

Selective Endovascular Balloon–Occlusion for Cesarean Delivery in Patients with Abnormal Placentation: Review of Literature and Presentation of a Case

Devanand Mangar, M.D.,^{1,2} Jaya Kolla, M.D.,² Rachel Karlinski, Ph.D.,^{1,2}
Hesham Omar, M.D.,^{2,3} Mitchel Hoffman, M.D.,⁴ and Enrico Camporesi, M.D.^{1,2,5}

Abstract

Background: Removal of abnormal placentation is associated with severe bleeding and is a recognized cause of maternal morbidity and mortality. Complications of abnormal placentation include excessive bleeding during placental removal and the need for cesarean hysterectomy. Newer technologic advances, in the form of obstetrical ultrasound and advanced computed tomography and magnetic resonance imaging, have enabled antenatal diagnosis of these abnormalities and, therefore, allow elective management, instead of on an emergency basis. **Case:** In this article, we report a case that demonstrates the use of electively placed, bilateral intravascular balloons guided within the common iliac arteries to control bleeding in a patient with placenta percreta. **Review:** We also complete a review on the literature pertaining to the role of vascular balloon occlusion in abnormal placentation. The use of occlusive balloons and/or embolization has recently been described to reduce postoperative blood loss in patients with abnormal placentation; however, several described anastomoses can explain the continued bleeding. A review of all publications was completed, regarding abnormal placentation, where an endovascular occlusive balloon and/or embolization were used to reduce blood loss. **Conclusions:** We conclude that a multidisciplinary approach between the interventional radiologist and the obstetrician are important for a favorable outcome. Prophylactic bilateral common iliac artery balloons placed immediately before surgery in patients with abnormal placentation is the safest method by which a reduction in blood loss may be obtained. However, further research and prospective studies are needed to properly assess the efficacy of each of the described techniques for better control of bleeding in these patients, as well as the most appropriate timing for repeated occlusive periods, to minimize unfavorable ischemic events. (J GYNECOL SURG 25:113)

¹Florida Gulf-to-Bay Anesthesiology, Tampa, FL.

²Tampa General Hospital, Tampa, FL.

³Department of Cardiology, Cairo University.

⁴Department of Obstetrics and Gynecology, University of South Florida, Tampa, FL.

⁵Department of Surgery and Anesthesiology, University of South Florida, Tampa, FL.

Introduction

PLACENTA ACCRETA is an abnormal penetration of the uterine wall by placental villi affecting approximately 1:2500 pregnancies. Three forms of abnormal placentation have been described,¹ according to the depth of uterine invasion. Placenta accreta is defined as placental villi penetration of the myometrium and accounts for 78% of all forms. Placenta increta (17%) shows placental villi penetration of the myometrium extending to the serosa, and placenta percreta (5%) is the most severe form, with villi penetrating beyond the serosal layer and, in some instances, invading neighboring organs, especially the bladder.¹

Complications of abnormal placentation include excessive bleeding during placental removal and the need for cesarean hysterectomy. Risk factors include multiparity, previous cesarean deliveries, advanced maternal age, and prior dilation and curettage (D&C). Previous management to control hemorrhaging was achieved either by manual pressure on the aorta during surgery, direct clamping of the abdominal aorta, or by ligation of the internal iliac arteries. Newer technologic advances, in the form of obstetrical ultrasound and advanced computed tomography/magnetic resonance imaging (CT/MRI), have enabled antenatal diagnosis of these abnormalities in the majority of these cases and, therefore, allow elective management instead of on an emergency basis. In this article, we report a case that demonstrates the use of electively placed, bilateral intravascular balloons guided within the common iliac arteries to control bleeding in a patient with placenta percreta. Once hemostasis is achieved, a hysterectomy is performed. We completed a review of the literature pertaining to the role of vascular balloon-occlusion in abnormal placentation.

