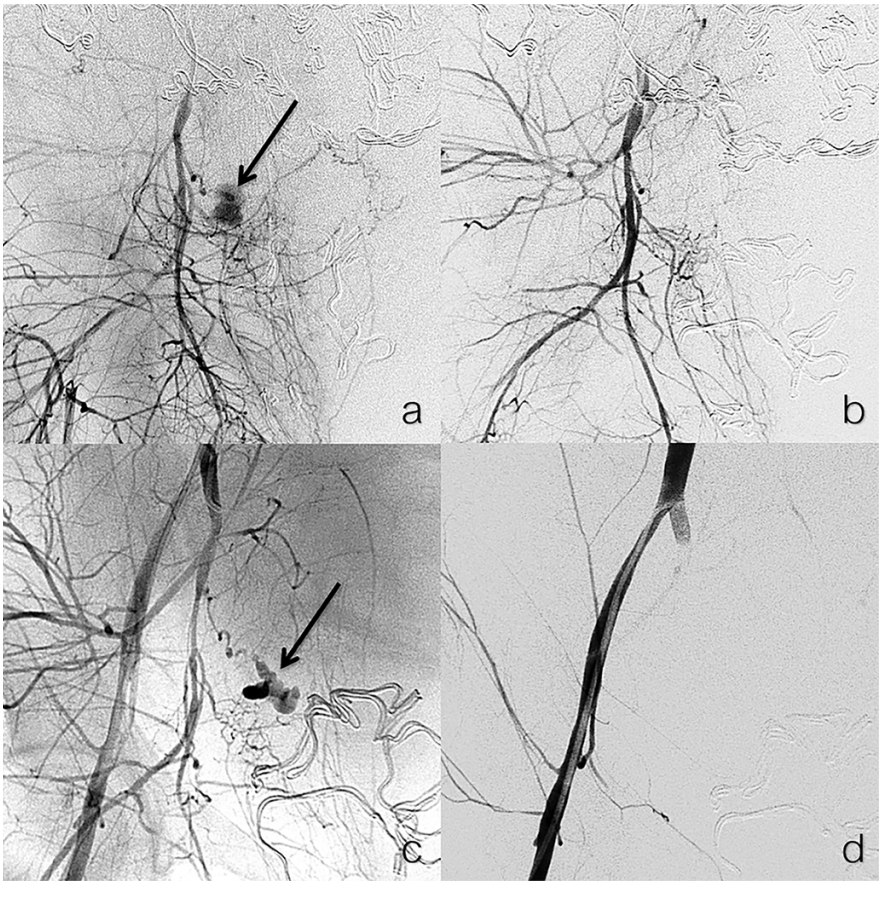


Fig 3. A 30-year-old patient with early PPH after normal vaginal delivery. (a) The initial pre-embolization angiography of right uterine artery demonstrates active contrast extravasation (arrow). (b) Post-embolization angiography after gelatin sponge embolization of the right uterine artery shows stasis of blood flow and no visualization of the active contrast extravasation. However, the patient developed recurrent per vaginal hemorrhage after embolization. (c) Selective right uterine angiography during the second UAE session shows recurrent active contrast extravasation (arrow) at the same location. The right uterine artery was re-embolized with NBCA. (d) Post-embolization angiography shows the disappearance of active contrast extravasation and lack of visualization of the terminal branches.

Abbreviations: PPH = postpartum hemorrhage, UAE = uterine artery embolization, NBCA = N-butyl cyanoacrylate

Thirteen patients (61.9%) underwent UAE for late PPH. One of the patients underwent uterine curettage before embolization for the removal of retained pieces of placenta. The most common angiographic finding in late PPH was pseudoaneurysm which was successfully embolized by the embolic material as shown in Table 3. No contrast extravasation was found in patients with late PPH at pre-embolization angiography. In all patients with angiographic findings of hyperemia only, non-selective embolization was done using gelatin sponge in the bilateral uterine arteries (Fig 4).

