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Retrospective analysis of 586 cases of placenta previa and accreta

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ABSTRACT

In this study, we conducted a retrospective investigation of all cases of placenta previa and accreta that were treated at a tertiary-level hospital to assess the effectiveness of balloon catheterisation at different levels. We evaluated the surgical and neonatal outcomes of 586 cases of placenta previa and accreta that were treated at our facility. This is the largest study of its kind. Depending on the severity and position of accreta, patients underwent balloon catheter placement in the aorta ($n = 252$) or common iliac artery ($n = 38$) before delivery by caesarean section. Data were collected regarding the duration of the surgery, number of cases (percentage) of balloon occlusion, and annual rate of hysterectomy. The blood loss (2207.89 ± 2044.95 ml) and transfusion volume (7.42 ± 7.872 U) in the common iliac occlusion group was greater than those in the aortic occlusion group (1967.66 ± 1466.64 ml and 6.54 ± 5.67 U, respectively); however, this difference did not reach statistical significance ($p > .05$). With the increase in the number of procedures performed over the years of study, the surgeons' skills improved significantly. The choice of balloon catheterisation must be made with careful consideration. Our results highlight the significance of suture skill and the experience level of surgeons.

KEYWORDS

Placenta previa; placenta accreta; balloon occlusion; suture skill

IMPACT STATEMENT

- **What is already known on this subject:** The optimal method for the management of placenta accreta remains debateable. Prophylactic balloon catheters placed within arteries to control intraoperative bleeding play an important role in the management of patients with placenta accreta.
- **What the results of this study add:** The common iliac artery occlusion group tended to have a greater amount of blood loss and a higher requirement of transfusion than the aortic occlusion group; however, this difference was not statistically significant. We also analysed the difference in the complications across different periods of the study period and observed a clear improvement in the operative procedures over time.
- **What the implications are of these findings for clinical practice and/or further research:** Our study revealed that the surgeons' proficiency increases over time, leading to improved results and a lower rate of hysterectomy over the course of several years. We recommend that the choice for balloon catheter occlusion be made with caution and after careful consideration.

Introduction

Placenta accreta was first described in 1937 by Frederick C. Irving, an obstetrician, and Arthur T. Hertig, a pathologist (Kilcoyne et al. 2017; Millischer et al. 2017; Thiravit et al. 2017). Depending on the degree of placental penetration through the decidua basalis and myometrium, the placenta accreta spectrum can manifest as placenta creta, increta, or percreta (Kilcoyne et al. 2017; Millischer et al. 2017; Thiravit et al. 2017). Placenta accreta can cause maternal morbidity and mortality, and it is an important cause of life-threatening postpartum haemorrhage, hysterectomy, disseminated intra-vascular coagulation, and even death (Fan et al. 2017a).

Prenatal ultrasonography and magnetic resonance imaging (MRI) are used to identify the presence of abnormal placentation and thereby facilitate clinical management (Jauniaux and Bhide 2017; Kumar et al. 2017; Jauniaux et al. 2018). The optimal method for the management of placenta accreta still remains debateable. Prophylactic balloon

catheters placed within arteries to control intraoperative bleeding (Cui et al. 2017) play an important role in the management of patients with placenta accreta. However, because of the high cost of this procedure, the possibility of radiation exposure to the foetus, and complications associated with the use of balloon catheters, it is necessary that the choice of this technique be made only after careful consideration.

In this study, we sought to conduct a retrospective investigation of all cases of placenta previa and accreta treated at a tertiary-level hospital to assess the effectiveness of balloon catheterisation at different levels.

Materials and methods

Study protocol

This study was conducted as a retrospective investigation of all cases of placenta previa and accreta treated at our hospital between January 2012 and October 2017.

Patients

The high rate of caesarean delivery in the past few years and the introduction of the “two child policy” in January 2016 have led to a significant increase in the prevalence of abnormally invasive placenta in mainland China (Fan et al. 2017a). Primary health care centres are not equipped to provide effective treatment in these cases; therefore, an increasing number of patients are referred to tertiary hospitals. Shandong province has the highest rate of second-births in mainland China and has, therefore, met with unprecedented challenges in obstetrics. At Shandong Provincial Hospital, a tertiary-level hospital and referral centre for provincial critical care, we receive many patients with placenta previa and accreta, who are referred to our hospital for caesarean section from clinics across the entire province.