Anatomy

A previous widely adopted technique to control bleeding in patients with placenta percreta was bilateral ligation of the internal iliac arteries (IIAs). A recent alternative to IIA ligation is the preoperative placement of occlusive balloons in the IIA. The latter appears to be more effective, allowing the obstetrician to not be familiar with the technique of IIA ligation and immediately request occlusion of both IIA after cord clamping without the interference created by the small, bloody surgical field.²

The literature, however, has yet to clearly prove the effectiveness of this technique, possibly due to the large variability in vascular supply to pelvic organs and the anatomy of the vasculature between the common iliac arteries (CIAs), EIAs, and IIAs, and their anastomoses. After ligation or balloon occlusion of the IIAs, extensive anastomoses in the pelvic vasculature between branches of the IIA, branches of EIA and branches arising from the aorta have been able to explain the continued hemorrhage that may occur after IIA occlusion during surgery for placenta percreta.

Important anastomoses connecting the internal and EIAs include the following³:

1. The anastomoses between the obturator artery (branch of the IIA) with inferior epigastric artery and medial circumflex femoral artery (branches from the EIA)
2. Anastomosis between the uterine artery (from the IIA) and the ovarian artery (from the EIA)
3. Anastomosis between the middle rectal (from the IIA) and superior rectal arteries (from the inferior mesenteric)
4. Anastomoses of the hemorrhoidal branches of the IIA with the superior hemorrhoidal from the inferior mesenteric

5. Anastomosis between the lateral sacral with the middle sacral artery
6. Anastomosis between the superior gluteal and the posterior branches of the lateral sacral arteries.

It is reasonable that occlusion of the CIA does not block other sources of anastomoses arising proximally to the CIA, such as the middle rectal and superior hemorrhoidal arteries, which are branches originating from the inferior mesenteric artery. This explains the continued, but reduced, blood loss occurring after CIA occlusion. Occlusion of the abdominal aorta proximal to the inferior mesenteric artery is not applicable due to the complications of renal ischemia.

In addition to arterial blood loss, bleeding can also originate from the venous vasculature. Arterial balloons not only decrease arterial bleeding by reducing the mean arterial blood pressure, but also help decrease venous congestion and subsequent venous bleeding by reducing blood inflow.

These considerations support that an intravascular occlusive balloon, which can be precisely placed in the CIA immediately before surgery, will permit adequate, timely hemostasis.

Case Report

A 38-year-old female, G6 P1 at 36 week's gestation with a past surgical history of two cesarean sections, was admitted with placenta percreta found on ultrasound evaluation during her perinatal evaluation in the third trimester and verified by MRI prior to her admission for cesarean delivery. She had a history of three spontaneous abortions with a D&C for one. The patient was admitted based on recommended delivery of the child, as well as possible complications from bleeding during cesarean section and a possible need for cesarean hysterectomy. After extensive discussion with the patient, she made it evident her desire for

further childbearing, if possible. Due to the high morbidity and mortality risk, a multidisciplinary approach was considered to manage the patient. Just prior to cesarean section, the patient was admitted to interventional radiology for the placement of prophylactic bilateral common iliac artery balloons. The catheters were inserted under sedation and local infiltration through both femoral arteries, and the sheaths were secured in place (Fig. 1).

The patient was then immediately transferred from the catheter laboratory to the operating room, and general anesthesia was initiated uneventfully. A vertical midline incision was made after ultrasound identified the presence of placenta previa. The incision revealed the placenta extending outward toward the serosa without any extension to the urinary bladder or broad ligament. The surgeon felt that too much of the uterus was involved and future childbearing would not be a safe option; therefore, a hysterectomy was performed following delivery of the baby.

During the hysterectomy, excessive bleeding was noticed, which necessitated the inflation of the iliac balloons; the balloons were inflated for two 20-minute intervals and deflated for 2 minutes between inflations to decrease the incidence of distal limb ischemia. The patient received 7 units of packed red blood cells secondary to 4 L of blood loss. The hysterectomy was followed by a cystoscopy to determine the patency of both ureters. An injection of indigo carmine dye was given and was seen ejecting from both urethral orifices, confirming intact ureters bilaterally. After closing the abdomen, the iliac catheters were removed and pressure was held on both groins for 20 minutes for hemostasis. The patient tolerated the procedure well, was kept intubated, and was subsequently transferred to the intensive care unit. She was extubated the following morning, and her further hospital course was uneventful.

