

The management of patients with placenta percreta: A case series comparing the use of resuscitative endovascular balloon occlusion of the aorta with aortic cross clamp

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ABSTRACT

Due to the rising caesarean section (CS) rate, there has been an increase in placenta percreta (PP) cases. Resuscitative endovascular balloon occlusion of the aorta (REBOA) use has been successful in obstetric surgery for PP. In our institution, it has been introduced for prophylactic and therapeutic management in patients with PP. In our environment, the risks, benefits, and associated cost of REBOA use needed to be determined. In this case series, we report on five patients with PP where REBOA or aortic cross clamp were used and examine the associated outcomes.

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Key words: Aortic cross clamp, major obstetric hemorrhage, placenta accreta spectrum, placenta percreta, resuscitative endovascular balloon occlusion of the aorta

INTRODUCTION

A rise in placenta accreta spectrum (PAS) occurs with an increased caesarean section (CS) rate.^[1] The most severe form of PAS is placenta percreta (PP). It occurs when the chorionic villi of the placenta invade the full thickness of the myometrium and possibly surrounding structures.^[1]

The most significant risk factors for PP are previous CS and placenta praevia.^[2] Imaging is used to diagnose PP antenatally. Ultrasound is the initial modality used. Magnetic resonance imaging (MRI) is complementary to ultrasound in assessing placental invasion of surrounding structures.^[2] Antenatal diagnosis is critical to ensure timeous referral to a specialised center. A planned delivery with a multidisciplinary team (MDT) approach optimises outcomes.^[2]

CASE SERIES DESCRIPTION

A retrospective case series is reported. All cases of PP diagnosed antenatally from February 2018 to July 2019 were included. Data were collected from medical records. Consent was obtained from all patients.

All cases were diagnosed by ultrasound followed by MRI, which showed invasion into surrounding

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structures. An MDT, which included anesthesiologists, obstetricians, trauma surgeons, urologists, pediatricians, and intensivists, was involved in planning for all CS.

In the first case, iliac artery balloons were inserted preoperatively in the interventional radiology suite. This was performed under local anesthetic. It was technically difficult and resulted in a delay starting surgery. The iliac balloons were inflated during surgery for hemorrhage control but failed. The REBOA was then inserted. This allowed effective hemostasis to be achieved. Postoperative limb ischemia occurred requiring embolectomy.

In the second case, the REBOA was used preemptively. Although the device ruptured intraoperatively, hemostasis was achieved. A vascular injury occurred, requiring immediate ilio-femoral bypass.

Due to the vascular complications that occurred, it was decided to cross clamp the aorta in subsequent cases, as surgical access to the aorta was clear from placental invasion.

Table 1 summarises cases below.

DISCUSSION

REBOA has been suggested as a minimally invasive procedure used to control massive blood loss, as an alternative to aortic cross clamp.^[3] A sheath is placed into the femoral artery. The REBOA is placed through the sheath into the aorta, where it is inflated. The balloon is placed into one of three zones: Zone one (subclavian to celiac artery); zone two (celiac to renal arteries) or zone three (below renal arteries).^[3] The balloon provides complete, partial, or intermittent occlusion,^[3] allowing control of bleeding and reperfusion.

Indications for the use of REBOA include hemorrhagic shock, cardiac arrest where hemorrhage is below the diaphragm; control of intraabdominal, or retroperitoneal bleeding; control of pelvic; or proximal lower extremity hemorrhage.^[4] There is limited literature on the use of the REBOA in the obstetric setting. A previous case series by Wei *et al.*^[5] reported on experiences with the prophylactic use of the REBOA for caesarian section.^[5]

This case series introduces REBOA, as both a prophylactic and rescue device, in the obstetric setting in a sub-Saharan African tertiary hospital. We

