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The clinical evaluation of internal iliac arteries balloon occlusion for placenta accreta spectrum

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ABSTRACT

Objectives: To evaluate the balloon occlusion of the internal iliac arteries during a caesarean section in the group of patients with placenta accreta spectrum.

Material and methods: We analysed 29 pregnant women with placenta accreta spectrum. The study group consisted of 15 patients, who underwent a caesarean delivery with temporary bilateral internal iliac artery occlusion. In the control group, we examined 14 women who had a standard caesarean delivery without any radiologic procedure. We compared pre- and post-operative haemoglobin level, necessity of blood transfusion, intraoperative blood loss, intensive care requirement, complications, duration of surgery, anaesthesia and hospital stay.

Results: The history and obstetric outcomes were similar in both groups. The study group required fewer blood transfusions than the control group (p = 0.0176). We administered less packed red blood cells and fresh frozen plasma. Complications were more frequent in the control group (p = 0.0014). Complications related to occlusion of the internal iliac arteries did not occur. The intensive care unit transfer was more frequent in the control group (p = 0.0329). The duration of surgery and hospital stay did not differ between groups. The anaesthesia time was longer in a study group, which related to the radiologic procedure.

Conclusions: Caesarean delivery for placenta accreta spectrum with bilateral balloon occlusion of the internal iliac arteries requires fewer transfusions. It contributes to a decrease in the complication rate and maternal morbidity.

Key words: internal iliac artery occlusion; placenta accreta spectrum

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INTRODUCTION

The pathological implantation of the gestational ovum is responsible for placenta accreta spectrum. The improper placentation is associated with abnormal penetration of the villi into the uterine muscle. In placenta accreta chorionic villi are attached to the myometrium. Placenta increta invades into the myometrium. Placenta percreta penetrates the parametria and other adjacent tissues such as the bladder or rectum [1].

The main risk factors for placenta accreta spectrum are placenta previa and a history of surgery of the uterine muscle. The rate of this pathology has been increasing which is strictly associated with the rising level of caesarean section and the consequences of caesarean scar pregnancies. In the 1960s, it was diagnosed with an incidence of 1 per 4027 pregnancies. In the 1980s, it rose to 1 per 2510 pregnancies and again increased, to 1 per 500 pregnancies, in 2002 [1–3]. For this reason, there is a need for the assessment of the implantation site of pregnancy in the first trimester. Low implantation of the gestational sac at the uterine scar defect should be considered and treated as ectopic pregnancy. In case of low implantation outside of the scar defect, the pregnancy should be carefully monitored as this location of the placenta may be associated with placenta accreta spectrum [4].

According to the literature, invasive placentation may be detected by ultrasound with a sensitivity of 41% and a specificity of 88% in the first trimester of pregnancy [5, 6]. The accuracy of ultrasonography for the diagnosis of this pathology increases over time and reaches a sensitivity of 77–97% and specificity of 96–98% in the second and third trimesters of pregnancy [7–10]. There are also reports on the use of contrast-enhanced ultrasonography, which is permitted for use in pregnant women to improve blood flow through maternal-fetal interface visualisation and, at the same time, to determine the depth of penetration

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of the placental vascularity into the uterine muscle [11]. In more difficult cases, especially with a posterior location of the placenta, MRI can be useful [12, 13].

Invasive placentation is associated with severe complications in pregnancy and the peripartum period, including haemorrhage to various degrees, the necessity of hysterectomy, numerous blood transfusions, what can endanger the health and life of the patients. This condition qualifies as the most severe obstetric pathology [1]. In cases of placenta accreta spectrum the amount of blood loss during caesarean delivery is very often massive, reaching from 3000 to 5000 mL [14]. Ninety percent of these patients need transfusions, in whom 40% need more than 10 units packed red blood cells (PRBCs). The pathology of placentation is also one of the most common causes of peripartum hysterectomy.

In view of these facts, the early detection of placentation disorders is crucial for safety management. Determining the implantation site and degree of this abnormality enables proper prenatal surveillance and can help in avoiding emergency interventions which may lead to life-threatening situations with high maternal mortality, even of 7% [15, 16].

Early diagnosis allows for the best timing of pregnancy and planned delivery; concerning the preparation for operation and surgical technique to avoid severe consequences in the peripartum period. This paper presents the clinical evaluation of temporary bilateral balloon occlusion of internal iliac arteries in caesarean delivery with placenta accreta spectrum.

Objectives

The aim of this study is the clinical evaluation of the balloon occlusion of the internal iliac arteries in caesarean delivery in patients with diagnosis of placenta accreta spectrum.