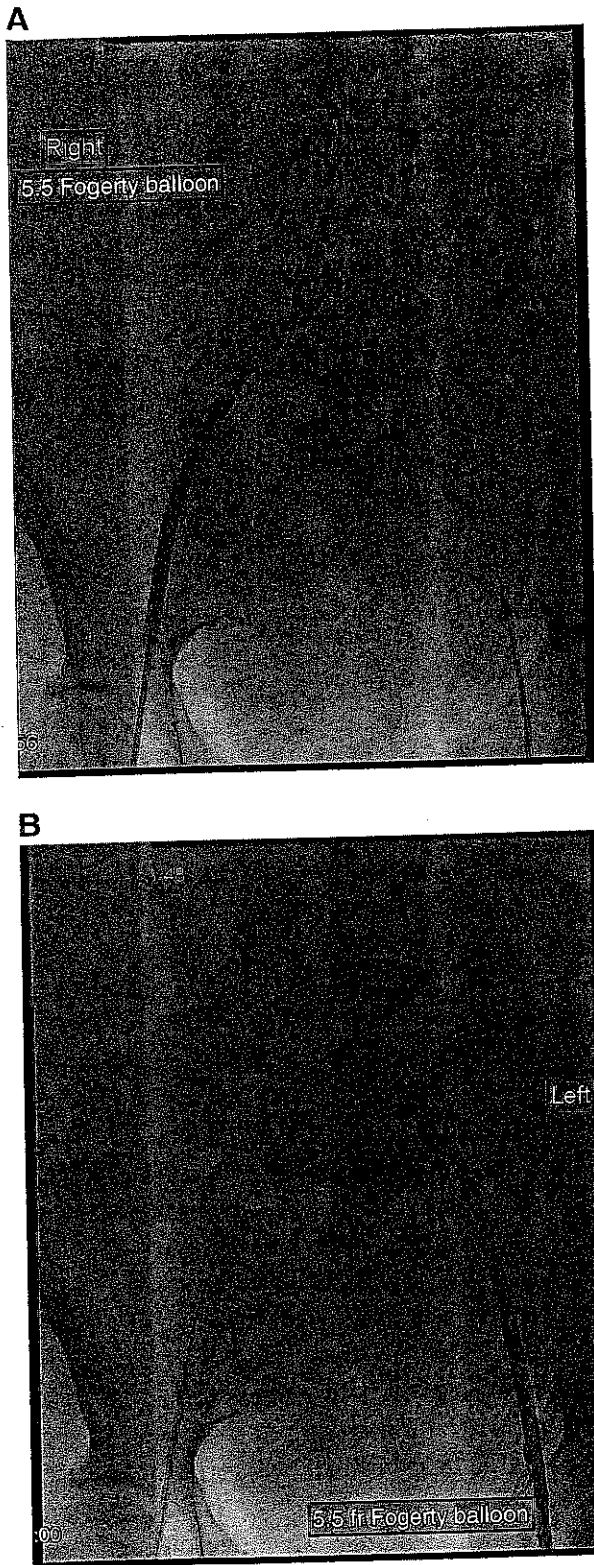


FIG. 1. Position of intravascular balloons in the left (A) and the right (B). Both balloons are inserted to occlude the common iliac artery on the ipsilateral side. The catheter and balloon are filled with contrast material.

Critical Analysis of Previous Literature and Search Methodology

We decided to review critically all publications on abnormal placentation within the last two decades, where an endovascular occlusive balloon and/or embolization were used to reduce blood loss.^{2,4-14} The search was performed through PubMed, using the following keywords: placenta percreta, balloon occlusion, and internal iliac artery occlusion. Our search resulted in 50 articles and was selectively reduced, based on a collective decision by all authors, according to the following criteria: (1) All patients were diagnosed with abnormal placentation; (2) all patients had a prophylactic placement of endovascular balloons prior to cesarean delivery; and (3) patients who underwent embolization were included within the literature review. Our review consisted of 12 articles that dealt with control of severe bleeding in patients with abnormal placentation and two letters to the editor of two clinicians' own personal experience.^{15,16} Table 1 represents a compilation of all data reviewed from this literature search, describing type of catheterization, estimated blood loss, and the final outcome from the patient's abnormal placentation.

