

Arterial Embolization for Prophylaxis and Treatment in Severe Obstetric and Gynecologic Hemorrhage

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ABSTRACT

Objective: To evaluate the efficacy and safety of arterial embolization for prophylaxis and treatment in severe obstetric and gynecologic hemorrhage.

Methods: A retrospective study was conducted among 17 patients who undergone arterial embolization for prophylaxis and treatment in severe obstetric and gynecologic hemorrhage between 2008 and 2013 at Siriraj Hospital. Efficacy of embolization, embolization procedure details, clinical outcomes and complications were collected and analyzed.

Results: The obstetric causes were abnormal placentation (n=6, 35.2%), postpartum hemorrhage (n=5, 29.4%), and intractable bleeding from gynecologic cause (n=6, 35.2%). The median age of the patients in prophylaxis for severe obstetric hemorrhage group, postpartum hemorrhage group and in the gynecologic group were 35 (range, 32-37 years), 31 (range 25-38 years), and 45 (range 28-61 years), respectively. Out of 17 patients, a total of 21 embolization procedures were performed. The technical success rate was 95.6%. Superselection into ovarian artery for embolization of arteriovenous shunting was unsuccessful in one patient. The clinical success rate was 82.6%. Second embolization was done in one patient. Major complication occurred in 3 patients which were microembolism of first dorsal metatarsal artery, pseudoaneurysm at the puncture site and lumbosacral plexopathy.

Conclusion: Arterial embolization has an important role in management of obstetric and gynecologic hemorrhage which is safe, effective and has a low rate of complications.

Keywords: Arterial embolization; obstetric hemorrhage; gynecologic hemorrhage

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INTRODUCTION

Percutaneous transcatheter arterial embolization has been widely described for treatment of pelvic hemorrhage related to trauma, obstetric emergencies, postoperative bleeding,

and gynecologic malignancies. The role of this technique has evolved over the last 3 decades.¹⁻³

Most obstetric and gynecologic vascular conditions can be managed using surgical techniques and medical management. However, in certain situations, percutaneous transcatheter arterial embolization can play a complimentary role.

In the present study, we evaluated the indications, efficacy, and complications associated with transarterial embolization for prophylaxis and treatment in obstetric and gynecologic hemorrhage.

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MATERIALS AND METHODS

After an institutional ethical board approval, 17 patients who undergone arterial embolization for prophylaxis and treatment in obstetric and gynecologic hemorrhage between 2008 and 2013 were included.

Medical records were reviewed to assess the following data: age, parity, delivery mode, gestational age, cause of the hemorrhage, indication for embolization, hematology parameters, and the volumes of transfused packed red blood cells. The collected data included the site of embolization, material used for embolization, angiographic findings and any postembolization complication. All the data were descriptively analyzed.

Technical success was defined as cessation of bleeding on angiography and/or angiographically successful embolization of the uterine or internal iliac branch or division. Clinical success was defined as cessation of bleeding without the need for repeat embolization within 7 days.

Complications are categorized using the definitions of the Society of Interventional Radiology (SIR) Classification system for complications by outcome.⁴

Patients

In six patients, placentation abnormality was diagnosed by Color Doppler ultrasonography and magnetic resonance imaging. This group was categorized 'prophylactic group'. Five patients underwent arterial embolization in an emergency setting from postpartum hemorrhage, which was categorized into 'postpartum hemorrhage group'. 'Gynecologic group' refers to the group of 6 patients who presented with intractable bleeding from gynecologic cause.

Embolization technique in prophylactic group

The day of the cesarean section, the patients' underwent arterial catheterization in an operating room. The technique involved bilateral femoral arterial punctures and insertion of a 5-F vascular sheath. Over a 0.035-inch super-smooth guide wire (Terumo), a 5-F cobra catheter (Cobra, Terumo) was used to select and place at the contralateral anterior division of internal iliac or uterine artery

under C-arm fluoroscopic guidance. The catheters were fixed. Then, cesarean section was done. After the baby was delivered, the entire placenta was left in place. Bilateral uterine artery or anterior division of internal iliac artery embolization was done with absorbable gelatin sponge (Gelfoam). Embolization was continued until stagnation of the flow in the treated arteries. Then hysterectomy was performed, during which the catheters were still left in the bilateral anterior division of internal iliac artery or uterine artery for repeat embolization if any further active bleeding occurred.