MATERIAL AND METHODS

This work included clinical data of 29 patients with prenatal diagnosis of placenta accreta spectrum who underwent caesarean section in the 2nd Department of Gynaecology and Obstetrics of Medical University in Wroclaw. The study was approved by the review board of the Department and was conducted in accordance with the Declaration of Helsinki. The requirement to obtain informed consent was waived because of the retrospective nature of this clinically acquired data. Of the 29 analysed cases, 15 patients were referred for caesarean section with temporary balloon occlusion of the internal iliac arteries (study group). The remaining 14 women had caesarean section without balloon occlusion (control group). They were operated on without the possibility of using temporary occlusion of the internal iliac arteries because of the absence of interventional radiology unit. The control group included two patients without a prior diagnosis of placenta accreta spectrum.

In all cases, except two patients from the control group who were diagnosed intraoperatively, the diagnosis of placenta accreta spectrum was based on ultrasonography and, if needed, verified by magnetic resonance imaging (MRI). Currently, in our institution, all patients suspected of placenta percreta are scheduled to undergo elective caesarean section before term followed by hysterectomy.

Catheterisation and placement of the internal iliac balloons at the level of the uterine arteries were performed before the caesarean section in the interventional radiology unit in the University Hospital.

The perioperative plan included the following:

1. Ultrasound diagnosis — assessment of the placenta location, especially for determining the placental borders to establish the site of the uterus incision;
2. Caesarean delivery after 34 weeks of gestation or earlier in case of maternal or foetal complications
3. Elective caesarean section planned for the morning hours dictated by the presence of the entire experienced staff:
   a) 7:00 am: cardiotocography in the obstetric ward and the referral of the patient to the radiology unit;
   b) 7:00-8:00 am: catheterisation of the internal iliac arteries with balloon placement at the level of the opening of the uterine arteries; conducting a test inflation of the catheter balloons to check proper occlusion and to determine the volume of the required contrast material; transfer of the patient to the operating theatre;
   c) 8:00 am: beginning of the caesarean section:
      — The abdomen was entered through a midline vertical incision despite previous transverse scar.
      — After entering the abdomen, the following activities were performed: identification of the presence of any visible blood vessels leading to parametrium; identification of abnormal placentation; identification of the upper border of the placenta via palpation or ultrasound mapping of the placental attachment site; determination of the incision site.
      — Atraumatic delivery of a baby.
      — Ligation of the umbilical cord.
      — In case of placenta percreta, no attempt to detach the placenta was undertaken.
      — Artery occlusion.
      — Lower segment closure with continuous suture with the placenta remaining intact.
      — In case of placenta percreta hysterectomy with dissection from adjacent tissues.
      — Suturing of the vagina.
      — Performance of the methylene-blue test to control any leakage from the bladder.
      — Deflation of balloons.
      — Haemostasis control.

— Closure of the peritoneal cavity with post-operative drainage.

d) Transfer of the patient to the radiology unit to remove catheters.

Every case was analysed in terms of blood loss. This parameter also reflected the general health condition of the patient, the necessity of transferring the patient to the intensive care unit, convalescence time, and post-operative course. Perioperative blood loss was estimated by the sum of the amount of blood in the pump, visual loss through the vagina, as well as the number of used blood-soaked mops and gauze pieces. Total blood loss during caesarean section was not determined by haemoglobin drop, as the anaesthesia progression often required massive blood transfusions to maintain proper vascular fill. As usual, there were difficulties to precisely assess the amount of blood loss during caesarean section; however, the total blood loss was estimated by the amount of required blood transfusions: packed red blood cells (PRBCs) and fresh frozen plasma (FFP), as well as the general condition of the patient after surgery, as evaluated by the need for a transfer to the intensive care unit. The criteria for transfer to the intensive care unit was vestibular-respiratory instability caused by hypovolemic shock.

The differences between the studied groups were analysed in terms of age, maternal height, maternal body weight, parity, blood group, obstetric history (number of any surgery within the uterus), concomitant diseases, course of current pregnancy, and gestational week at delivery, as well as fetal characteristics including fetal presentation, fetal body weight, and APGAR score. The health condition post-operatively was determined based on haemoglobin values in comparison to preoperative values, estimated blood loss, the number of units transfused intraoperatively, and necessity of treatment in the intensive care unit. The assessed intraoperative parameters included the time of anaesthesia, time of surgery, extent of surgery, post-operative complications, complications related to vessel occlusion, length of hospital stay.

The data were analysed for normality using the Kolmogorov-Smirnov test. Summary values are given as a mean (standard deviation from the mean) for variables with a normal distribution and median (range) for distributions other than normal. The comparison between two groups of variables with a normal distribution was conducted with the Student's t-test for independent variables; in the case of variables with a non-normal distribution, the Mann-Whitney U test was used. Two groups of categorical variables were compared with the Pearson's chi-squared test. Data were statistically significant at a value of $p<0.05$. Statistical analysis was carried out with Statistica software v. 10 (StatSoft, Tulsa, OK, USA).