This review demonstrates 49 cases of placenta accreta, percreta, or previa, with most patients being multiparas, with heterogeneous results, but no unequivocal demonstration of the utility of intravascular balloon for reducing blood loss. The vast majority of patients underwent simultaneous hysterectomy due to excessive bleeding. There were only two studies that demonstrated the use of common iliac occlusive balloons with minimal blood loss; this can be explained by the anastomoses of the pelvic vasculature, as mentioned earlier. However, several vascular complications were described from catheter placement, including lower limb ischemia due to iliac artery

TABLE 1. LITERATURE SEARCH DATA

Year/author/reference	No. of cases	Condition	Parity/age	Type of catheterization	EBL	Outcome
1995/Paull et al./ref. 4	1	Placenta percreta	Multiparas/33	Balloon occlusion of abdominal aorta	1500 mL	Total hysterectomy
1997/Dubois et al./ref. 5	1	Placenta percreta bladder invasion	G5 P3/32	Bilateral balloon inflation in the IIA and gelatine sponge embolization	2000 mL	Total hysterectomy
1999/Hansch et al./ref. 6	6	Placenta accreta; PROM; abortion	3 cases of multiparas; 2 cases of first delivery; 18-41 years old	5 cases of IIA embolization; 1 case of uterine artery embolization	2000-5500 mL; after embolization minimal loss of blood	1 Hysterectomy; 4 cases of C-sections; & 1 abortion
2000/Weeks et al./ref. 7	1	Placenta percreta	G9 P2/37	Bilateral balloon occlusion of the IIA	1500 mL	Hysterectomy
2001/Kidney et al./ref. 8	5	2 Cases of placenta accreta; 1 case of percreta; 2 cases of previa	All were multiparas; 2 cases of Grand multiparas 23-34	Bilateral balloon occlusion of the IIA	1100-4000 mL	Hysterectomy
2005/Ojala et al./ref. 9	7	7 Cases of placenta previa, accreta, and percreta multiple previous C-sections	Multiparas/32-42	7 cases of balloon inflation; 5 cases of embolization	3.1-10 L	3 Cases of hysterectomy; 4 cases of C-section
2005/Shih et al./ref. 2	1	Placenta accreta	G4 P1/34	Bilateral balloon occlusion of the common iliac artery	800 mL	Hysterectomy bladder repair
2006/Bodner et al./ref. 10	6	Placenta previa & Accreta/Percreta	Most were multiparas/24-43	Bilateral balloon occlusion of IIA and embolization of anterior division	1-7 L	5 Cases of hysterectomy and 1 case of uterine repair (2 of 6 patients had bladder repair)
2006/Sewell et al./ref. 11	1	Placenta accreta	G3 P2/37	Bilateral balloon occlusion of the common iliac artery	1500 mL	Hysterectomy and embolectomy due to postoperative popliteal artery embolus
2006/Fuller et al./ref. 12	6	Placenta accreta/percreta/AVM	5 cases were multiparas; 1 case was a primigravida	Bilateral balloon occlusion of the IIA	800 mL-5 L	3 Cases of hysterectomy and 3 cases of cesarean section
2007/Greenberg et al./ref. 13	1	Placenta accreta	G4 P2/27	Balloon occlusion of the IIA	2000 mL	Hysterectomy and left-lower limb ischemia due to left iliac thrombosis
2008/Mok et al./ref. 14	13	Placenta previa, accreta, and percreta and atonic uterus	Most were multiparas having previous C-section/23-39	6 cases with bilateral IIA balloon occlusion; 1 case of embolization gelatin sponge; 6 cases had no inflation of balloon	4-14 L; 28 L; 0.3 L-3 L	5 Cases of hysterectomy; 8 cases of C-section

EBL, estimated blood loss; IIA, internal iliac artery; PROM, premature rupture of membranes; AVM, arterio-venous malformation.

thrombosis in 1 patient and popliteal artery embolism in another. Overall, most researchers felt that the use of intravascular balloon reduced blood loss.