Embolization technique in postpartum hemorrhage group and gynecologic group

After the femoral artery catheterization, aortic bifurcation angiogram was done by using a 5-Fr pigtail catheter (Pigtail, Terumo). Embolization was done at the uterine artery or anterior division of internal iliac artery if angiographic findings shown dilatation, tortuous vessels, hypervascularity, or hyperemia. If there was an extravasation of the contrast media, arteriovenous shunting or pseudoaneurysm, selective catheterization into the vessel as close as possibly to the bleeding point or abnormal site was performed by using microcatheter system (Progreat, Terumo). Embolic material was selected by type, size and site of the lesion. A post embolization angiographic study was done in all cases to ensure the complete occlusion of vessels.

RESULTS

Between 2008 and 2013, a total of 17 patients underwent arterial embolization. The indications of arterial embolization were prophylaxis for severe obstetric hemorrhage (n=6), postpartum hemorrhage (n=5) and emergency intractable bleeding from gynecologic cause (n=6). The median age of the patients in prophylaxis for severe obstetric hemorrhage group, postpartum hemorrhage group and in gynecologic group were 35 (range, 32-37 years), 31 (range 25-38 years), and 45 (range 28-61 years), respectively. Out of 17 patients, a total of 23 embolization procedures were performed. Overall, the technical success rate was 95.6% and the clinical success was 82.6%.

In six patients (Table 1), placenta previa with placenta increta or placenta percreta were diagnosed in the second or third trimester. All of the patients had history of multiparity. All pregnancies were singleton. The average gravidity was 4 and the average parity was 2.3. In this group, elective cesarean section with hysterectomy and arterial embolization during the surgery were planned. The primary goal of bilateral uterine or anterior division of internal iliac artery embolization was to control and decrease blood loss during hysterectomy. Cesarean section, and hysterectomy with prophylactic catheterization and embolization

were successfully performed in all patients. The placenta and uterus were completely removed. Two patients (case 1.2 and 1.6 (Fig 1)), who had placenta percreta with urinary bladder invasion, required urinary bladder repair, had more blood loss, and needed more blood transfusion with longer duration of operation time. A major complication resulting from arterial embolization was microemboli which occurred in one patient (case 1.3). Three hours after bilateral anterior division of internal iliac artery embolization, the patient felt pain at her left first toe, at which microembolism was suspected. The bleeding was spontaneous

TABLE 1. Clinical characteristics and embolization data of the prophylactic obstetric group.

Case No.	Age	Parity	GA	Obstetric history	Indication	Embolized artery	Blood loss (ml)	Blood transfusion (ml)	Duration of surgery (minutes)	Bladder repair	Length of stay	Complication
1.1	37	G4P3	32	Previous C/S	Placenta previa with placenta increta	Bilateral Uterine artery	2500	2U(769)	180	No	10	No
1.2	27	G4P1 A2	37	Previous C/S	Placenta previa with placenta percreta	Bilateral Uterine artery	7500	8U(2102)	330	yes	8	No
1.3	39	G4P3	35	Previous C/S CA breast S/P Chemotherapy +mastectomy	Placenta previa totalis with placenta percreta	Bilateral Internal iliac artery	2000	3U(647) 7U (2661)**	180	No	26	Yes*
1.4	25	G3P2	37	Previous C/S	Placenta previa with placenta percreta	Bilateral Uterine artery	3500	5U(1161)	210	No	7	No
1.5	40	G5P3	34	Previous C/S	Placenta previa with placenta percreta	Bilateral Uterine artery	3000	3U(726)	180	No	6	No
1.6	31	G4P2	37	Previous C/S	Placenta previa with placenta percreta	Bilateral Uterine artery	7700	10U(2394)	390	yes	10	No

*About 3 hours after bilateral anterior division of internal iliac artery embolization, the patient felt pain at left first toe. The left first toe turn pink colour to purple. Microembolism of first dorsal metatarsal artery was suspected. **Total blood transfusion of the patient after clinical of intraabdominal bleeding.

