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ORIGINAL ARTICLE

# Thrombosis after aortic balloon occlusion during cesarean delivery for abnormally invasive placenta

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**ABSTRACT**
**Background:** Abnormally invasive placenta is a major cause of postpartum hemorrhage and cesarean hysterectomy. An increasing number of obstetricians worldwide employ prophylactic aortic balloon occlusion to manage bleeding during cesarean delivery in these patients. However, the safety of this procedure in pregnant women has not been confirmed.
**Methods:** The clinical records of patients who were suspected of having abnormally invasive placenta and who received prophylactic aortic balloon catheterization before cesarean delivery were retrospectively studied for thrombotic complications.
**Results:** There were 121 patients with suspected abnormally invasive placenta who received prophylactic aortic balloon catheterization before surgery and 115 had the balloon inflated during surgery. Twelve of these 121 patients (10%) developed thrombotic complications. Except for one case of venous thrombosis, all other patients exhibited arterial thrombosis in the limbs on the catheterization side and 11 cases (92%) of thrombosis were discovered within 24 hours of delivery. Eventually, eight patients received arterial thromboembolectomy, and four patients received conservative anticoagulation treatment.
**Conclusion:** Aortic balloon occlusion for the management of bleeding in women with an abnormally invasive placenta may not uncommonly result in thrombosis. Therefore, the risks and benefits of the procedure must be carefully weighed before it is utilized in these patients.
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***Keywords***: Aorta; Occlusion; Placenta; Abnormally invasive; Balloon catheter; Complications; Thrombosis

## Introduction

Abnormally invasive placenta (AIP) is classified as one of placenta accreta, placenta increta, and placenta percreta, according to the depth of invasion of placental villi into the myometrium, and it is a major cause of severe obstetric bleeding and hysterectomy.[1] As aortic balloon occlusion (ABO) can block the pelvic collateral circulation, an increasing number of obstetricians, especially in China, have used this procedure to control bleeding in patients with AIP, aiming for preservation of the uterus. Many studies have concluded that this procedure can effectively reduce intraoperative blood loss during cesarean delivery and some show a reduced hysterectomy rate.[2–6] Although the reported incidence of ABO complications is very low,[4,7,8] severe complications such as lower limb necrosis and aortic rupture may occur.[9,10] The safety of this procedure has not been reported in obstetric patients. Our hospital has applied prophylactic ABO to AIP patients since 2013, and several patients have developed thrombotic complications. In this study, the clinical data of these women with a thrombosis are reported and retrospectively compared with data of patients who received this procedure but did not develop thrombosis. We aimed to quantify the thrombotic risks of ABO, explore the cause of thrombosis, and improve clinical practice for this increasingly used procedure.

## Methods

This retrospective study was conducted from January 2013 to March 2017 and was approved by the ethics committee of our hospital. It is a secondary analysis and was approved at the time of seeking ethical approval for the overall study. The inclusion criteria of the study were patients diagnosed preoperatively with

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AIP, who received prophylactic aortic balloon catheter placement before cesarean delivery; and patients who developed thrombotic complications after this procedure. The prenatal diagnosis of AIP was based on prenatal ultrasound and/or magnetic resonance imaging (MRI) findings or clinical risk factors, and clinical risk factors for AIP were defined as the presence of placenta previa, complicated by a history of at least one prior cesarean delivery. The disease condition was evaluated by multidisciplinary medical teams before cesarean delivery. After being informed about the risks, patients made an informed decision to agree to or avoid the additional procedure of ABO.

All cesarean deliveries were completed by the postpartum hemorrhage rescue team of our department. Members of this team include three obstetricians with more than 20 years of cesarean delivery experience. The diagnosis of AIP after surgery was based on a pathological examination of either placental bed biopsies or hysterectomy specimens after surgery; or the surgeon's inability to develop a clear cleavage plane between the placenta and the uterus, together with massive bleeding from the implantation site. Two interventional radiologists (A and B) completed the catheterization procedure, which was identical for all patients.

