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CLINICAL ARTICLE

Temporary balloon occlusion of the internal iliac arteries to prevent massive hemorrhage during cesarean delivery among patients with placenta previa

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ABSTRACT

Objective: To evaluate the effectiveness of temporary balloon occlusion of the internal iliac artery before uterine incision to prevent massive obstetric hemorrhage during cesarean delivery among patients with anterior placenta previa. **Methods:** In a retrospective cohort study conducted at Amphia Hospital Breda (Breda, Netherlands), data were analyzed from women with anterior placenta previa who delivered by cesarean between January 1, 2001, and September 30, 2012. Cases with and without balloon occlusion of the internal iliac artery were included. The primary outcomes were the amount of blood loss during cesarean delivery, drop of hemoglobin level, and blood loss of more than 1000 mL. **Results:** Of 68 eligible women, 42 (62%) had temporary balloon occlusion and 26 (38%) had no balloon occlusion. Median blood loss was 800 mL (interquartile range [IQR] 488–1113) in the balloon group and 1000 mL (IQR 694–1307) in the no balloon group ($P = 0.06$). Blood loss of 1000 mL or more was recorded in 16 (38%) women in the balloon group and 18 (69%) in the no balloon group ($P = 0.01$). **Conclusion:** Temporary balloon occlusion of the internal iliac artery before uterine incision during cesarean delivery could potentially reduce blood loss among patients with anterior placenta previa. Large, randomized controlled trials are needed to confirm the results.

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1. Introduction

With the increasing incidence of cesarean delivery across the world, the prevalence of complications due to abnormal placenta localization is also rising [1]. The prevalence of placenta previa ranges from 0.3% to 0.9% among patients who have not had a previous cesarean delivery, but increases to as much as 10% among patients who have undergone four or more cesareans [2–5]. Placentation in the lower uterine segment increases the chance of massive postpartum hemorrhage (>1000 mL), independent of the use of uterotonic agents [2,6,7]. The risk of massive blood loss during cesarean delivery is increased further in women with an anterior placenta previa, because the placenta has to be traversed before the neonate can be delivered. Massive blood loss is associated with increased maternal and neonatal morbidity and mortality [2].

Selective uterine artery embolization has been performed since 1979 to reduce the amount of blood loss among patients with placenta-associated pathology and persistent hemorrhage after vaginal delivery.

Complications of embolization include vessel injury (dissection or rupture), hematoma, or pseudoaneurysm formation at the puncture site; non-target embolization; contrast-induced nephropathy; and/or allergic reactions [8–11]. The incidence of these complications has not been reported after delivery, but it might be more common among this group than among the overall population because arteries of pregnant women are more compliant and there is increased risk of a thromboembolism.

An alternative method to occlude the uterine arteries is the use of temporary perioperative balloons in the internal iliac artery. Studies on balloon occlusion for patients with known or suspected placenta accreta during cesarean delivery or hysterectomy have shown mixed results [7,12,13]. Although guidelines suggest that this approach is a possible management option [2], in most studies the balloons were directly inflated after the neonate was delivered. To our knowledge, no study has evaluated the effectiveness of balloon occlusion for patients with anterior placenta previa at the time of incision in the lower uterine segment (i.e. seconds before delivery of the neonate).

Owing to an increasing incidence of placenta previa at the Amphia Hospital Breda (Breda, Netherlands), the aim of the present study was to evaluate the effectiveness of temporary balloon occlusion of the internal iliac artery in preventing massive obstetric hemorrhage during cesarean delivery for patients with anterior placenta previa.

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2. Materials and methods

A retrospective cohort study was performed using data obtained from the clinical obstetric database of the Amphia Hospital Breda. Women with a known anterior placenta previa who delivered a newborn by cesarean between January 1, 2001, and September 30, 2012, were included. Patients were excluded from analyses when information on the location of the placenta was missing. Because guidelines from different countries suggest that temporary balloon occlusion is a potential treatment option to prevent hemorrhage in patients with placenta previa [2,3], approval from the local ethics committee was not required. All patients gave informed consent before the procedure.

The medical files of eligible patients were manually checked for maternal characteristics, such as the presence and position of the placenta previa, the use of temporary balloon occlusion, the amount of blood loss during cesarean delivery, and maternal and perinatal morbidity. Placenta previa had been diagnosed by second-trimester transvaginal sonography and then re-evaluated at 32 weeks. If placenta previa was still present, an elective cesarean was planned at 37 weeks of gestation, as recommended by Dutch national guidelines [3]. Since 2005, patients with an anterior placenta previa have been informed about the possibility of temporary balloon occlusion and its potential benefits [2]. Preoperatively, the potential benefits, possible complications, use of radiation during fluoroscopy, and contraindications of the procedure (i.e. contrast allergy or renal failure) were discussed with the patient.

