Intraoperative Intermittent Blocking of the Common Iliac Arteries in Cases of Placenta Percreta without the Use of Fluoroscopy

Intraoperative intermittierende Blockung der Arteriae iliacae communes bei Placenta percreta unter Vermeidung von Röntgenstrahlung

Authors S. Heinze[1, 2], B. Filsinger[3], G. Kastenholz[4], R. J. Schröder[4]

Affiliations
[1] Institute of Forensic Medicine, Goethe-Universität Frankfurt am Main, Germany
[2] Institute of Diagnostic and Interventional Radiology, Klinikum Oldenburg, Oldenburg, Germany
[3] Maternity Clinic, St. Marienkrankenhaus, Ludwigshafen, Germany
[4] Department of Radiology, St. Marienkrankenhaus, Ludwigshafen, Germany

Key words
- placenta accreta/percreta
- iliac artery ballon occlusion
- uterine hemorrhage
- cesarean section

Abstract

Background: The number of patients with placenta accreta, percreta and increta is increasing. The morbidity and mortality are higher mostly due to hemorrhage. Therefore, new methods to reduce the risk of severe bleeding are necessary.

Methods: Three patients were treated in collaboration by obstetricians, urologists, anesthesiologists, and radiologists. An MRI of the pelvis was performed and the diameters and lengths of the iliac arteries were measured to avoid fluoroscopy during the preoperative placement of catheter balloons into the iliac arteries. During the operational procedure the balloons were inflated and deflated depending on the operative site and the occurrence of bleeding.

Results: In comparison to the literature, severe bleeding was clearly reduced. No complications of the intervention were observed.

Conclusion: The presented method to reduce severe bleeding might represent significant progress in the management of abnormal placenta implantation. Nevertheless, further controlled studies are needed in order to establish evidence-based recommendations.

Key Points:
- Reduction of perioperative hemorrhage in cases of placenta accreta, percreta, and increta.
- A preinterventional MRI of the pelvis allows measurement of the illiac arteries so that the fetus is not exposed to radiation.
- The short occlusion time (under the nominal pressure of the balloon) of the common iliac arteries reduced interventional complications.

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Zusammenfassung

Hintergrund: Die Zahl der Patientinnen mit Plazenta accreta, percreta und increta ist ansteigend. Bei diesen besteht eine hauptsächlich durch schwere Blutungen verursachte erhöhte Morbidität und Mortalität. Daher werden neue Methoden benötigt, um diese zu reduzieren.

Material und Methoden: Drei Patientinnen wurden interdisziplinär durch Gynäkologen, Urologen, Anästhesiologen und Radiologen betreut. Vor der Sectio caesarea wurde eine MRT-Untersuchung des Beckens durchgeführt, um den Durchmesser und die Länge der Beckengefäße zu bestimmen und eine Röntgenstrahlenexposition während der Platzierung von Ballonkathetern in der Arteria iliaca communis vor der Sectio zu vermeiden. Während der Operation wurden die Ballons in Abhängigkeit vom Operationssitus und auftretenden Blutungen inflatiert bzw. deflatiert.

Ergebnisse: Im Vergleich zur Literatur konnte die Blutung deutlich reduziert werden. Röntgenstrahlung wurde vollständig vermieden, und es traten keine postinterventionellen Komplikationen auf.

Schlussfolgerung: Die hier vorgestellte Methode zur Reduktion des Blutungsrisikos könnte einen deutlichen Fortschritt im Management der abnormen Placentaimplantation darstellen. Weitere kontrollierte Studien sind jedoch erforderlich, um evidenzbasierte Empfehlungen aussprechen zu können.

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Correspondence
Dr. Sarah Heinze
Institute of Diagnostic and Interventional Radiology,
Klinikum Oldenburg gGmbH
Institut für Diagnostische und Interventionelle Radiologie
Rahel-Straus-Straße 10
26133 Oldenburg
Germany
Tel.: ++ 49/4 41/40 37 75 74
heinze@uni-mainz.de

Introduction

Abnormal implantation of the placenta in the form of placenta accreta or percreta is associated with infiltration of the chorionic villi into or through the uterine wall with adherence to or infiltration of neighboring organs in some cases. Morbidity and mortality for the mother and child are increased due to postpartum bleeding which totals 3000 – 5500 ml on average [1]. The frequency of abnormal placental implantation is increasing [2, 3]. Therefore, minimally invasive prophylaxis of severe bleeding during Cesarean section that can be achieved intraoperatively with temporary occlusion of the iliac artery (usually the internal iliac artery) is becoming increasingly important in the prevention of bleeding [4 – 7]. As a result of subsequent embolization of the afferent arteries with degradable particles, an otherwise obligatory hysterectomy can be avoided in some cases [8 – 11]. The significance of temporary balloon occlusion is controversial [1 – 7]. The goal of our report is to document three such cases in which the use of intraoperative X-rays could be completely avoided. To our knowledge, this has not been described in the literature to date.

