

Outcome of Transient Hypogastric Artery Balloon Occlusion with Cesarean Hysterectomy in Abnormal Adherent Placenta: Case Series

Keerati Hongsakul, M.D.¹, Jitwadee Suwanlee, M.D.¹, Sorracha Rookkapan, M.D.¹, Kittipitch Bannangkoon, M.D.¹, Ninlapa Pruksanusak, M.D.², Yuthasak Suphasynth, M.D.², Shafie Abdullah, M.D.³, Chandran Nadarajan, M.D.³

¹Department of Radiology, ²Department of Obstetrics and Gynecology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

³Department of Radiology, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, Kelantan 16150, Malaysia.

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Abstract:

Objective: To evaluate the outcome of pregnant women with abnormal placentation who underwent transient hypogastric artery balloon occlusion with cesarean hysterectomy.

Material and Methods: Descriptive retrospective study of patients with abnormal adherent placenta who underwent transient hypogastric artery balloon occlusion with cesarean hysterectomy between January 2014 and December 2016. Data were recorded and analyzed.

Results: Fourteen pregnant women with abnormal placentation were included in our series. Most patients underwent cesarean hysterectomy at less than 37 weeks of gestational age. The sonograms of 7 cases overestimated the severity of placenta adherence compared with the pathological diagnosis. The median estimated blood loss was 4,350 milliliters (mL). The median estimated blood loss in placenta accrete, increta and percreta were 3,000 mL, 5,337 mL and 5,150 mL, respectively. One case had a procedure-related complication: perforation of the small branch of the anterior division of the right hypogastric artery from the guidewire.

Conclusion: Intraoperative transient balloon occlusion of the hypogastric arteries was an effective method and safe treatment for controlling the massive intraoperative bleeding of cesarean hysterectomy. This technique can be an alternative option in combination with surgery in cases of abnormal placental adherence.

Keywords: adherent placenta, cesarean hysterectomy, hypogastric artery, transient balloon occlusion

Contact: Asst. Prof. Keerati Hongsakul, M.D.
Department of Radiology, Faculty of Medicine, Prince of Songkla University,
Hat Yai, Songkhla 90110, Thailand.
E-mail: keeratihongsakul@yahoo.com

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Introduction

Morbidly adherent placenta is a general term that includes placenta accreta, increta and percreta. Placenta accreta refers to a condition in which the placental villi invades the superficial myometrium; placenta increta refers to the invasion of the myometrium by the placental villi; and, placenta percreta, the most severe form, refers to the villi tissue penetrating the full thickness of the myometrium and invading the uterine serosa or adjacent organs.¹ Incidence of adherent placenta increases directly in correlation with a history of previous cesarean section.² In these cases, the anatomy is frequently distorted, tissues are more friable, neovascularization is present, tissue planes are less defined, and massive hemorrhages are more likely. These factors worsen progressively with deeper placental invasion. The maternal mortality rate has been reported to be 7.0%.³

Nowadays, the rate of previous cesarean section continues to rise; thus, the incidence of abnormal adherent placenta has also increased.⁴ Treatment of adherent placenta is a hysterectomy. Several surgical techniques have been performed to minimize blood loss in these patients. Ligation of the internal iliac artery is one of the techniques used to control bleeding. However, the success rate to control bleeding is less than 50.0% due to the rapid recruitment of collateral vessels in the pelvic cavity.⁵⁻⁷

Due to the advancement of minimally invasive techniques in interventional radiology, the national guidelines of the UK⁸ recommend the use of interventional radiology with prophylactic placement of internal iliac artery balloon occlusion catheters to reduce intraoperative bleeding during caesarean section for women with abnormal placentation. Several studies have reported that temporary balloon occlusion is relatively safe and associated with a reduced estimated blood loss and fewer massive transfusions compared with groups without balloons.⁹⁻¹⁴ In contrast, some literature has reported no statistical difference in mean of estimated blood loss, volume of replaced blood products, fluid replacement needs, operating

room time or postoperative recovery time between patients in balloon occlusion and non-balloon occlusion groups.^{4,15} Even though temporary balloon occlusion of the hypogastric artery is minimally invasive, there are reports of complications, including arterial occlusion, pseudoaneurysm, ruptured artery and dissection.^{16,17}