Abbreviations: C/S= cesarean section; U= units

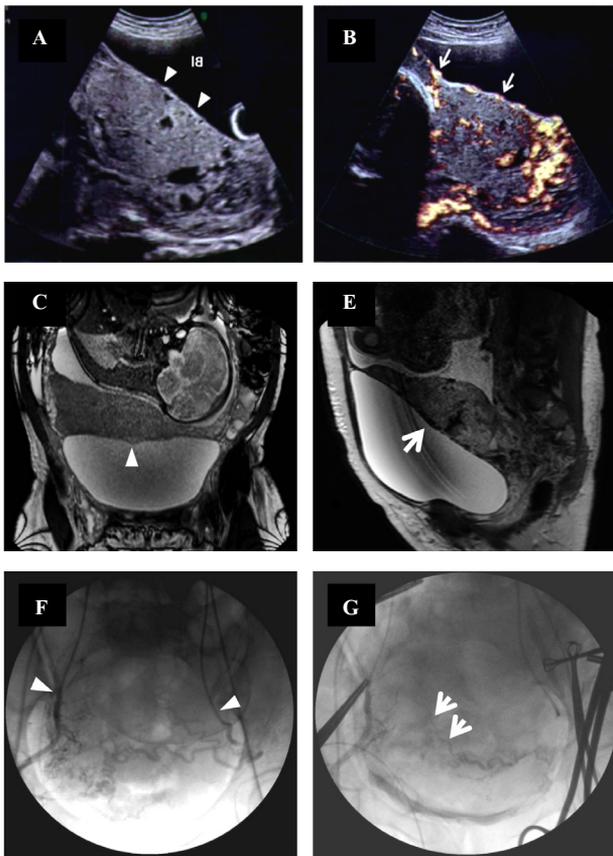


Fig 1. A 31-year-old woman with placenta percreta. (A,B) Transabdominal Color Doppler ultrasound at 36 weeks' gestation showed placenta covered internal os completely, no hypoechoic space between placenta (arrow head) and urinary bladder wall and multiple vascular flow after doppler turn on (arrow), suggested placenta previa with percreta invaded urinary bladder (BI). (C) Preoperative MR imaging at 37 weeks' gestation, coronal T2W image revealed complete absence of myometrial layer with interruption of serosal layer of placenta at bladder dome (arrow head). (D) Sagittal T2W image depicted vascular flow void area attach to urinary bladder (arrow). These findings confirmed that placenta percreta invaded urinary bladder. (E,F) Angiogram from C-arm fluoroscopy showed Cobra catheters placed in anterior division of bilateral internal iliac artery (arrow head) with dilated tortuous vessel supply the placenta. (F) Post embolization showed contrast staining at placental bed (arrow) and diminished blood flow.

stopped with conservative treatment by heparin reversal and blood component transfusion.

In postpartum hemorrhage group (Table 2), the patients presented with early postpartum hemorrhage (n=3) and late postpartum hemorrhage (n=2). Two patients presented with active

vaginal bleeding. Three patients presented with hypovolumic shock, which resulted from uterine atony, HELLP syndrome and retroperitoneal hematoma. Angiographic findings were dilated, tortuous uterine artery with hyperemia (n=3) and pseudoaneurysm (n=2, Fig 2). The selected embolic materials were absorbable gelatin sponge (n=4), NBCA (n-butylcyanoacrylate) glue (n=2), and coils (n=1). One patient (case 2.5, Fig 3) had therapeutic abortion, because of the underlying medical disease of mitral valve stenosis for which mitral valve repair was done for overdose of warfarin during undesired pregnancy. She developed hypovolemic shock from retroperitoneal hematoma after the termination of pregnancy. Bilateral internal iliac artery embolization using absorbable gelatin sponge was performed. After arterial embolization, her hematocrit still dropped. CT scan was performed after first embolization which revealed slightly increased size of the large retroperitoneal hematoma and a 1.1 cm pseudoaneurysm at right common femoral artery. Repeated bilateral internal iliac artery embolization was done successfully and coils embolization of a right common iliac artery pseudoaneurysm were successfully performed.

In intractable hemorrhage related to gynecologic cause (Table 3), five patients had advanced stage of cervical cancer. Another patient had an intraabdominal hematoma after myomectomy and re-explored for hysterectomy. In cervical cancer group, three patients had previous history of chemotherapy or radiotherapy treatment. Two patients (case 3.1 and 3.2) underwent second arterial embolization, with the prolongation of first session at 1 month and 7 months, respectively. A total of 9 sessions of arterial embolization were performed in this group. The angiographic findings were dilated, tortuous uterine artery with tumor brush in 5 sessions, extravasation in 2 sessions, pseudoaneurysm in 1 session, and a small arteriovenous fistula in 1 session. Gelfoam was used in 5 sessions and combined Gelfoam and coils was used in 1 session. Polyvinyl alcohol (150-250 μm and 300-500 μm) and NBCA (n-butyl-2-cyanoacrylate) glue were used in 1 session. Bilateral uterine or anterior division of internal iliac artery embolization was performed

TABLE 2. Clinical characteristics and embolization data of the postpartum hemorrhage group.