TABLE 3. Angiographic findings and types of embolic agent used

Angiographic findings	Embolic agents			
	Gelatin sponge	PVA	Coil	NBCA
Extravasation	2	1	1	2
Pseudoaneurysm	3	0	1	4
Hyperemia	9	0	0	0

Abbreviations: PVA = polyvinyl alcohol, NBCA = N-butyl cyanoacrylate

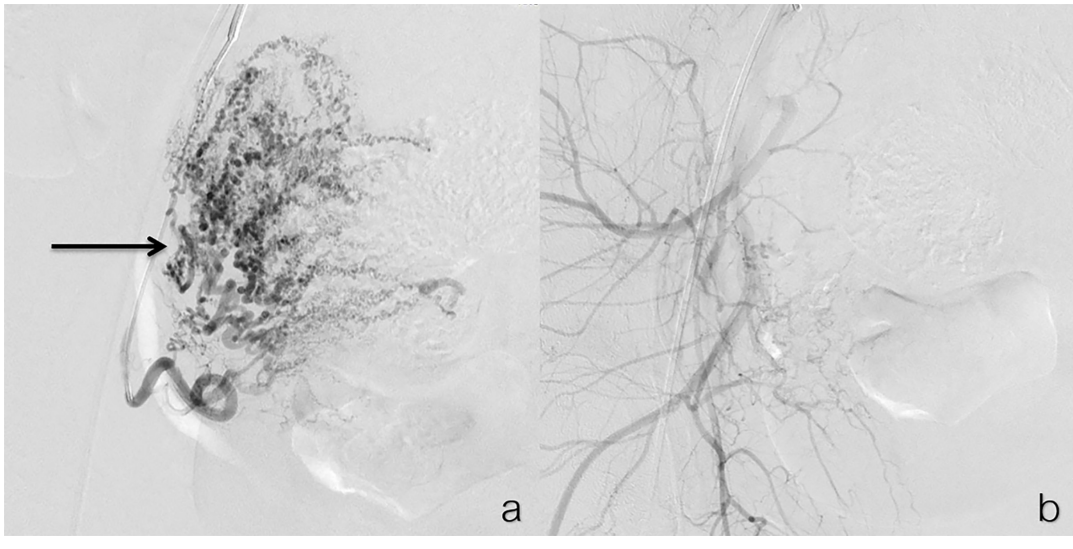


Fig 4. A 25-year-old woman developed endometritis with late PPH after cesarean section. (a) Selective pre-embolization right uterine angiography demonstrates hyperemia of the hypertrophied right uterine artery and its terminal branches (arrow) supplying the recently gravid uterus. No active contrast extravasation is identified. (b) Post embolization angiogram after selective gelatin sponge embolization of the right uterine artery shows stasis of blood flow and lack of visualization of the terminal branches.

Abbreviation: PPH = postpartum hemorrhage

DISCUSSION

PPH is a threatening cause of maternal morbidity and mortality. In most cases, obstetricians are able to prevent PPH with active management by using uterine massage and uterotonic therapy. When PPH occurs, multispecialty approaches are needed, including aggressive fluid resuscitation, massive blood transfusion, and application of uterine-sparing devices such as balloon tamponade, compression sutures, and arterial ligation.[5] If PPH cannot be controlled by these methods, hysterectomy remains as the definitive treatment for the patients.

However, the emergence of transarterial embolization as a treatment option in this group of patients helps in alleviating symptoms and reducing the number of hysterectomies. Brown et al[11] reported the first successful endovascular treatment for intractable PPH in 1979. Several more case reports followed with similarly encouraging results.[9] They helped to push endovascular treatment to the front line of management of PPH which failed conservative therapy.

In our study, the most common cause of early PPH requiring UAE is uterine atony (62.5%), which is same as reported in the previous studies.[12,13] Early PPH is a common presenting symptom of uterine atony. In most cases, uterine atony can be controlled with pharmacological interventions without the need for surgical interventions.

For late PPH, the common vascular pathology for UAE is pseudoaneurysm (53.8%). Although the other causes of late PPH such as endometritis and retained pieces of the placenta are more common than pseudoaneurysm in general populations, these conditions can be treated and bleeding controlled with pharmacological treatments and obstetric interventions. The presence of active contrast extravasation was associated with early PPH: meanwhile, the presence of a uterine artery pseudoaneurysm was associated with late PPH (p-value of 0.016). According to the natural history, active extravasation often presents with acute onset of bleeding and pseudoaneurysm usually presents with intermittent bleeding episodes.

In our study, we found that UAE was an effective treatment for control of intractable bleeding in both early and late PPH. The clinical success rates in this study were 90.5%, corresponding to previously published data which is between 73% and 100%.[12, 13] In clinical failure cases, two patients had a repeated UAE due to rebleeding in the case of extravasation, which were successfully treated by repeated embolization using permanent embolic materials. Park et al[14] reported the clinical failure after gelatin sponge embolization in a case of active extravasation. The literature review also showed that patients with active extravasation visualized angiographically were more likely to require repeated embolization ($P < 0.01$).[15] It is because gelatin sponge is a nonpermanent material which can spontaneously resolve over time leading to recanalization of the injured vessel. Therefore, gelatin sponge should not be recommended in cases of active extravasation or patients with coagulopathy.