Before cesarean delivery, patients were transferred to the interventional radiology (IR) suite for abdominal aortic balloon catheterization. A vascular closure device was placed through the (preferred) right femoral artery, under local anesthesia. A 12-French vascular sheath (RCF-12.0-38-J, Cook Medical Inc, Bloomington, USA) was inserted, to place a balloon catheter below the renal artery (Fig. 1). The balloon was inflated, and the volume required to occlude the blood flow of the abdominal aorta was recorded. Then, the balloon was deflated, and the balloon catheter was filled with 5 mL of diluted heparin solution. The sheath system was fixed to the skin.

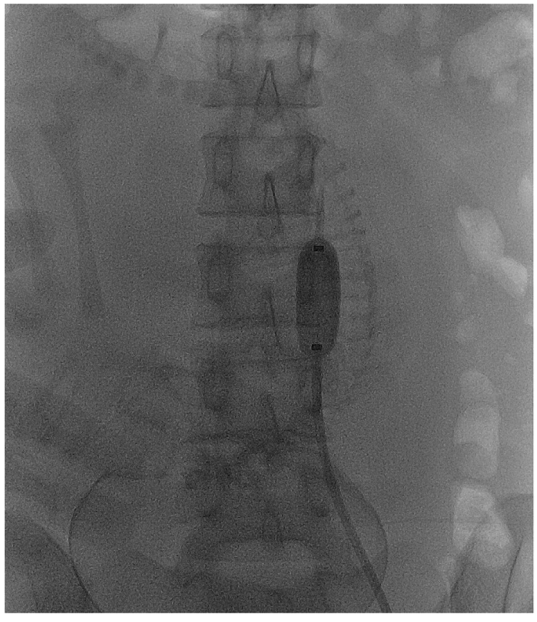

**Fig. 1** The location of the aortic balloon catheter in relation to the lumbar vertebrae

Patients were then transferred to the operating room, and cesarean delivery was performed under general anesthesia or combined spinal-epidural anesthesia (CSE). Intraoperatively, the balloons were inflated at the obstetrician's request, either before uterine incision or immediately after delivery and umbilical cord clamping. If it was necessary for occlusion to continue for 40 minutes, the balloon was deflated for 10 minutes to prevent lower limb ischemia and necrosis.

After cesarean delivery, the patients were transferred to the ward, post-anesthesia care unit, or intensive care unit, based on their type of anesthesia and general condition. The sheath system was removed by an interventional radiologist. Compression hemostasis at puncture points was achieved using a vascular compression device, and this device was removed after the punctured lower limb had been immobilized for eight hours. The dorsalis pedis artery pulse and skin temperature of both lower limbs were closely monitored after surgery, and vascular color ultrasound or digital subtraction angiography (DSA) were used to detect thrombosis.

The clinical data collected included maternal demographic information, diagnostic information, the anesthetic and surgical procedures, the estimated blood loss, the duration of surgery, the transfusion details, the details about the ABO, the patient's general condition, and the treatment of thrombosis. Patients were followed up by telephone after the delivery.

Continuous variables are presented as mean ± standard deviation or as median (with interquartile range), and were analyzed using analysis of variance and by the Mann–Whitney U-test if the data were not normally distributed. Categorical variables are presented in the form of a rate and were analyzed using the $\chi^2$ test. All analyses were performed using SPSS 19.0 (SPSS Inc., Chicago, IL, USA). The results were considered statistically significant at $P < 0.05$.

## Results

Between January 2013 and March 2017, a total of 121 pregnant women underwent prophylactic aortic balloon catheter insertion before cesarean delivery, and 115 of them had the balloon inflated during surgery. Of these patients, 113 were confirmed to have an AIP at surgery and/or at biopsy. Twelve of the 121 patients (10%) developed vascular thrombosis in the lower limbs, with all such cases occurring after October 2015. The general, surgical, and thrombosis-associated conditions of these 12 patients are shown in Table 1.

Except for cases 6 and 7, all other patients had a previous cesarean delivery. All 12 patients were in the third

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