No.	Age	Parity/ GA	Indication	Delivery method	Presenting symptom	Coagulo- pathy or thrombocy- topenia	Blood transfusion (PRC/Unit)	Angiographic findings	Embolized vessel/Material	Complication
2.1	25	P3	Late post partum hemorrhage	C/S(1 mo)	Vaginal Bleed	No	3U	Pseudo aneurysm at Lt UA	1Rt UA/Gelfoam 2Lt arterial feeder/Coil 3Lt UA/50%Glue	No
2.2	31	G2P1 A1	Late postpartum hemorrhage	C/S(2 mo)	Vaginal Bleed	No	1U	Dilate tortuous Rt UA	Bilateral IIA/ Gelfoam	No
2.3	38	G2P1 GA37	Post partum hemorrhage	C/S+ Hysterecto- my	Massive hemorrhage from uterine atony with shock	Yes	17U	Hyperemia bilateral UA	Bilateral UA/ Gelfoam	No
2.4	28	G1P0G A38	Postpartum hemorrhage	V/E	Shock with HELLP	Yes	9U	Pseudo aneurysm at vaginal branch of Lt UA	Arterial feeder/50% Glue	No
2.5	34	G4P2 A1 GA20	Postpartum hemorrhage	Therapeutic Abortion	MS S/P MVR on Warfarin, Warfarin overdose, shock, retroperitoneal hemorrhage	No	1U	Hyper- vascularity of bilateral UA	Bilateral IIA/Gelfoam	Pseudoaneurysm at Rt CFA

Abbreviations: GA, gestational age; PRC, pack red cell; C/S, cesarian section; V/E, vacuum extraction; Lt, left; Rt, right; UA, uterine artery; MS, mitral valve stenosis; MVR, mitral valve repair; CFA, common femoral artery; U, units; IIA, internal iliac arteries; HELLP, hemolysis, elevated liver enzyme, low platelets

in 7 sessions. Angiographic findings of one patient (case 3.3, Fig 4) who had an intraabdominal hematoma after myomectomy and re-explored hysterectomy was suspected of small arteriovenous fistula at her left ovarian artery.

DISCUSSION

In our series, the indications for arterial embolization consist of prophylaxis of severe obstetric hemorrhage in placenta accreta, postpartum hemorrhage, and intractable bleeding from gynecologic cause. Our experience of uterine fibroid

embolization has been discussed by Prabhasavat and colleagues.⁵ Therefore, the uterine fibroid embolization has not been included in the study. Prophylaxis severe obstetric hemorrhage in *placenta accreta*

The primary goal of bilateral uterine or anterior division of internal iliac artery embolization is to control and decrease blood loss during hysterectomy. Traditionally, the treatment of placenta accreta and placenta percreta has involved cesarean hysterectomy with intraoperative bilateral hypogastric or uterine artery ligation.² This technique is effective only for bleeding due to