Discussion

Placenta accreta describes an abnormally firm adherence of the placenta to the uterine wall. This pathology commonly occurs in women who have undergone previous uterine curettage or cesarean sections. While the estimated blood loss during routine cesarean section is 1000 mL, bleeding during cesarean hysterectomy, due to abnormal placentation, has been reported to require up to 70 units of replacement blood products. In a review of the literature performed by Miller et al.,¹ the amount of blood loss during cesarean hysterectomy was described in 62 patients with placenta accreta. Blood loss exceeded 2 L in 41 patients, 5 L in 9 patients, 10 L in 4 patients and 20 L in 2 patients. This illustrates the significant variance in blood loss and the morbidity associated with this disorder, as well as the importance of preoperative diagnosis with the use of either abdominal ultrasound or MRI for proper surgical planning.

A recent published letter to the editor by Judlin and Thiebaugeorges¹⁵ demonstrated, from their own experience, the efficacy of bilateral hypogastric ligation in the cessation of bleeding in obstetric hemorrhaging and abnormal placentation, with resulting hysterectomy or conservative procedures.¹⁷ Previous management of severe uncontrolled postpartum hemorrhage unable to be controlled by uterine massage, uterotonic agents, or vaginal packing often resulted in ligation of the uterine artery and/or hysterectomy, resulting in sterility, which may not be the desired effect for many patients. Recent pelvic arterial catheterization techniques, involving the placement of prophylactic arterial balloons in IIAs or CIAs with or

without endovascular embolization has led to a decrease in organ-directed blood flow and better hemostasis. Successful cases have also been reported of tamponade of the placental site with a specially designed balloon inflated in the uterine cavity.¹⁸

The use of catheter-based balloon arterial occlusion was first described by Paull et al.⁴ in 1995, where he used an 18-mm infrarenal aortic balloon. This was followed by several case reports describing the use of occlusive balloons to block IIAs with or without endovascular embolization. However, there were two case reports that described the placement of the arterial balloons in the CIAs resulting in significantly less bleeding than those placed in the IIAs.

A letter to the editor by Le Ray and Audibert¹⁶ described their success with the prophylactic placement of intravascular balloons in the IIAs and agree with their critique of using heparin within the catheters and sheaths to reduce ischemic complications. In addition to heparinization, we recommend the perioperative placement of endovascular balloons (preferably 1–2 hours prior), as well as the rapid removal of sheaths and catheters postoperatively (preferably in the operating room, prior to transferring to the PACU). In our case report, we are illustrating the use of bilateral CIAs occlusive balloons for the management of severe bleeding in a case with placenta percreta. At our institution, we prefer placing the balloons in the common, rather than the internal, iliac arteries for better hemostasis. We base our decision on the fact that the pelvis has a rich blood supply and good collateral circulation between the branches of the IIAs and EIAs and the anastomoses that exists between both. This explains the reduction, but not the complete cessation, of bleeding following bilateral internal iliac occlusion.

The use of occlusive balloons and/or embolization has recently been described

to reduce postoperative blood loss in patients with abnormal placentation; however, we assume that the previously described anastomoses can explain the continued bleeding. A previous publication¹⁹ supports that a more proximal occlusion of blood flow (CIA) might be associated with an even more complete reduction in blood loss and has prompted our review.

Conclusions

Removal of abnormal placentation is associated with severe bleeding and is a recognized cause of maternal morbidity and mortality. Early collaboration and a multidisciplinary approach between the interventional radiologist and the obstetrician are important for a favorable outcome. Prophylactic bilateral CIA balloons placed immediately before surgery in patients with abnormal placentation appears to be a safe method by which a reduction in blood loss may be obtained. However, further research and prospective studies are needed to properly assess the efficacy of each of the described techniques for better control of bleeding in patients with abnormal placentation, as well as the most appropriate timing of repeated occlusive periods, to minimize unfavorable ischemic events.

Disclosure Statement

No competing financial conflicts exist.