Method

In three healthy patients between the ages of 29 and 40 in good general health with preceding births and Cesarean sections, a Cesarean section was performed in the 28th gestational week + 6 days, 36th gestational week + 2 days, and 36th gestational week + 6 days. All births were without complication for the child. The preceding clinical, ultrasound, and MRI examinations showed a placenta increta or percreta (**Table 1**, **Fig. 1**). In some cases, there was suspicion of placental adhesion to the bladder wall or invasion of the bladder wall.

To improve risk management, a multidisciplinary approach was selected: Based on the preceding MRI examination of the pelvis on 3 planes with T1 and T2 weighting, the distance from the common femoral artery to the aorta under consideration of the origin of the internal iliac artery was measured when possible. In addition, the diameter of the individual vessels was determined (**Fig. 2**).

During and following Cesarean section and during hysterectomy and placental resection, intermittent occlusion of the common iliac arteries was performed bilaterally or unilaterally, depending on the particular situation regarding surgery and bleeding, for a maximum of 5 minutes. This provided surgeons with a clear view of the operative site (**Fig. 3**). Prior to the start of Cesarean section, 7F or 8F introducers with a length of 11 cm were inserted bilaterally into the common femoral artery using the standard Seldinger technique while controlling arterial reflux. Due to the preceding measurement based on the available cross-sectional images, the balloon occlusion via manometer was able to be performed without fluoroscopy and without intravenous contrast agent application under the nominal pressure of the balloon. During the intervention, the catheter lumen was continuously rinsed with an NaCl solution to prevent thrombosis. Following the complete removal of the placenta and a hysterectomy, a cystorrhaphy was performed by the attendant urologist in the second patient. Prior to the intervention, the planned procedure and the associated risks were explained to the patient and her family in detail.

Results

The prepared angiography system was not needed in any of the three cases. The introducers were able to be placed without complication using the Seldinger technique and the balloon catheters were able to be advanced. The data obtained as previously described by measuring the vessels on MRI were fully sufficient for the occlusion procedure so that X-rays as well as contrast agent administration were not necessary. Complications caused by the intervention such as aneurysms or peripheral embolisms due to thrombus formation were not observed in any of the patients.

It was possible to reduce the intraoperatively measured blood loss to 600, 700, and 1500 ml, respectively, in the three cases. Hemoglobin values, volume and blood substitution, and pathological analysis results are specified in **Table 1**.

All patients recovered quickly from the intervention which was well tolerated. The newborns also did not experience any complications following the intervention.

Discussion

Delivery via Cesarean section and atypical configuration of the placenta have increased in recent years [12, 13]. Typical abnormal configurations are placenta accreta with penetration through the decidua basalis, placenta increta with myometrial invasion, and placenta percreta with penetration of the serosa and possible infiltration of neighboring organs. All three forms are typically accompanied by placenta previa. Obligatory ultrasound and optional magnetic resonance imaging are suitable for preoperative diagnostics. Increased blood loss is typically observed during delivery and especially during subsequent placenta removal and hysterectomy [14]. According to Read et al. [14], an average blood loss of 3.8 l was observed in 22 patients with placenta accreta. For example, an analysis of 62 patients with placenta accreta showed blood loss of more than 2 liters in over 90 % and more than 5 liters in almost 25 % [15]. Blood transfusions are therefore usually unavoidable [8].

The increased risk of blood loss can be reduced by prophylactic balloon occlusion of the abdominal aorta, the common iliac artery, the internal iliac artery, or the uterine artery [10, 16, 17]. However, there are only a few studies regarding this topic. The method is controversial discussed in the literature and controlled studies are lacking. According to other studies, the blood loss, required blood volume substitution, operation time, and duration of hospital stay are not significantly reduced [16, 18]. This can be primarily attributed to the pronounced collateralization that prevents ischemia during occlusion [19], in particular via the obturator artery as a connection between the external and internal iliac artery [20].

The first descriptions of bleeding control via temporary balloon occlusion are from the years 1953 and 1954 [21, 22]. Balloon occlusion for the purpose of reducing bleeding was performed successfully in the year 1995 [9] in the case of a

Table 1 Relevant preoperative, operative and postoperative parameters of the three patients.