The inclusion criteria in this study were placenta previa and accreta (with a history of one or more deliveries by caesarean section), as confirmed by Doppler ultrasonography and MRI and subsequently confirmed by intraoperative and postoperative pathologic examination. Only cases with both placenta previa and accreta were included in this study. Thus, cases with only placenta previa or accreta were excluded.

Patients who required treatment were classified into two groups depending on the severity and position of accreta, and the indicator for the procedure was complete or almost total absence of the normal muscular layer in the lower uterine segment or accreta, covering a width of greater than 3 cm. Patients who met the above condition were assigned to the two groups depending on whether the balloon catheter was placed in the aorta ($n=252$) or common iliac arteries ($n=38$) before delivery by caesarean section (according to the patients' choice with full informed consent). The remaining 296 patients did not undergo any intervention until delivery. Before delivery, the patients and their families were informed of the risks for the mother and child due to placenta previa and accreta. Each case was analysed individually, including symptoms, gestational week, maternal age, degree or scope of accreta, and complications. Preoperative ultrasonography and MRI were performed to determine the severity and position of placenta accreta, which is a critical point to consider in the prophylactic use of balloon catheters. If balloon occlusion was considered, interventional radiologists were consulted. The relationship between the bladder and the length of cervix was also taken into consideration. If necessary, a urologist was consulted before or during the surgery. Preoperative arrangements were made for adequate blood for transfusion.

For placement of the balloon catheter in the aorta, local anaesthesia was induced, followed by puncture of the right femoral artery. A 9F sheath and occlusion balloon catheters (BALD 18 × 40 mm Crystal) were inserted with the tips in the aorta, below the level of the renal artery. For the placement of the balloon catheter in the common iliac arteries, a 7F sheath and balloon catheters (Fogarty) were inserted bilaterally via the femoral arteries at the level of the fifth lumbar vertebra, under local anaesthesia. After insertion of the catheters, the placement of the balloon and effective vascular

occlusion were confirmed by contrast angiography during balloon inflation. The volume of the contrast agent required to inflate each balloon was recorded. After the placement of the catheters was completed, the patients were transferred to the operating room of the obstetrics department.

Epidural anaesthesia or general anaesthesia was administered for caesarean section. All of the patients who underwent balloon occlusion required general anaesthesia because these patients could not flex their legs for the administration of the epidural injection, due to the presence of the femoral catheters. Intra-arterial blood pressure was measured during the operation in all cases. Immediately after the delivery and clamping of the umbilical cord, the balloons were inflated using a predetermined volume of normal saline. The duration of the occlusion was determined and recorded to be less than 35 min in all cases. If a second occlusion was needed, an interval of 10 min was required. The balloons were routinely deflated once haemostasis was achieved, and the catheters were removed after the operation once the vital signs of the patient stabilised.

The clinical outcome in each case was recorded in complete detail, including the estimated blood loss, amount of intra-operative blood transfusion, and need for caesarean hysterectomy. Maternal complications related to balloon occlusion were also recorded.

Similar to arterial balloon catheterisation, other surgical techniques were required. The duration of the surgery, number of cases (percentage) of balloon occlusion, and rate of hysterectomy were also recorded every year.

Statistical analysis was performed using SPSS (version 17.0; SPSS, Chicago, IL). A p value < .05 was considered statistically significant.

Results

During the study period, 586 cases of placenta previa and accreta were diagnosed. There were no cases of maternal or foetal mortality. Cases of only placenta previa or accreta were excluded from this study (approximately 2%) (Tables 1 and 2).

Among the 586 patients, 252 underwent catheter placement in the aorta, while 38 patients had catheter placement in the common iliac arteries. The remaining 296 patients underwent caesarean section without intervention. Caesarean section was performed at an average gestational age of 35 weeks, which is consistent with the standard guidelines (Jauniaux and Bhide 2017). In this study, balloon occlusion was the chosen intervention in patients with severe accreta, including complete or almost total absence of the normal muscular layer in the lower uterine segment, or accreta covering a width of lower uterine segment greater than 3 cm. No intervention was employed in the cases of mild or moderate accreta. Therefore, we performed statistical analysis only for the two groups that underwent balloon catheterisation, because of the homogeneity of cases. Analysis of the severity of accreta in the two intervention groups revealed no significant intergroup difference.

Table 1. Characteristics of 586 cases of placenta previa and accreta.