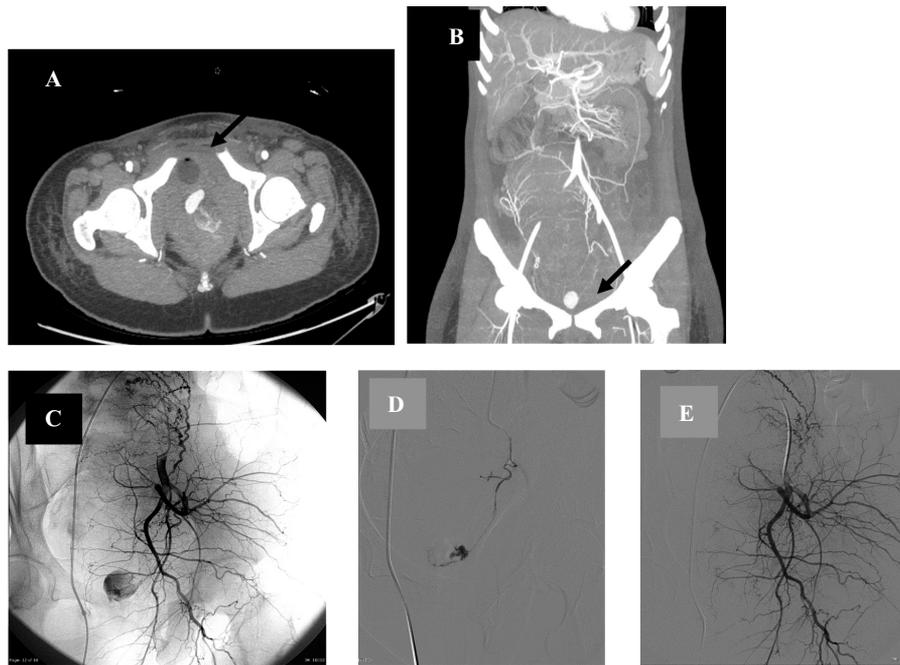


Fig 2. A 28-year-old woman with postpartum hemorrhage; (A,B) Axial and MIP coronal CT images depicted a pseudoaneurysm (arrow) at left side of pelvic cavity supplied by branch of left internal iliac artery. (C) Left internal iliac angiography revealed a contrast-filled outpouching lesion fed by vaginal branch of left uterine artery, compatible with a pseudoaneurysm. Superselective catheterization into the vaginal branch using a coaxial microcatheter was done. (D) Embolization was performed using 50% concentration of NBCA glue, prepared by mixing of 1 ml of NBCA glue and 1 ml of Lipiodol. (E) Postembolization angiogram demonstrated complete obliteration of the pseudoaneurysm and feeding vessel. Glue cast in vaginal branch of left uterine artery was shown.

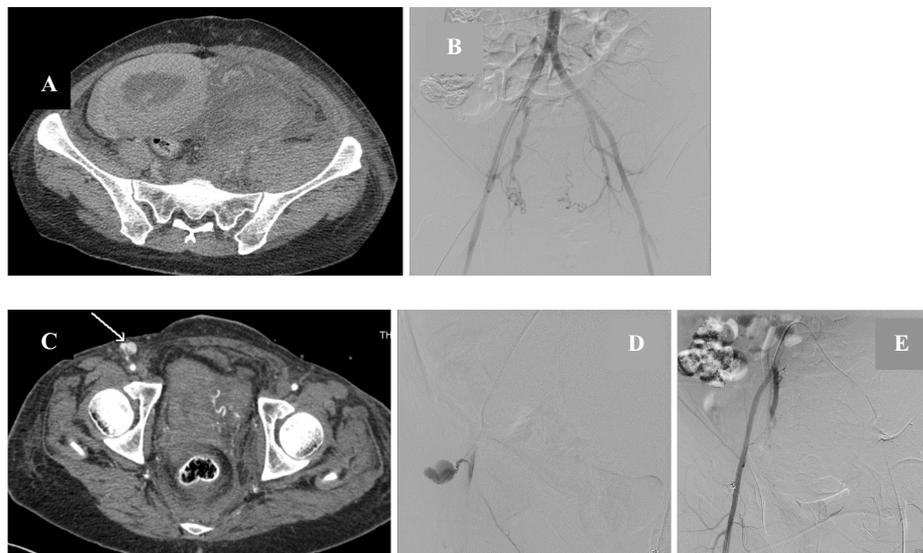


Fig 3. A 34-year-old woman with postpartum hemorrhage, with underlying of mitral valve stenosis S/P mitral valve repair and treated with warfarin during undesired pregnancy and postpartum hemorrhage occurred after pregnancy termination. (A) Axial CT image revealed retroperitoneal hematoma at left side of pelvic cavity. (B) Bilateral internal iliac artery angiography and embolization using absorbable gelatin sponge were performed. (C) CT scan after first embolization revealed a 1.1 cm pseudoaneurysm at right common femoral artery. Repeat bilateral internal iliac arteries embolization was done successfully. (D) Superselective catheterization into the aneurysmal neck followed by coils embolization of the right common iliac artery pseudoaneurysm was performed using 5 pieces of 2mmx5 mm and 1 piece of 4mmx4mm fiber platinum coils (Boston Scientific Co.). (E) Postembolization angiogram demonstrated complete obliteration of the pseudoaneurysm.

TABLE 3. Clinical characteristics and embolization data of gynecologic group.