RESULTS

The analysis included 29 cases of pregnant women with invasive placentation hospitalised in the 2nd Department of Gynaecology and Obstetrics Medical University in Wroclaw. Fifteen patients underwent caesarean delivery with bilateral balloon occlusion of the internal iliac arteries (study group), and 14 had caesarean delivery without a radiological procedure (control group). There were no significant differences between the two groups in terms of clinical characteristics. A comparison of the studied groups is presented in Table 1.

Two women from the study group and six from the control group delivered at term. Reasons for early delivery included bleeding — four cases; threatening preterm delivery (shortening of the cervix) – four cases; premature rupture of membranes — three cases; pregnancy-induced hypertension – one case; and HELLP syndrome — one case.

Before the caesarean section, placenta accreta spectrum was suspected in 27 patients; in two cases, this diagnosis was not expected before the surgery. In the end, placenta percreta was diagnosed in 19 patients, all of whom underwent hysterectomy. The diagnosis was confirmed both intraoperatively and histopathologically.

In the study group, following caesarean section, hysterectomy without oophorectomy was performed in 11 patients, while in 4 patients, no hysterectomy was needed. In the control group, hysterectomy without oophorectomy was performed in 8 patients. In 6 control patients with partial accretism the uterus was preserved.

During surgery, the study group required less blood transfusions than the control group ($p = 0.0176$). We administer less packed red blood cells and fresh frozen plasma. Post-operative haemoglobin was markedly but insignificantly lower in the control group ($p = 0.0519$) than in the study group. The complications were higher in the control group ($p = 0.0014$). The perioperative and post-operative period was uneventful in two cases from the control group and in 11 cases from the study group ($p = 0.0014$). In the control group, complications such as disseminated intravascular coagulation, haemorrhage, bladder damage, respiratory failure, and death were reported. Two patients required relaparotomy. In the study group, 4 patients experienced haemorrhage, haemorrhagic shock, bladder damage and post-operative wound infection. The intensive care unit transfer was higher in control group ($p = 0.0329$). Complications related to temporary balloon occlusion of the internal iliac arteries did not occur.

The duration of surgery and hospital stay did not differ between groups. The duration of anaesthesia was longer in the study group due to the need for additional time for catheter placement. Intraoperative characteristics are presented in Table 2.

Table 1. Patient characteristics

Parameter	Control group (n = 14)	Study group (n = 15)	p value
Age; years [mean (SD)]	34.7 (4.87)	34.0 (5.04)	0.9650
Height; cm [mean (SD)]	165 (3.56)	166 (5.89)	0.7752
Maternal Weight; kg [mean (SD)]	77 (10.59)	70 (11.63)	0.1376
BMI [mean (SD)]	28.35 (4.34)	25.50 (4.14)	0.0847
Gravida [median (range)]	3.5 (1–9)	2 (2–9)	0.9103
Delivery [median (range)]	2.5 (1–6)	2 (1–8)	0.9093
Gestational week at admittance [median (range)]	35 (23–39)	31 (12–38)	0.0762
Previous CSs [median (range)]	1 (0–4)	1 (0–3)	0.9074
Previous CS [n(%)] No Yes	 5 (35.71) 9 (64.29)	 1 (6.67) 14 (93.33)	0.0537
Previous vaginal deliveries [median (range)]	0 (0–4)	0 (0–4)	0.9270
Previous miscarriages [median (range)]	0 (0–5)	0 (0–3)	0.4772
Newborn body mass; g [mean (SD)]	2640 (552)	2319 (666)	0.1831
APGAR [median (range)]	8 (5–10)	9 (0–10)	0.9823
Comorbidities [n(%)] No Yes	 6 (42.86) 8 (57.14)	 6 (40) 9 (60)	0.8760
Presentation [n(%)] vertex twins pelvic transverse	 6 (42.86) 3 (21.43) 3 (21.43) 2 (14.29)	 13 (86.67 2 (13.33) 0 0	0.0514