	Aortic group (n = 252)	Common iliac group (n = 38)	p	Control (n = 296)
Maternal age (years)	32.69 ± 4.62	32.66 ± 4.47	.968	32.74 ± 4.84
Gestational age at delivery (weeks)	35.54 ± 2.04	35.18 ± 4.05	.388	35.46 ± 3.03
Gravidity	3.37 ± 1.23	3.21 ± 1.02	.451	3.47 ± 1.31
Placenta creta	0	0		189
Placenta increta	192	29	.795	99
Placenta percreta	60	9		8
Blood loss (ml)	1967.66 ± 1466.64	2207.89 ± 2044.95	.489	1338.18 ± 1286.14
Transfusion (U)	6.54 ± 5.67	7.42 ± 7.872	.513	3.99 ± 5.29
Surgery time (min)	191.05 ± 59.40	200.00 ± 80.75	.412	153.02 ± 57.33
Admission days	9.23 ± 5.02	10.47 ± 10.41	.236	8.25 ± 5.34
Birth weight (g)	2817.69 ± 491.13	2784.74 ± 645.68	.713	2771.97 ± 710.07

Table 2. Characteristics of 586 cases of placenta previa and accreta by year.

	2012 (n = 22)	2013 (n = 14)	2014 (n = 64)	2015 (n = 67)	2016 (n = 189)	2017 (n = 230)
Duration of operation (min)	206.36 ± 60.36	212 ± 46.62	194.17 ± 57.60	166.4 ± 58.67	147.31 ± 59.29	138.62 ± 47.09
Aortic	0	4 (28.5%)	52 (81%)	42 (62%)	86 (45%)	68 (29%)
Common iliac	0	0	0	0	25 (13%)	13 (5%)
Hysterectomy	15 (68%)	9 (64%)	26 (40%)	11 (16%)	15 (7%)	10 (4%)

In addition, we compared the two groups in terms of estimated intra-operative blood loss and requirement for transfusion. The group that underwent balloon occlusion of the common iliac arteries had a greater amount of blood loss and a higher requirement of transfusion as compared to the group that underwent aortic occlusion; however, this difference was not significant. There was also no significant difference between the hysterectomy rates in the two groups.

We also analysed the difference in the operation time and hysterectomy rate across different periods of the study period and observed a clear improvement in the operative procedures. In 2012, the balloon technique had not yet been applied in the management of placenta accreta, and surgeons had not acquired sufficient skills in the surgical management of placenta previa and accreta, resulting in a high rate of conversion to hysterectomy (68%). In 2014, with the gradual rise in the popularity of balloon technology, the technique was performed in more than 80% of the cases of accreta. With the increase in the proficiency of the surgeons in performing the balloon occlusion, the rate of hysterectomy decreased from 68% to 40%. A sudden increase in the prevalence of placenta accreta resulted in an increased dependence on the balloon technique among obstetricians. However, because of the lack of surgical skills required for the treatment of placenta accreta, the rate of hysterectomy was relatively high. With the increase in the number of cases of placenta accreta, there was an improvement in the suture technique. In 2017 (until October), the rate of balloon occlusion among cases of placenta accreta decreased to 34%, while the rate of hysterectomy decreased to 4%. Therefore, it may be considered that fewer patients would need balloon occlusion and that the expertise of the obstetricians had improved.

In the aortic occlusion group, one patient developed femoral arteriovenous fistula, which was successfully managed by fistula repair. In addition, 46 patients in the aortic occlusion group and 12 patients in the common iliac occlusion group had markedly weakened or non-palpable pulsation of the dorsalis pedis artery after the operation; no patients in either

intervention groups developed ischaemia. Ultrasound examination revealed the formation of a thrombus in the upper femoral artery in seven cases in the aortic occlusion group and in one case in the common iliac occlusion group. At the end of the follow-up period of 1–3 months, all patients achieved complete functional and sensory recovery of the lower extremities.

Discussion

In this study, we sought to conduct a retrospective investigation of all cases of placenta previa and accreta that were treated to assess the effectiveness of balloon catheterisation. We successfully reveal the optimal method for placenta accreta and emphasise the important role of surgical skills in such procedures.

The clinical treatment of placenta accreta is rather difficult and challenging for obstetricians. Treatment of the condition is associated with high rates of complications, such as severe obstetric haemorrhage, shock, disseminated intravascular coagulation, multiple organ failure, and even fatality. Delivery by caesarean section, along with hysterectomy, is considered the gold standard in the treatment for placenta accreta. However, in clinical practice, we find that irrespective of the age, women strongly prefer to retain the uterus. Therefore, depending on the level of experience of the surgeon, various types of suture techniques may be effectively employed, thereby reducing the need for hysterectomy and preserving the patient's fertility for the future (Du et al. 2014).