Case	Age	Cause	Previous treatment	Co-morbidity	Coagulopathy or thrombocytopenia	Blood transfusion (units)	Angiographic findings	Embolized vessel / Material	Clinical success	Complication
3.1	49	CA CX IVB (lung and liver metastases)	Palliative CMT	No	No	4U	Dilated tortuous bilateral UA and hypervascularity	Bilateral UA/Gelfoam	Yes	No
3.1.1*			No	No	13U	Dilated and tortuous	Bilateral UA/Gelfoam	Yes Bilateral UA	No	
3.2	50	CA CX IIIB	ICRT+ ERT+ CMT	No	No	3U	Two pseudoaneurysm from branch of Rt UA	Bilateral UA/Gelfoam	yes	No
3.2.1***				No	No	2U	Extravasation from branch of anterior Rt IIA	1.Branch of anterior Rt IIA/ Gelfoam and coil 2.Rt internal pudendal artery/ Gelfoam 3.Lt UA/Gelfoam	yes	No
3.3	34	Intra-abdominal hematoma with shock	No	Multiple intramural myoma S/P myomectomy+ re-explore hysterectomy	No	4U	Small AVF at Lt ovarian artery	No	No (Fail super selection, spontaneous stop)	No
3.4	61	CACX IIIB	ICRT	No	No	1U	Hyperemia	Anterior bilateral IIA /Gelfoam	Yes	No
3.5	39	CACX IIIB	CMT+RT	AIDS Gut obstruction	No	5U	Extravasation Rt UA	Rt UA, anterior Rt IIA /PVA 150-250, 300-500+Glue20-25%	Yes	Lumbosacral plexopathy
3.6	39	CACX IVA	No	No	No	3U	Dilated bilateral UA	Bilateral UA/ Gelfoam	Yes	No

*The second embolization was performed after the first time for 1 month.

Repeat embolization was performed after the first embolization for 2 days. Post embolization revealed faint vascularity suspected collateral flow from left ovarian artery. *The second embolization was performed after the first time for 7 months.

Abbreviations: CA CX, cervical cancer FIGO staging; Lt, left; Rt, right; UA, uterine artery; IIA, internal iliac arteries; AVF, arteriovenous fistula; DIC, disseminated intravascular coagulopathy; DVT, deep vein thrombosis; ICRT, intracavitary radiotherapy; ERT, external radiotherapy; CMT, chemotherapy; RT, radiotherapy; AIDS, acquired immunodeficiency syndrome

