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CLINICAL ARTICLE

Direct puncture embolization of the internal iliac artery during cesarean delivery for pernicious placenta previa coexisting with placenta accreta

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ABSTRACT

Objective: To evaluate direct puncture embolization of the internal iliac artery with hemostatic gelatin sponge particles to treat pernicious placenta previa coexisting with placenta accreta during cesarean delivery. *Methods:* A retrospective study was conducted of data from women with pernicious placenta previa and placenta accreta who underwent direct puncture embolization of the internal iliac artery during cesarean delivery at a center in China between September 1, 2013, and February 28, 2015. Information regarding surgical procedures, operative data, and outcomes during hospitalization were obtained from medical records. *Results:* The procedure was successful in all 16 cases included. Mean operative time was 78 minutes (range 65–90) and mean estimated blood loss was 1550 mL (range 1000–2500). Complications such as fever, buttock pain, or acute limb ischemia were not observed. The procedure was performed after partial cystectomy for two patients with bladder invasion. Postoperative Doppler imaging indicated uterine recovery and normalized uterine blood flow in all patients. *Conclusion:* Direct puncture embolization of the internal iliac artery during cesarean delivery was a safe, effective, simple, and rapid method to control hemorrhage among women with pernicious placenta previa and placenta accreta.

1. Introduction

Pernicious placenta previa (defined as placenta previa attached to previous cesarean delivery scars [1]) is often associated with placenta accreta: in a retrospective study [2], Sumigama et al. showed that 37% of cases of placenta previa among women who had previously delivered by cesarean were associated with placenta increta/percreta. In the past 10 years, the incidence of pernicious placenta previa coexisting with placenta accreta has gradually risen in China as a result of the increased use of cesarean delivery, as well as implementation of a two-child policy [3].

Pernicious placenta previa and placenta accreta can lead to life-threatening maternal hemorrhage and appreciable challenges for clinical management. Postpartum hemorrhage caused by pernicious placenta previa coexisting with placenta accreta is more severe than that caused by uterine atony, with a mean blood loss of 3000–5000 mL [3]. In the study by Sumigama et al. [2], mean intraoperative blood loss was 3630 ± 2216 g among the patients with pernicious placenta previa and placenta increta and 12 140 ± 8343 g among those with placenta percreta; 4.35% of the affected women died due to hemorrhage.

Furthermore, clinical treatment of this condition is complex. Inappropriate management could result in severe bleeding and instantaneous shock. Several techniques are currently available to treat pernicious placenta previa coexisting with placenta accreta during cesarean delivery. These methods include internal iliac artery ligation, hysterectomy, interventional arterial radioembolization, and balloon occlusion of the artery [4–8]. However, all these methods have limitations and their clinical efficacy is far from ideal owing to technical difficulties, increased duration, and the requirement for complex equipment [9]. The risk of hysterectomy among women with pernicious placenta previa and placenta accreta increases with the number of previous cesarean deliveries [4,10,11].

Internal iliac artery ligation was initially used to control intraoperative bleeding associated with cervical cancer, but later became an option for the treatment of postpartum hemorrhage [12,13]. The uterus can be preserved for some patients with severe postpartum hemorrhage treated by internal iliac artery ligation, and maternal outcome can be improved [5]. However, the procedure is usually performed by experienced surgeons or by obstetricians with a lot of surgical experience. The internal iliac artery must be freed in this operation, which can lead to the injury of ureter and iliac vein, severe pelvic-floor bleeding, prolonged operation time, and postoperative ureteral fistula [13]. Additionally, the effective hemostasis time of this procedure can be short because of the plentiful blood flow from collateral circulation.

Pernicious placenta previa coexisting with placenta accreta has traditionally been treated by hysterectomy during cesarean delivery to

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prevent life-threatening bleeding [14,15]. Hysterectomy can achieve the goal of controlling bleeding; however, the sudden loss of fertility after this operation can result in substantial negative consequences for physical and mental health [16]. Additionally, cesarean hysterectomy requires more time and experience than does simple hysterectomy, and is associated with severe intraoperative hemorrhage [17]. This procedure should, therefore, be performed only when conservative treatment is ineffective. For cultural reasons, it is our experience that women in China tend not to accept hysterectomy because it will lead to the loss of fertility.

Interventional arterial radioembolization therapy requires a plastic catheter to be inserted into either the bleeding uterine artery or internal iliac artery, with gelatin sponge particles injected into the target blood vessel under radiographic guidance [18]. Uterine artery or internal iliac artery radioembolization can effectively prevent bleeding and decrease the incidence of hysterectomy.

However, this technique must be performed in well-equipped hospitals with close coordination among skilled radiologists and obstetricians. Primary hospitals in China are often inadequately equipped and lack suitable resources to perform radioembolization. In most cases, patients are transferred to the radiology department for postoperative radioembolization when surgical hemostasis fails during cesarean delivery. However, owing to continuous bleeding and hemodynamic instability, it is unsafe to transfer women with placenta accreta who are undergoing cesarean delivery from the operating room to the radiology department. The transfer of patients will delay the rescue time, increase the amount of bleeding, and raise the need for hysterectomy. Cesarean delivery could be performed in the radiology department of well-equipped hospitals, which would allow the radiologist to undertake preoperative prophylactic internal iliac artery catheterization using radiographic guidance while the patient is anesthetized, followed by cesarean delivery by the obstetric team. Immediate emergency radioembolization might be performed when hemorrhage after delivery is uncontrollable.