Prophylactic placement of endovascular balloon catheters to control haemorrhage in placenta accreta has been a long-standing topic of debate (Masamoto et al. 2009; Martinelli et al. 2010). The most commonly performed intervention procedure is the balloon occlusion of the internal iliac artery. However, because the uterine artery has an extensive collateral circulation, occlusion of the internal iliac artery may not always reduce bleeding to a satisfactory degree. Therefore, in the past, many investigators have focussed on balloon occlusion of the aorta and common iliac arteries. However, the

conclusions of these studies are diverse in terms of the efficiency of the procedure and the rate of complications. This may be due to differences among the studies in terms of the selection of cases, study design, experience of operators, subjective judgment for clinical parameters, and definition of placenta accreta (Minas et al. 2015; Salim et al. 2015; Fan et al. 2017b). The majority of these studies are based on small sample sizes, which limits the significance of their results. Our study is based on the analysis of the data of 586 cases that were collected over a period of 5 years, reliably indicating that balloon occlusion is safe and can effectively control blood loss in patients with placenta accreta. The main benefits of this technique are the availability of a clear surgical field, good bleeding control and rapid haemostasis, thereby decreasing the need for hysterectomy. These findings are consistent with those of Panici et al. (2012), Xie et al. (2017), and Luo et al. (2017). This is the first study that exhibits the difference in the effects of balloon placement between the aortic and common iliac techniques. No difference was noted in the position and severity of placenta accreta in the aortic occlusion group and the common iliac occlusion group, which ensures the accuracy and comparability of the results of the statistical analysis in our study. Interestingly, we found no statistically significant intergroup differences in the estimated intraoperative blood loss and transfusion volume of the two groups. However, we must acknowledge that common iliac occlusion could only be performed during the last 2 years of the study period and, even then, this method was only performed in a small number of cases; this may have skewed the results to some extent. Further research is necessary to compare the two methods. Because the balloon occlusion of the common iliac arteries is a bilateral procedure, it would require a longer duration for completion of the operation and involves a greater degree of radiation exposure to the foetus (Minas et al. 2015). Conversely, aortic occlusion is more commonly performed in clinical practice, which could mean that surgeons have a greater experience in using this technique.

In view of the potential risks of the operation, including ischaemia in the lower extremities, aortic rupture, aortic dissection, branch vessel occlusion, reperfusion injury, and iliac artery thrombosis, it is necessary to carefully assess the risk–benefit of the operation. Therefore, the choice to perform this procedure must be made with great care (Dilauro et al. 2012; Sentilhes et al. 2013; Chen et al. 2017).

Our findings also highlight the importance of the surgeon's proficiency in suture placement and level of experience. With the increase in the number of procedures performed, the surgeon's proficiency improved significantly over the years, leading to a considerable decrease in the number of cases of balloon occlusion and rate of hysterectomy. Different surgical methods have been reported by different authors, depending on their experiences, including bilateral ligation of the ascending uterine artery, resection of the location of placenta accreta, uterine B-lynch suturing, simple suture, 8-suturing, continuous suture, and interrupted suture, among others (Huang et al. 2014; Matsubara et al. 2013; Mohamed and Mohammed 2019). These differences are especially important in low-resource countries. The aim is to

ensure fast and effective haemostasis and cessation of severe bleeding from the placental attachment site. Regrettably, our study does not eliminate the impact of the differences in the skills of the operating surgeons.

To the best of our knowledge, this study is the largest of its kind. However, our study does have a few limitations, which include its retrospective nature and the difference in the sample sizes of the two balloon occlusion groups. Further investigations from multiple centres that include a greater number of cases are warranted.

To conclude, our findings indicate that balloon occlusion of the common iliac arteries entailed greater blood loss and a higher need for transfusion than occlusion of the aorta. Our study also revealed that the surgeons' proficiency increases over time, leading to improved results and a lower rate of hysterectomy over the course of several years. We recommend that the choice for balloon catheter occlusion be made with caution and after careful consideration.

Disclosure statement

A disclosure statement reporting no conflict of interest has been inserted. Please correct if this is inaccurate.

Data availability

The datasets generated and analysed during the present study are available from the corresponding author on reasonable request.

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