BMI — body mass index; CS — cesarean section; SD — standard deviation

Table 2. Comparison of intraoperative data between the control and study group

Parameter	Control group (n = 14)	Study group (n = 15)	p value
Pre-operative Hb [mean (SD)]	11.76 (1.09)	11.78 (1.17)	1.0000
Post-operative Hb [mean (SD)]	6.96 (2.53)	8.75 (1.78)	0.0519
Necessity of blood transfusion [n(%)] No Yes	 0 14 (100)	 5 (33.33) 10 (66.67)	**0.0176**
Packed red blood cells [median (range)]	6 (3–21)	2 (0–10)	**0.0028**
Fresh frozen plasma (FFP) [median (range)]	4 (3–13)	1 (0–11)	**0.0104**
Platelet concentrates [median (range)]	0 (0–11)	0 (0–10)	0.4598
Estimated blood loss; ml [median (range)]	2250 (800–5000)	1700 (400–4500)	0.0686
Gestational weeks at delivery [median (range)]	36 (31–39)	35 (28–38)	0.0742
Hospital stay; days [median (range)]	29.5 (8–85)	41 (9–167)	0.2847
Duration of anesthesia; min [mean (SD)]	2:09 (1:06)	4:57 (1:22)	**0.0001**
Duration of surgery; min [mean (SD)]	1:41 (1:04)	1:58 (0:44)	0.4023
Complications [n(%)] No Yes	 2 (14.29) 12 (85.71)	 11 (73.33) 4 (26.67)	**0.0014**
Intensive care requirement [n(%)] No Yes	 7 (50) 7 (50)	 13 (86.67) 2 (13.33)	**0.0329**

Hb — haemoglobin; SD — standard deviation; significant differences are marked in bold

DISCUSSION

Our study showed that caesarean delivery with bilateral balloon occlusion of the internal iliac arteries resulted in a lower transfusion requirement and lower complication rate in comparison to caesarean section without this occlusion.

In the review of literature, many studies lead to contradictory conclusions regarding prophylactic balloon occlusion of the internal iliac arteries [17]. In a study from 2016 based on 13 cases with temporary bilateral balloon occlusion of the internal iliac arteries, the mean perioperative blood loss was 1261 mL. Over half of the patients required blood transfusion, and two of them were transferred to the intensive care unit. In the present study, the mean estimated blood loss was 1847 mL in the study group and 2757 mL in the control group. Although this difference was insignificant, the need for blood transfusion was greater in the control group versus the study group. Thus, we conclude that the advantage of prophylactic balloon occlusion of the internal iliac arteries is not only the facilitation of the removal of the uterus due to reduced perioperative bleeding, but also a decrease in numerous complications related to massive blood loss, including a reduction in the number of transfusions [18].

Similar outcomes were reported by other authors from different centres worldwide [19, 20]. There are different variants of this technique described in the literature, which are based on the occlusion of the other vessels than the uterine artery. In the case of closure of the common iliac artery, there is a need to intraoperatively monitor proper blood perfusion to the lower limbs or reduce the intraoperative time. Both factors are not favourable for those doing the operation [21]. In another study of 105 patients (57 with catheters placed in the abdominal aorta and 48 in the internal iliac artery), patients undergoing abdominal aortic occlusion experienced less blood loss, required a smaller volume of blood transfusion, and had shorter balloon insertion time and fluoroscopy time; the latter translated into a decrease in fetal radiation dose than for patients with internal iliac artery occlusion [22]. There are also papers that report high embolisation of the abdominal aorta under the origin of the renal arteries [23, 24].

However, there are published unfavourable reports concerning the application of this technique. In a study performed in an Australian medical centre that presented 52 cases of pregnant women, 27 of whom were operated on without catheters with balloons and 25 of whom had catheters, no differences were revealed in terms of estimated blood loss, post-operative drop in haemoglobin, or the number of blood transfusions. Additionally, two cases of acute thromboembolic complications related to temporary embolisation occurred [21]. In another study on the adverse consequences of the described procedure of catheterising minor pelvis vessels, the perioperative rupture of the right iliac artery took place, requiring massive transfusion and admission to the intensive care unit [25].

The complication rate of bilateral balloon occlusion of the internal iliac arteries ranges between 6 and 16%. The most significant complication with the incidence of five percent is acute ischemia of the lower limbs due to a thromboembolic event or the rupture of the vessel. Other complications include pseudoaneurysms or uterine necrosis. In our study, no complications occurred in any of the 15 patients undergoing this procedure [26, 27].

For the early prevention of placenta accreta spectrum, it is important to diagnose a scar defect after caesarean section delivery, but also to detect an improperly located gestational sac. All patients with low implantation of gestational sac and surgeries of the uterine muscle in their history, especially those who have had multiple caesarean sections should be closely monitored to detect possible symptoms of placenta accreta spectrum [6, 28].

Early detection of pathologic placentation enables proper planning and delivery timing. Caesarean section should be performed with a multidisciplinary team and sufficient blood bank supply in a tertiary referral centre what may contribute to a decrease in the complication rate and maternal mortality.

CONCLUSIONS

Temporary bilateral occlusion of the internal iliac arteries in the caesarean delivery for placenta accreta spectrum improves the quality of the surgery and the patients' general health condition. According to our study, this modality contributes to the reduction in the transfusion requirement and the decrease in the rate of complications. Although our work shows benefits of balloon occlusion of internal iliac arteries during caesarean delivery in patients with placenta accreta spectrum, further studies are essential to choose the best surgical technique in pathological implantation.

Conflict of interest

All authors declare that they have no conflicts of interest.

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