In our hospital, which is the only tertiary hospital in Southern Thailand, we have performed transient hypogastric balloon occlusion adjunct with cesarean hysterectomy since 2014, in order to reduce maternal blood loss in pregnant women with abnormal adherent placenta. The objective of our study was to determine the outcome of transient hypogastric artery balloon occlusion with cesarean hysterectomy in abnormal adherent placenta.

Material and Methods

Patients

This was a retrospective study of all the pregnant women with imaging diagnosis of abnormal adherent placenta who underwent transient hypogastric balloon occlusion with cesarean hysterectomy in Songklanagarind Hospital between January 2014 and December 2016. The data were retrieved from interventional radiology records and the hospital database. Finally, 14 pregnant women were included. This study was approved by the Human Research Ethics Committees of our institution.

Procedure

Procedures were performed in the operating room. Patients were in the supine position. The skin and both inguinal areas were cleaned with antiseptic solution. Bilateral common femoral punctures were performed under ultrasound guidance and local anesthesia by lidocaine injection; then a 5 French (Fr) vascular sheath was inserted in each side. Next, selection of each hypogastric artery was performed using Advantage guidewire (Terumo, Leuven, Belgium) and a 5-Fr internal mammary catheter using the contralateral approach under portable C-arm fluoroscopic

guidance. Both catheters were removed; then a 6-mm in diameter and 40-mm in length semi-compliant balloon catheter (Mustang, Boston Scientific Corporation, MA, USA) was inserted over the guidewire and placed at the common trunk of each hypogastric artery. The hub of each balloon catheter was connected to an inflator and the fixation of each balloon catheter was completed. Cesarean section was performed under general anesthesia. After the delivery of the neonate and the umbilical cord was clamped, the balloons were inflated to the nominal pressure (10 atmospheres) for 5 minutes (Figure 1) and then the pressure was decreased by 2 atmospheres every 10 minutes until it was down to 2 atmospheres, where it was maintained until the surgical procedure was finished. However, the pressure could be adjusted regardless of the severity of bleeding during the surgical procedure. After finishing the surgical procedure, balloons were deflated and removed followed by manual compression at both groins for hemostasis.

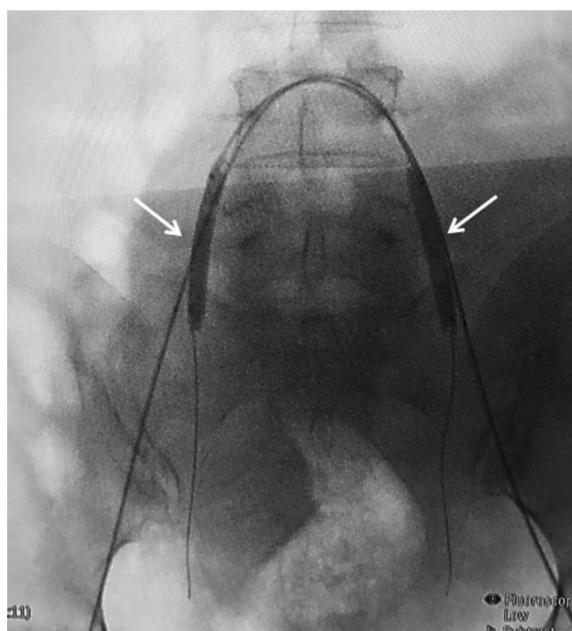


Figure 1 Radiography showing balloons (arrows) in bilateral hypogastric arteries

Data evaluation and statistical analysis

Data on patient demographics, obstetric history, laboratory and pathologic results, operative findings, and complications were obtained from the electronic medical record system and radiology information system database. The quantitative data were expressed as median (maximum, minimum), while the qualitative parameters were presented as counted numbers.