	Pat. 1 (BG)	Pat. 2 (NH)	Pat. 3 (SR)
age	40 years	30 years	29 years
number of earlier pregnancies	2	4	3
number of earlier births	2 cesarean sections (including 1 stillbirth)	3 cesarean sections	1 spontaneous birth 1 cesarean section
other history	history of intrapartum uterine rupture, gestational diabetes	borderline disorder	–
gestational week at time of delivery	36 + 2	28 + 6	36 + 6
configuration of the placenta (pathology)	complete placenta previa with focal placenta increta parametrial right, covering of the entire surface of the internal orifice of the uterus	placenta accreta, increta, and percreta in the region of the isthmus and endocervix	placenta increta implanted deep in the anterior wall of the isthmus, 4 cm large left lateral uterine wall defect in the region of the placenta percreta
fetal presentation	head presentation	head presentation	breech presentation
APGAR score	9/9/10	3/5/6	4/8/9
surgical intervention	longitudinal laparotomy, cesarean section with longitudinal uterotomy in the region of the fundus, adhesiotomy, hysterectomy (supracervical)	cystoscopy, splinting of the ureters, longitudinal laparotomy, cesarean section with longitudinal uterotomy, adhesiotomy, hysterectomy (supracervical)	cystoscopy, splinting of the ureters, hysterectomy, longitudinal laparotomy, cesarean section with longitudinal uterotomy, adhesiotomy, hysterectomy (supracervical)
Hb value immediately prior to delivery	12.9 g/dl	10.5 g/dl	12.1 g/dl
Hb value immediately after delivery	11.5 g/dl	8.4 g/dl	6.8 g/dl
blood loss	600 ml	700 ml	1500 ml
applied blood substitute	–	–	2 erythrocyte concentrates 1 fresh frozen plasma
angiographic intervention material used	8F introducer, XXL large diameter balloon dilatation catheters (L: 4 cm, D: 18 mm)	7F introducer, XXL large diameter balloon dilatation catheter (L: 2 cm, D: 14 mm)	7F introducer, XXL large diameter balloon dilatation catheter (L: 2 cm, D: 14 mm)
fluoroscopy time	0	0	0
dose area product	0	0	0
amount of contrast agent applied	0	0	0

Fig. 1 MRI examination of the pelvis showing the placenta (T2-weighted images, sagittal).

Fig. 2 MRI examination of the pelvic vessels (T2-weighted images, coronal).

postpartum hemorrhage. These successes were confirmed in further studies [18, 21].

Kidney et al. [23] showed reliable hemostasis with only minimal complications via temporary occlusion without particle embolization in the case of placenta accreta. Polytransfusions were needed in only one patient in another study by Li et al. [8], while only a single blood transfusion and volume substitutions were sufficient in 12 of 21 patients [8]. Dubois et al. [24] described temporary occlusion with few thromboses and an average blood loss of approx.

Fig. 3 Operative site before hysterectomy.

1.6 l in placenta percreta. In a retrospective study, Bodner et al. [16] found no reduction in average blood loss in the case of temporary balloon occlusion and subsequent gel foam embolization of the internal iliac artery bilaterally in the case of placenta accreta compared to a control group not treated in this way.

Complications were described for example by Sewell et al. [11] in a patient with placenta accreta after multiple Cesarean sections in the form of a thromboembolism of the popliteal artery with consecutive distal acute ischemia after 25-minute occlusion.

The cases documented by us show a different result with respect to blood loss and hemoglobin value decrease but are all lower than the blood loss to be expected in the case of placenta accreta [14]. None of the studies and case reports to date have been able to definitively prove a benefit of temporary balloon occlusion (e.g. [4, 25]) due to the low number of cases or the lack of a control group. However, occlusion of the common iliac arteries theoretically seems more promising than occlusion of only the internal iliac arteries given the easier collateralization. Nonetheless, the method with the fewest complications and the greatest chance of success should be determined in each case to ensure improvement or no change but not worsening of the patient's situation [1]. Due to the good collateralization, additional embolization is recommended despite the success rate of balloon occlusion of 40 % in some cases [20]. However, prior embolization that is reported to have a success rate of more than 95 % in some cases [26, 27] is accompanied by greater radiation exposure for the patient than temporary occlusion. Alternatively, ligature of the internal iliac artery can be considered. With balloon occlusion however not being permanent, hemostasis beginning immediately, and the visibility of the operative site improving immediately [3, 26]. Due to significant collateralization, the failure rate in the case of vessel ligature, balloon occlusion, and embolization with respect to hemostasis can be expected to be similar. However, occlusion of larger upstream arteries is only justifiable on a temporary basis so that balloon occlusion seems to be advantageous here.

Radiation exposure for the patient and personnel was able to be completely avoided in the cases described by us by measuring the vessels in advance. This has not been previously described in the literature.

Various studies report on radiation exposure and possible ways of reducing it. The fetal and maternal fluoroscopy time is between 4:30 and 8:12 minutes depending on the study and case [8, 9]. Reduction attempts have included changing tube and patient positioning, selecting fluoroscopy parameters (no magnification, collimation, road mapping) and using a particularly experienced interventionalist [28].

In our study radiation during balloon occlusion could be completely eliminated due to preinterventional measurement and planning. However, non-selective temporary occlusion should be advantageous since there is less collateralization and hemostasis is therefore as effective as in selective occlusion or embolization of the arteries supplying the uterus. In particular, the temporary occlusion performed in our patients should reduce the risk of thromboembolisms depending on the operative site.

Conclusion

Despite a lack of controlled studies proving a significant reduction in bleeding with the use of balloon occlusion in the case of abnormal configuration of the placenta, this method can be used on a prophylactic basis, in particular since radiation-based potential risks can be completely avoided by preinterventional planning. However, further controlled studies are needed to be able to make evidence-based recommendations.

Clinical relevance

1. Compared to the literature, blood loss was able to be significantly reduced in our cases.
2. As a result of MRI measurement as described for the first time here, the use of radiation could be avoided.
3. The complication rate could be decreased by temporary occlusion depending on the operative site.

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