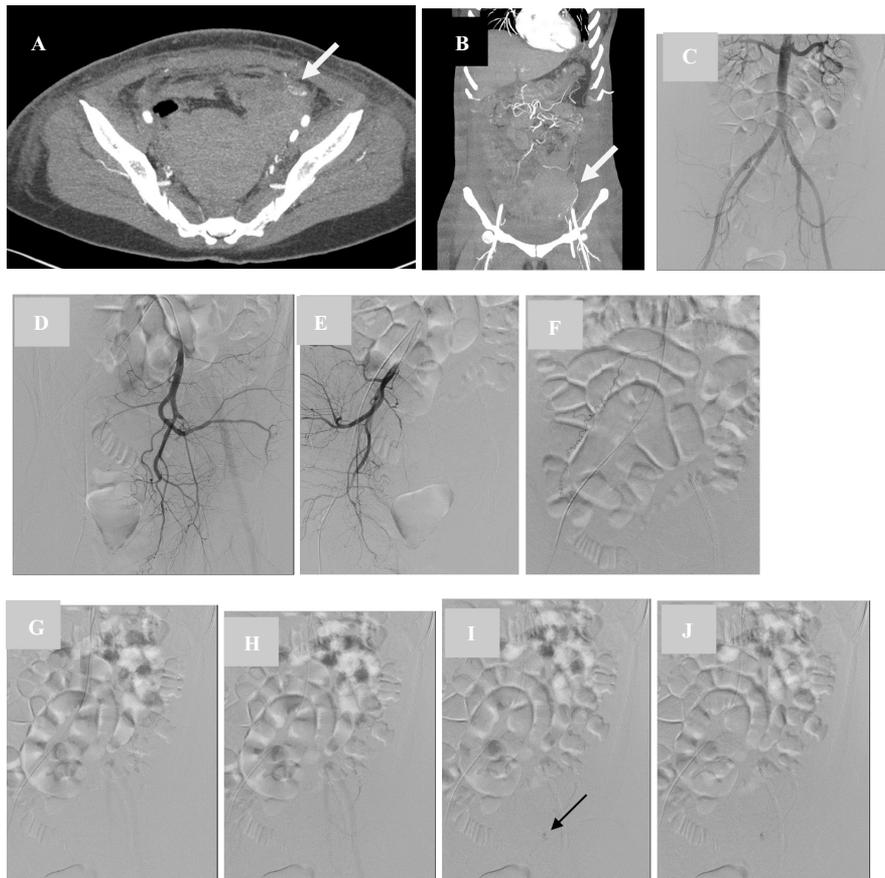


Fig 4. A 34-year-old woman with intraabdominal hematoma, S/P myomectomy and re-explore hysterectomy, developed hypovolumic shock. **(A,B)** Axial and coronal MIP CT images showed a large intraabdominal hematoma with abnormal contrast opacification at left side of pelvic cavity (arrow). **(C)** Aortogram revealed obliteration of bilateral uterine arteries due to previous hysterectomy. **(D,E)** Selection into bilateral internal iliac artery was performed and angiogram showed no detectable abnormality. **(F)** A right ovarian artery was selected using a 4-Fr Simmon catheter. **(G,H,I,J)** Left ovarian angiography revealed a small out pouching lesion (arrow) with relative early contrast-filled in left ovarian vein, suspected of a small arteriovenous fistula. Superselection into left ovarian artery for embolization of arteriovenous shunt was unsuccessful due to small sized vessel. Spontaneous cessation of bleeding was occurred after conservative treatment.

uterine atony, not for placenta accrete in which the bleeding occurs from the extensive collateral system. In previous studies,^{2,6,7} the prophylactic selective arterial embolization in the patients with placenta accrete or percreta resulted in lowering intraoperative blood loss in which the estimated blood loss of the patients with placenta accreta or percreta who underwent arterial embolization was about 1,500-4,000 ml. Tan and colleagues⁷ also reported the efficacy of perioperative embolization using the occlusion balloons technique in reducing intraoperative blood loss and transfusion requirements. In our study, the estimated blood loss was 2,000-7,700 ml. In cases related with urinary bladder invasion which required bladder repair, the estimated blood loss was more than

7,000 ml. Other advantages of the arterial embolization techniques over surgical intervention are that the catheter can be inserted more distal and at a specific location, leading to prevent bleeding via collateral vessels, clear visualized collateral vessels and other sources of bleeding, which can immediately determine the procedural success.⁸ We accessed via the bilateral femoral artery and used absorbable gelatin sponge as an embolic material. The absorbable gelatin sponge is more cost effective, more available, and provides only temporary occlusion with no evidence of prolonged ischemia to pelvic organ and can be performed with smaller size of vascular sheath as compared to occlusion by balloon technique.

Postpartum hemorrhage

Postpartum hemorrhage is the most common cause of maternal morbidity and mortality. Bleeding of 500 ml more following a vaginal delivery, 1,000 ml or more following cesarean section, need of blood transfusion, or hematocrit drop 10% or more during postpartum period are the definition of postpartum hemorrhage. Uterine atony is the most common causes in early postpartum hemorrhage which occurs within the first 24 hours after delivery.^{9,10} The other causes include retained products of conception, coagulopathy, vaginal or uterine laceration, placenta abruption, and uterine arteriovenous malformation.¹¹ Delayed postpartum hemorrhage is defined as bleeding after 24 hours, but within 6 weeks after delivery and usually occurs because of retained products of conception.¹ Other causes are endometrial inflammation or infection, uterine arteriovenous malformation or pseudoaneurysm. The treatment for postpartum hemorrhage includes conservative measures, administration of uterotonic medications, laceration repair, uterine packing, and correction of underlying coagulopathies.¹ Arterial embolization has emerged as a treatment option. The angiographic technique was first described in 1979 by Brown and colleagues.¹² Nowadays, this embolization technique has remained unchanged from the initial report. There are numerous reported cases of successful transcatheter arterial embolization in controlling postpartum bleeding with the success rate of 94.9%-97%.^{10,13} The advantages of arterial embolization over surgery include easy identification of the bleeding site with subsequent targeted embolization, preservation of the uterus and fertility, decreased risk of bleeding from collateral circulation, and allowance of repeat embolization.¹⁴ Arterial embolization technique, with subselective embolization of the uterine artery or vaginal artery is performed. An absorbable gelatin sponge is the agent of choice because it causes a temporary arterial occlusion with recanalization of blood flow within weeks. If the exact source of bleeding cannot be identified, empiric embolization of the anterior division of the internal iliac artery is done using absorbable gelatin sponge slurry or pledgets. Bilateral embolization should be performed because bleeding can

continue through transpelvic collateral vascular supply. In some literatures, other embolic materials have been selected in some certain situations. There are several reported successful treatments for postpartum hemorrhage using coils embolization.^{3,10,15} Pelage and colleagues⁹ reported successful arterial embolization of a false aneurysm of the uterine artery using n-butyl-2-cyanoacrylate.