Results

The demographic data are shown in Table 1. The mean age was 35.3 years. Most patients (10 patients) underwent cesarean hysterectomy at less than 37 weeks of gestational age. One case (patient no. 13) had the lowest gestational age at 27 weeks 3 days, and the child was stillborn. Most cases (12 patients) had a history of previous cesarean section. When compared with pathological diagnosis, there were 7 cases in which the sonogram overestimated the severity of placenta adherence.

Summarization of the operative data of the patients is shown in Table 2. The median pre- and post-operative hematocrit levels were 35.2% and 31.0%, respectively. The median estimated blood loss (EBL) was 4,350 mL. Median transfused packed red blood cells (PRBC) and fresh frozen plasma (FFP) were 1,060.5 and 1,071 mL. There was one case (patient no. 12) that did not receive PRBC or FFP.

Summarization and outcome of each group of placenta adherence are shown in Table 3. Most pregnant women in this study had placenta increta. There were 2 cases of diagnosed placenta adherence from prenatal sonogram; however, there was no placenta adherence from pathological diagnosis. The highest median estimated blood loss was found in the placenta increta group. Women with placenta increta in this study also received the most transfused PRBC and FFP.

The intra-operative complication of perforation of the small branch of the anterior division of the right hypo-

gastric artery from the guidewire was found (patient no. 10). Ligation of the vessel was performed to correct this complication. There was no post-operative complication related to this interventional procedure.

Table 1 Demographic and obstetric data of the patients

Patient number	Age (year)	Gravida	Gestational age		Previous C/S	Prenatal diagnosis	Pathologic diagnosis
			(week)	(day)			
1	38	G3P1A1	34	5	Yes	Percreta	Increta
2	30	G2P1	33	3	Yes	Increta	Accrete
3	39	G3P2	35	5	Yes	Increta	Increta
4	38	G2P1	37	6	No	Percreta	No
5	35	G4P1A2	37	3	No	Accrete	No
6	39	G4P2A1	36	0	Yes	Accrete	Increta
7	34	G4P2A1	39	0	Yes	Percreta	Increta
8	37	G3P1A1	35	0	Yes	Percreta	Percreta
9	27	G3P2	37	2	Yes	Percreta	Increta
10	40	G5P4	34	1	Yes	Increta	Percreta
11	33	G3P2	36	5	Yes	Increta	Increta
12	30	G3P2	35	5	Yes	Increta	Accrete
13	40	G2P1	27	3	Yes	Increta	Increta
14	34	G6P2A3	33	3	Yes	Increta	Increta

G=gravida, P=the outcome of those pregnancies, A=the abortion of those pregnancies, C/S=cesarean section

Table 2 Patients' operative data

Patients number	Pre-operative Hct (%)	Operative time (min)	Post-operative Hct (%)	EBL (mL)	Transfused PRBC (mL)	Transfused FFP (mL)
1	30.4	255	30.9	6,000.0	908.0	1,059.0
2	38.0	255	29.8	5,000.0	1,033.0	1,458.0
3	29.0	345	27.6	7,500.0	2,002.0	2,180.0
4	38.3	195	37.9	1,700.0	1,031.0	499.0
5	35.0	315	30.2	1,500.0	290.0	0.0
6	36.1	235	31.1	3,000.0	632.0	1,083.0
7	34.0	380	33.8	2,300.0	1,545.0	1,600.0
8	35.3	240	32.5	4,500.0	1,150.0	986.0
9	31.3	335	28.0	4,200.0	1,190.0	850.0
10	34.1	395	24.7	5,800.0	1,551.0	1,214.0
11	35.3	365	33.8	11,000.0	4,605.0	3,828.0
12	37.2	269	34.6	1,000.0	0.0	0.0
13	31.5	245	27.9	5,000.0	1,088.0	1,685.0
14	36.8	225	34.6	3,700.0	855.0	626.0
Median	35.2	262	31.0	4,350.0	1,060.5	1,071.0