References

1. Miller DA, Chollet JA, Goodwin FM. Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol* 1997;177:210.
2. Shih JC, Lie KL, Shyu MK. Temporary balloon occlusion of the common iliac artery: New approach to bleeding control during cesarean hysterectomy for placenta percreta. *Am J of Obstet Gynecol* 2005;193:1756.
3. Gray, H. *Anatomy of the Human Body*. Philadelphia, PA: Lea & Febiger, 1918; Bartleby.com, 2000.
4. Paull JD, Smith J, William L, Davison G, Devine T, Holt M. Balloon occlusion of the abdominal aorta during caesarean hysterectomy for placenta percreta. *Anaesth Intens Care* 1995;23:731.
5. Dubois J, Garel L, Grignon A, Lemay M, Leduc L. Placenta percreta: Balloon occlusion and embolization of the internal iliac arteries to reduce intraoperative blood losses. *Am J Obstet Gynecol* 1997; 176:723.
6. Hansch E, Chitkara U, McAlpine J, El-Sayed Y, Dake M, Razavi M. Pelvic arterial embolization for control of obstetric hemorrhage: A five-year experience. *Am J Obstet Gynecol* June 1999;180:1454.
7. Weeks S, Stroud T, Sandhu J, Mauro M, Jaques PF. Temporary balloon occlusion of the internal iliac arteries for control of hemorrhage during cesarean hysterectomy in a patient with placenta previa and placenta. *JVIR* 2000;11:622.
8. Kidney DD, Nguyen AM, Ahdoot D, Bickmore D, Deutsch LS, Majors C. Prophylactic perioperative hypogastric artery balloon occlusion in abnormal placentation. *AJR* June 2001;176:1521.
9. Ojala K, Perala J, Kariniemi J, Ranta P, Raudaskoski T, Tekay A. Arterial embolization and prophylactic catheterization for the treatment for severe obstetric hemorrhage. *Acta Obstet Gynecol Scand* 2005;84:1075.
10. Bodner LJ, Nosher JL, Gribbin C, Siegel RL, Beale S, Scorza W. Balloon-assisted occlusion of the internal iliac arteries in patients with placenta accreta/percreta. *Cardiovasc Intervent Radiol* 2006;29:354.
11. Sewell MF, Rosenblum D, Ehrenberg H. Arterial embolus during common iliac balloon catheterization at cesarean hysterectomy. *Obstet Gynecol* 2006;108:746.
12. Fuller AJ, Carvalho B, Brummel C, Riley ET. Epidural anesthesia for elective cesarean delivery with intraoperative arterial occlusion balloon catheter placement. *Anesth Analg* 2006;102:585.
13. Greenberg JL, Suliman A, Iranpour P, Angle N. Prophylactic balloon occlusion

- of the internal iliac arteries to treat abnormal placentation: a cautionary case. *Am J Obstet Gynecol* Nov 2007;197:470.e1.
14. Mok M, Heidemann B, Dundas K, Gillespie I, Clark V. Interventional radiology in women with suspected placenta accreta undergoing caesarean section. *Int J Obstet Anesth* 2008;17:255.
 15. Judlin P, Thiebaugeorges O. The ligation of hypogastric arteries is a safe alternative to balloon occlusion to treat abnormal placentation. *Am J Obstet Gynecol*. 2008;199:e11.
 16. Le Ray C, Audibert F, Dubois J. Prophylactic balloon occlusion of the internal iliac arteries to treat abnormal placentation. *Am J Obstet Gynecol* 2008;199:e11.
 17. Kayem G, Anselem O, Schmitz T, Goffinet F, Davy C, Mignon A, Cabrol D. Conservative versus radical management in cases of placenta accreta: A historical study. *J Gynecol Obstet Biol Reprod (Paris)*. 2007;36:680.
 18. Mechery J, Burch D. Alternative management of placenta accreta. *Gynecol Surg* 2005;3:41.
 19. O'Rourke N, McElrath T, Baum R, Cammann W, Tuomala R, Stuebe A, Kodali BS. Cesarean delivery in the interventional radiology suite: A novel approach to obstetric hemostasis. *Anesth Analg* 2007;104:1193.

Address correspondence to:

Enrico Camporesi, M.D.

Tampa General Hospital

1 Tampa General Hospital Circle

Tampa, FL 33606

E-mail: ecampore@health.usf.edu