Intractable bleeding from gynecologic causes

The earliest gynecologic application of arterial embolization was in treatment for intractable pelvic hemorrhage related to pelvic malignancies. Pisco and colleagues¹⁶ reported 69% complete and 21% partial control of bleeding in 108 patients with pelvic neoplasm who underwent arterial embolization. Yamashita and colleagues¹⁰ reported 100% temporary control of bleeding in 17 patients with malignant neoplasms. However, reembolization was required in 3 patients. These patients had undergone subsequent treatment for underlying neoplasm with radiation, surgery, or chemotherapy. Mihmanli and colleagues¹⁷ reported successful cessation of intractable vaginal bleeding by arterial embolization using polyvinyl alcohol particles in patients with gynecologic malignancies. In our study, two patients with advanced stage of cervical cancer required second arterial embolization despite subsequent treatment. Bilateral embolization is also recommended to control bleeding because of transpelvic collateral vascular supply. Based on the previous reports, the arterial embolization plays an important role in urgent control of significant bleeding in the setting of pelvic neoplasm.

The overall complication rate of arterial embolization for obstetric and gynecologic hemorrhage has been reported about 6-9%. This includes transient post procedural fever, transient foot ischemia, transient buttock ischemia, paravaginal abscess, groin hematoma, pelvic abscess, abdominal wall abscess, external iliac perforation, and bladder gangrene.^{2,3,13} Complications from migration of embolic material to the general blood circulation are rare. Thus, it is very important to be careful in catheterization to reduce the risk of the ischemic complications. Pseudoaneurysms or arteriovenous fistulas, which occurred as local

complications after femoral arterial catheterization, has been reported with the incidence of 0.02%-9%.^{18,19} Therapeutic options have evolved from traditional surgical option toward minimally invasive technique including ultrasound-guided compression, ultrasound-guided percutaneous thrombin injection, and endovascular management by embolization or stent-graft placement.²⁰ We report a case of iatrogenic pseudoaneurysm at right common femoral artery with successful coil embolization.

For the radiation exposure and reproductive function after arterial embolization to control obstetric and gynecologic hemorrhage, it is estimated that a radiation dose of 20 Gy can cause irreversible damage to the ovary and infertility.²¹ In uterine artery embolization, the absorbed ovarian dose was reported at 4.90 to 65.8 cGy.⁷ For fetal radiation dose, radiation-related risks throughout pregnancy vary according to the gestational age. For a given radiation dose, the risk to the fetus is most significant during the first trimester, less in the second trimester, and least in the third trimester. Several well-recognized published documents provide guidance regarding the radiologic imaging of pregnant woman. The fetal dose is considered negligible at less than 50 mGy. With regard to doses of more than 50 mGy, the increase over background incidence for organ malformation and the development of childhood cancer combined is only about 1%.²² Bilateral catheterization of internal iliac arteries can be performed easily in a gravid uterus within 30 minutes time and less than 5-8 minutes of fluoroscopic time.²³ The fetal radiation dose with prophylactic uterine artery catheterization in the studies by Bodner et al.,²⁴ and Levine et al.,²⁵ were 3.2 and 6.1 rads, respectively. However, although the risks are small, it is important to ensure that radiation doses are kept as low as reasonably achievable. In the literature, normal menses resumed after arterial embolization without hysterectomy in almost all patients. Several studies have demonstrated that woman can have normal pregnancies after arterial embolization.^{3,7,15,24,26,27}

The limitation of the study was the study design which was a retrospective review. Some important clinical details might have been missed and

there was no long-term follow-up data. However, the study showed that the procedure in these emergencies and life threatening conditions were done with a high success rate and can save the patient's life. As a referral center these techniques can be trained and more appropriate skill will be obtained in the future.

CONCLUSION

Our experience confirms the usefulness of arterial embolization for a variety of life threatening conditions associated with obstetric and gynecologic hemorrhage. Selective arterial catheterization and embolization are safe and effective to control severe bleeding.

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