Preoperative prophylactic placement of an occlusion balloon in the bilateral internal iliac artery or abdominal aortic can reduce uterine artery pressure and blood loss among patients with placenta accreta when the balloon is inflated to temporarily occlude the primary blood supply to the uterus [6,7]. Although such occlusion of the internal iliac arteries was considered safe, substantial intraoperative blood loss and the need for transfusion were reported in one study; consequently, the common iliac arteries, rather than the internal iliac arteries, were proposed as the optimum location for the occlusion balloon [8]. Thon et al. [19] reported that balloon occlusion of the internal iliac artery was useful for only some patients; furthermore, the risks of blood loss and hysterectomy remained high. These researchers also showed that balloon catheters were associated with adverse outcomes, including groin hematoma, air in pressurized lines, symptomatic hypotension, leg ischemia, and catheter migration [19]. Balloon occlusion might also damage the arterial wall, resulting in the formation of iliac artery thrombosis, iliac artery pseudoaneurysm, and deep-vein thrombosis [20].

Both interventional radioembolization and balloon occlusion of the artery under radiation have limitations for widespread clinical application. These techniques must be performed in hospital with adequate resources and experienced doctors. Both methods also expose the mother and fetus to ionizing radiation. The safety of such maternal–fetal exposure requires further research. Additionally, it can be a threat to mother and fetus if the internal iliac artery catheters are inserted before cesarean delivery after anesthesia: in one study [19], pregnant women had supine hypotension during insertion, and the fetus was in a state of intrauterine hypoxia.

The combination of cesarean delivery and interventional treatment requires close coordination of the multidisciplinary team. Any breakdown in the procedure will delay time to treatment and increase the risk of bleeding. Establishing a new method to promote hemostasis that is simple, fast, and effective would bring substantial clinical benefits. The aim of the present study was to evaluate a novel operative strategy involving direct puncture embolization of the internal iliac artery to control bleeding during cesarean delivery among Chinese women.

2. Materials and methods

A retrospective study was conducted among patients with pernicious placenta previa coexisting with placenta accreta who attended the Department of Obstetrics and Gynaecology, No. 202 People's Liberation Army Hospital, Shenyang, China, for cesarean delivery between September 1, 2013, and February 28, 2015. Eligible patients met the inclusion criteria: placenta previa with at least one previous cesarean delivery and the major placenta attached to the uterine scar; placenta accreta suspected by ultrasonography or magnetic resonance imaging, and confirmed by histologic examination; and direct puncture embolization of the internal iliac artery performed during cesarean delivery. Patients for whom there was insufficient data and those who had no desire to preserve fertility were excluded. The protocol was approved by the ethics committee of the present study center. All included patients had provided written informed consent at the time of treatment for the use of their data in future studies.

Before cesarean delivery, each patient and her family were informed about the risks of pernicious placenta previa coexisting with placenta accreta, the procedure details, and the potential complications of internal iliac artery embolization during cesarean delivery. Preoperative preparation procedures included careful assessment by Doppler ultrasonography and magnetic resonance imaging of the site to establish invaded depth, scope of placenta accreta, and extrauterine organs affected. The administrative department of hospital was informed and effective coordination set up among a multidisciplinary team, which comprised staff from the departments of obstetrics, urology, anesthesia, and neonatology, as well as the blood bank. Sufficient supplies of the blood products, coagulation factors, and instruments required for surgery were made available. Large-bore venous access and central venous pressure access were inserted before surgery.

All operations were performed under epidural anesthesia. Scar tissue was removed from the abdominal wall before entering the intraperitoneal cavity. A transverse incision (approximately 3 cm in length) was made in the seromuscular layer of the uterine segment, which avoided the placenta. The amniotic sac was ruptured with forceps and the amniotic fluid promptly aspirated. Neonates were delivered rapidly after making a bilateral tear of 10–12 cm to the incision. A 20-IU dose of oxytocin was administered intravenously immediately after delivery. Thereafter, a dose of 10–20 IU oxytocin (dissolved in 500 mL of a 0.9% solution of saline) was administered by continuous intravenous infusion, and repeated as necessary. Prostaglandin F2α (250 μg) was injected into the uterine muscle to control hemorrhage. The incision edges were held by oval forceps and the uterine cavity was packed using a gauze pad to stop bleeding from the uterine incision and placental tissue.

Direct embolization of the internal iliac artery was performed after temporary hemostasis had been established. The uterus was removed from the pelvis and then retracted upwards and laterally to expose the common iliac artery and its branches. An incision was made in the peritoneum over the blood vessel (3–5 cm in length), along the internal iliac artery, and the ureter was pushed medially. The bifurcation of the common iliac artery was fully exposed and the internal iliac artery was carefully identified. A 100-mg aliquot of hemostatic gelatin sponge particles (diameter 1000–1400 μm) was dissolved in 20 mL 0.9% saline and then carefully transferred into a 20-mL syringe. The dissolved particles were injected into the internal iliac artery using a 14-gauge needle from a position approximately 2.5 cm below the bifurcation of the common iliac artery. The needle of the syringe was held at a 45° angle from the horizon, with the slope of the tip pointing downward. To stop any bleeding, the injection site was pressed with a

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