Hct=Hematocrit, EBL=estimated blood loss, PRBC=packed red blood cells, FFP=fresh frozen plasma

Table 3 Characteristics and outcomes in each group of abnormal placental adherence based on pathological diagnosis

Characteristics	Patients without abnormal adherence (n=2)	Patients with placenta accreta (n=2)	Patients with placenta increta (n=8)	Patients with placenta percreta (n=2)
Age (years)	36.5	30.0	35.5	38.5
Gestational age (week)	37.0	34.0	35.0	35.0
Estimate blood loss (mL)	1,600.0	3,000.0	5,337.0	5,150.0
(min, max)	(1,500, 1,700)	(1,000, 5,000)	(2,300, 11,000)	(4,500, 5,800)
Transfused PRBC (mL)	660.5	516.5	1,603.1	1350.5
Transfused FFP (mL)	249.5	729.0	1,613.8	1,100.0
Decreased Hct level (%)*	2.6	5.4	2.1	6.1

*pre-operative hematocrit subtract with post-operative hematocrit

PRBC=packed red blood cell, FFP=fresh frozen plasma, Hct=hematocrit, min=minimum, max=maximum

Discussion

For the evaluation of the degree of placental invasion, ultrasound can overestimate the diagnosis compared with the pathological method. The median EBL of the combination of transient balloon occlusion in hypogastric arteries and cesarean hysterectomy in this study was 4,350 mL. Placenta increta was the most common type of blood loss in our series. We found one case with a complication that was related to the procedure.

Sonogram is widely accepted to be the primary modality for prenatal diagnosis and exclusion of abnormal placentation because it is highly accurate, does not expose the patient to radiation, and inexpensive.¹⁸ Results from a systematic review and meta-analysis of the diagnosis of abnormal placentation by ultrasound showed an 81.0–91.0% sensitivity, 95.0–99.0% specificity, 65.0–93.0% positive predictive value, and a 98.0% negative predictive value.^{19,20} However, ultrasound might overestimate the severity of placental invasion as found in 50.0% of the cases in our series. The reasons may be affected by bias due to the inclusion of a single expert, prior knowledge of patients' risk factors, and a wide variability of definitions on the

placenta accreta spectrum.²¹ Additionally, an ultrasound is operator dependent, and thus outcome is related to the skill and experience of the operator. Magnetic resonance image (MRI) has a role in the diagnosis of adherent placenta when the sonogram evaluation is equivocal.²² In cases in which the diagnosis by sonogram is definitive, MRI is used to plan for surgery, especially for the evaluation of the invasion of any adjacent organs in case of placenta percreta.²² There were 4 pregnant women in this study who underwent MRI to evaluate adherent placenta because of an equivocal sonogram result. However, the results were not different than their previous sonograms.

Several studies have reported that the preoperative placement of temporary balloon occlusion is relatively safe and associated with a reduced estimated blood loss and fewer massive transfusions compared with a group without balloon occlusions for the cesarean hysterectomy.^{9–14} A study by Miller et al.²³ reported that blood loss during cesarean hysterectomy without temporary balloon occlusion in 62 pregnant women with adherent placentas was between 2,000 to 20,000 mL, whereas blood loss in this study ranged from 1,000 to 11,000 mL. The mean EBL in our