Approximately 1 hour before surgery was scheduled, the patient was transferred to the interventional radiology suite. Catheter placement was performed by certified vascular interventional radiologists. After local anesthesia, both femoral arteries were punctured via the Seldinger technique and 6-French sheaths (Cook, Bloomington, IN, USA) were put in place. Selective catheterization of the contralateral internal iliac artery was then done under fluoroscopic guidance and a 5.5-French, semi-compliant over-the-wire Fogarty Thru-Lumen Embolectomy balloon catheter (Edwards Lifesciences, Irvine, CA, USA) (Fig. 1) was inserted. The balloons were positioned between the origin of the internal iliac artery and the bifurcation of the anterior and posterior division, which was angiographically confirmed by injecting 8 mL of 50% diluted contrast medium (Hexabrix 200, Guerbet, Roissy, France) retrograde through the sheaths. In cases of emergency cesarean, the patient was transferred directly to the operation theatre, and the catheters were put in place there.

Cesarean procedures were performed by one of 15 consultant obstetricians of the Department of Obstetrics and Gynecology. For all patients, a low transverse incision was used. Before incision of the lower uterine segment, the interventional radiologist inflated the balloons with 2–3 mL of saline solution to stop the blood flow from the internal iliac artery to the uterine arteries. After the incision in the lower uterine segment, the neonate was delivered within 2 minutes. Immediately after delivery, 5 IU of intravenous oxytocin (Syntocinon, Sigma-Tau, Rome, Italy; 5 IU/mL) was given as a bolus. The placenta was delivered by



Fig. 1. The over-the-wire Fogarty Thru-Lumen Embolectomy catheter (Edwards Lifescience Irvine, CA, USA) used for temporary balloon occlusion of the internal iliac arteries during cesarean delivery among patients with placenta previa.

manual removal or by controlled cord traction. Hemostasis was obtained by manual pressure and, from 2010 onwards, vascular plugs (Angio-Seal, St Jude Medical, St Paul, MN, USA) were used. After the uterus was closed and hemostasis was obtained, the balloons were deflated. Within 12 hours of surgery, the catheters and sheaths were removed by the interventional radiologist.

Radiation during pregnancy can potentially cause fetal damage. Adverse effects of radiation are mostly described in the first trimester of pregnancy: after 20–25 weeks of gestation, there are no known teratogenic effects. It is not clear which doses cause radiation damage, but doses below 100 mGy (10 rads [radiation absorbed dose]) seem to have no obvious effect on the fetus. This dose, which is comparable to at least three pelvic computed tomography scans or 20 pelvic radiographs, is generally not used. Clearly, radiation reduction techniques such as short fluoroscopy time, minimum frame rate per second, and smallest radiation area [14] should be applied. At the study hospital, the mean fluoroscopy exposure time for this procedure was 3.5 minutes (range, 1–10 minutes); for the mother, this dose is comparable to approximately five pelvic radiographs. In some cases, longer fluoroscopy times were caused by a steep angle of the aortic bifurcation; in one patient, for whom the fluoroscopy took 10 minutes, the right internal iliac artery originated from the aortic bifurcation [14].

The primary study outcomes were total amount of blood loss, change in hemoglobin level from before surgery to 1 day after surgery, and percentage of patients with blood loss of more than 1000 mL. Secondary outcomes were maternal and perinatal morbidity and mortality. Blood loss during surgery was measured by weighing compresses and blood collected by suction from the operation area (minus the amount of amniotic fluid) caught in measuring trays.

Statistical analysis was carried out with SPSS version 19 (IBM, Armonk, NY, USA). Data are presented as mean \pm SD or median (interquartile range [IQR]). To compare patients with and those without temporary balloon occlusion, Student *t* tests or the non-parametric Mann–Whitney *U* test (if applicable) were used for continuous variables, and the χ^2 test or Fisher exact test (if applicable) was used for categorical variables. *P* < 0.05 was considered statistically significant.

3. Results

Among 68 women with an anterior placenta previa who underwent cesarean delivery, 42 (62%) had temporary balloon occlusion (Fig. 2). Among the 26 who had no balloon occlusion, 14 (54%) delivered before 2005, when the balloon occlusion technique was introduced in the study hospital. The other 12 (46%) patients who did not undergo balloon occlusion but delivered after 2005 were admitted out of hours with acute blood loss, in labor, or with signs of fetal distress. Emergency cesareans were performed, and the attending obstetricians deemed that there was no time to undertake temporary balloon occlusion. There

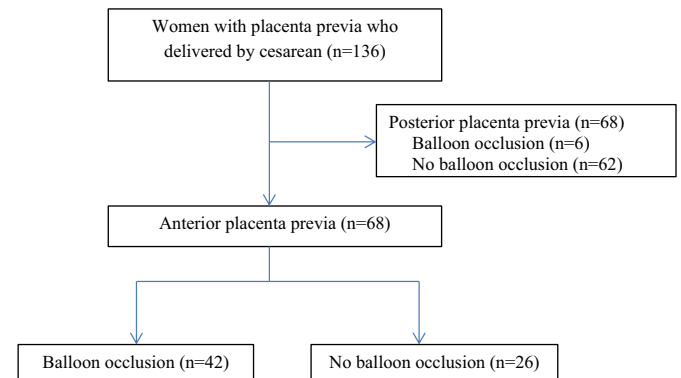


Fig. 2. Flow chart showing derivation of the study population of women with anterior placenta previa and cesarean delivery with or without balloon occlusion.

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