According to the previously published data, the commonly encountered immediate UAE complications include arterial dissection, allergic reaction to the contrast medium used, hematoma at the puncture site, and pain.[10,16] Fortunately, there was no immediate complication in our study.

This study does have some limitations. Firstly, the study population was small, resulting in some findings which are statistically not significant. Secondly, we did not collect the long-term data of the patients including long-term complications and effects on fertility. We would suggest future studies in this field to include bigger sample populations and include a long-term follow up of these patients.

In conclusion, our results show that UAE should be the preferred treatment for intractable PPH when other conservative treatments have failed.

REFERENCES

1. Kim TH, Lee HH, Kim JM, Ryu AL, Chung SH, Seok Lee W. Uterine artery embolization for primary postpartum hemorrhage. Iran J Reprod Med. 2013;11(6):511-8.
2. Winograd RH. Uterine artery embolization for postpartum hemorrhage. Best Pract Res Clin Obstet Gynaecol. 2008;22(6): 1119-32.
3. Pelage JP, Soyer P, Repiquet D, Herbreteau D, Le Dref O, Houdart E, et al. Secondary postpartum hemorrhage: treatment with selective arterial embolization. Radiology. 1999;212(2):385-9.
4. Tuncalp O, Souza JP, Gulmezoglu M, World Health O. New WHO recommendations on prevention and treatment of postpartum hemorrhage. Int J Gynaecol Obstet. 2013;123(3):254-6.
5. Doumouchtsis SK, Papageorghiou AT, Arulkumaran S. Systematic review of conservative management of postpartum hemorrhage: what to do when medical treatment fails. Obstet Gynecol Surv. 2007;62(8):540-7.
6. Combs CA, Murphy EL, Laros RK, Jr. Factors associated with hemorrhage in cesarean deliveries. Obstet Gynecol. 1991;77(1):77-82.
7. Combs CA, Murphy EL, Laros RK, Jr. Factors associated with postpartum hemorrhage with vaginal birth. Obstet Gynecol. 1991;77(1):69-76.
8. Soncini E, Pelicelli A, Larini P, Marcato C, Monaco D, Grignaffini A. Uterine artery embolization in the treatment and prevention of postpartum hemorrhage. Int J Gynaecol Obstet. 2007;96(3):181-5.
9. Pais SO, Glickman M, Schwartz P, Pingoud E, Berkowitz R. Embolization of pelvic arteries for control of postpartum hemorrhage. Obstet Gynecol. 1980;55(6):754-8.
10. Vedantham S, Goodwin SC, McLucas B, Mohr G. Uterine artery embolization: an underused method of controlling pelvic hemorrhage. Am J Obstet Gynecol. 1997;176(4):938-48.
11. Brown BJ, Heaston DK, Poulson AM, Gabert HA, Mineau DE, Miller FJ, Jr. Uncontrollable postpartum bleeding: a new approach to hemostasis through angiographic arterial embolization. Obstet Gynecol. 1979;54(3):361-5.
12. Pelage JP, Limot O. [Current indications for uterine artery embolization to treat postpartum hemorrhage]. Gynecol Obstet Fertil. 2008;36(7-8):714-20.
13. Chauleur C, Fanget C, Tourne G, Levy R, Larchez C, Seffert P. Serious primary post-partum hemorrhage, arterial embolization and future fertility: a retrospective study of 46 cases. Hum Reprod. 2008;23(7):1553-9.
14. Park KJ, Shin JH, Yoon HK, Gwon DI, Ko GY, Sung KB. Postpartum hemorrhage from extravasation or pseudoaneurysm: efficacy of transcatheter arterial embolization using N-butyl cyanoacrylate and comparison with gelatin sponge particle. J Vasc Interv Radiol. 2015;26(2):154-61.
15. Kirby JM, Kachura JR, Rajan DK, Sniderman KW, Simons ME, Windrim RC, et al. Arterial embolization for primary postpartum hemorrhage. J Vasc Interv Radiol. 2009;20(8):1036-45.
16. Boulleret C, Chahid T, Gallot D, Mofid R, Tran Hai D, Ravel A, et al. Hypogastric arterial selective and superselective embolization for severe postpartum hemorrhage: a retrospective review of 36 cases. Cardiovasc Intervent Radiol. 2004;27(4):344-8.