study was 4,350 mL, which was higher than several studies that used temporary balloon occlusion⁹⁻¹⁴ showing mean EBL ranging from 800 to 2,800 mL. The reason may be that most of the subjects in our study were pregnant women with placenta increta and percreta, whereas in previous studies⁹⁻¹⁴ they were pregnant women with placenta accreta, which is less severe. Moreover, a few studies^{4,15} performed the combination of embolization of the bilateral hypogastric arteries to reduce pelvic circulation. In our study, however, combined embolization was not performed because we were concerned about increasing pelvic ischemia and the length of the operation. A study by Chou et al.²⁴ reported the EBL in 13 pregnant women with adherent placenta; most subjects in their study had placenta increta and percreta, which is similar to our study. Mean intraoperative blood loss was $1,902.3 \pm 578.8$ mL (range 500–8,000 mL), which was less than in our study. The temporary balloon occlusions in their study were performed at the level of the bilateral common iliac arteries because they believed this technique had more definitive devascularization. However, this technique is high risk for acute limb ischemia due to distal emboli to popliteal artery and acute thrombosis of the external iliac artery.²⁴ Additionally, the overall gestational age at cesarean hysterectomy in the study of Chou et al.²⁴ was less than our study (median 30.5 weeks, ranging from 19 to 36 weeks) and therefore intraoperative blood loss might have been lower. Even though most of the literature indicated that temporary balloon occlusion showed a good result for decreasing the EBL from cesarean hysterectomy, there were a few studies that showed no statistically significant difference in blood loss between the using and non-using balloon occlusion groups.^{4,15} Additionally, there was no statistical significance in volume of replaced blood products, fluid replacement needs, operating room time, or postoperative recovery time.^{4,15}

The main risk of bleeding during surgery depends on the severity of the invasive placenta. The most severe placental invasion is placenta percreta due to much collateral arterial supply; thus, it is the cause of a high chance of bleeding during the operation. However, in this series, the group with the most blood loss was women with placenta increta because they were the majority of the population in this study, whereas we had only 2 cases of placenta percreta. The variety of obstetric doctors performing cesarean hysterectomy in our hospital was another factor related to blood loss, varying according to experience, skill and technique.

Most case series and case reports declared that balloon occlusion was safe and had a low morbidity; however, complications from balloon occlusion have been reported. The study by Carnevale et al.¹⁴ presented 2 of 21 cases that had acute ilio-femoral occlusion due to long operations. Both of these cases were treated by embolectomy. Another case report by Sewell et al.²⁵ also described acute popliteal occlusion requiring embolectomy. Other complications related to the procedures that were reported include pseudoaneurysm, ruptured artery, and dissection.^{16,17} Our series found one case of a guidewire penetrating from a small branch of the anterior division of the right hypogastric artery into the pelvic cavity. It was treated by ligation. We suspect the cause may have been the deep position of the tip of the guidewire into the aforementioned branch. There was no procedural related acute ilio-femoral or popliteal occlusion in our series, which is similar to previous studies.^{16,17}

Temporary balloon occlusion is a feasible technique for cesarean hysterectomy. This technique is not difficult and can be performed under C-arm fluoroscopic guidance in the operating theater before cesarean hysterectomy. Practically, the duration of balloon catheter placements at the bilateral hypogastric arteries does not exceed 30 minutes. Two important factors of the procedures are the

proper position of balloon placement and the appropriate size of balloon catheter for effective devascularization and reducing complications. The proper position of the balloon must be in common with the hypogastric artery and can be located by using the bony landmark; the upper end of the balloon should be located at the lower endplate of the L4 vertebra. The size of the balloon should not exceed 6 mm in diameter and 20 to 40 mm in length. In our opinion, this technique can be performed as an adjunct procedure to cesarean hysterectomy in cases of pregnancy with adherent placenta, particularly placenta increta and percreta.

This study had some limitations. Firstly, it was a retrospective study with a small number of enrolled patients. Secondly, the decision whether or not to perform balloon occlusion before cesarean hysterectomy depended on discussions between obstetric doctors, which might have been a cause of selection bias. Lastly, the effect of radiation exposure to the neonate was not determined because we used a portable C-arm fluoroscopic X-ray system that could not record the radiation dose.

Conclusion

Abnormal adherent placenta is a serious obstetric condition that can lead to maternal morbidity. Our case series showed that transient hypogastric artery balloon occlusion with cesarean hysterectomy was an effective method and safe treatment for controlling massive intra-operative bleeding. This technique can be an alternative option in combination with surgery for treating pregnant women with abnormal adherent placenta.

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Conflict of interest

There are no potential conflict of interest to declare.

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