Table 1: Case series summary

Case	1	2	3	4	5
Age (years)	37	42	29	15	36
Gravidity (G) and parity (P)	G3P2	G4P2	G3P2-1	G1P0	G4P3
Gestational age (weeks)	34	33	34	34	35
Previous CS	2	2	2	0	3
Comorbidities	HPT*, RVD [†] , preeclampsia	RVD	-	-	HPT, RVD
Anaesthesia	GA [‡]	GA	GA	GA	GA
Operative time (h)	4:00	10:50	2:25	3:20	4:49
Estimated blood loss (mL)	7500	2700	800	1200	2500
Cell saved blood given (mL)	2500	910	237	0	900
Blood products	6 RPC [§] , 4 FFP ^{**} , 10 Cryo ^{**} , 1 Plt ^{‡‡}	3 RPC, 3 FFP, 7Cryo	-	-	2 RPC, 1 Plt
Preoperative HB (g/dL)	10	12	11,2	9.9	10.8
Postoperative HB (g/dL)	10	9	11,4	10,7	10
Crystalloid (ml)	2400	2000	2000	1600	2000
Colloid (ml)	1000	-	-	500	-
Inotropes	Yes	Yes	Yes	No	Yes
REBOA	Yes, rescue	Yes, preoperative insertion	Yes, preoperative insertion. Not inflated	No, aortic cross clamp	No, aortic cross clamp
Apgar score	Poor Intubated	Poor Intubated	Poor Intubated	Poor Intubated	Poor Intubated
ICU	Yes, intubated	Yes, intubated	Yes, extubated	Yes, extubated	Yes, intubated
Relook Laparotomy	1	1	1	2	0
Complications	Vascular: Limb ischemia, embolectomy	Balloon rupture Vascular injury: Ilio-femoral bypass Bladder injury	Sepsis	Bleeding TAH required	-

*Hypertension, [†]Retroviral disease, [‡]General anaesthesia, [§]Red blood cells, ^{**}Fresh frozen plasma, ^{**}Cryoprecipitate, ^{‡‡}Platelets

note the reduction in blood loss, but also report on the complications and suggest this procedure may not be the ideal intervention in such an environment.

The current literature supports our findings with regard to blood loss. REBOA use allows for control of bleeding, reduction in blood loss and a decrease in transfusion and intravenous fluid use.^[6,7] A systematic review on the use of REBOA for caesarian section in patients with morbidly adherent placenta by Manzano *et al.*^[6] suggests that REBOA is superior when compared to other endovascular occlusion techniques. It suggested even with occlusion of iliac, uterine and hypogastric arteries other arterial collateral supply allows for continued blood loss. In this case series, the occlusion of the iliac arteries failed to assist in controlling hemorrhage.

The larger case series by Wei *et al.*^[5] published similar findings of reduced blood loss and blood transfusion in 45 cases with PAS. Only three cases had PP and the mean blood loss was 3333 mL. In our case series all five cases had PP with a similar mean blood loss.

Although the benefits of REBOA have been documented, it is important to acknowledge its limitations. Recent guidelines emphasised the importance of specialised training in the use of this technique.^[4] This may be a limiting factor in resource constrained environments.

Complications with REBOA use are well documented.^[8,9] Placement of the femoral sheath can result in pseudoaneurysm formation, dissection, hematoma, thrombo-emboli, and aorto-iliac injuries. The balloon may rupture leading to vessel damage and bleeding. Prolonged inflation may lead to ischemia and related complications.^[4] Wei *et al.*^[5] reported two complications: Limb ischemia requiring embolectomy and a femoral nerve injury secondary to ischemia. In our case series, two patients experienced vascular complications. Acute kidney injury (AKI) may also occur following REBOA inflation.^[10] In the obstetric setting balloon placement is infra-renal and thus the risk of AKI due to use of the balloon is minimised. A systematic review by Ordonez *et al.*^[7] did not report on AKI as a complication. No AKI was noted in our series.

Due to vascular complications experienced, aortic cross clamp was used in subsequent cases. Similar blood loss was noted. No vascular complications occurred in these patients. Aortic cross clamping

is also not without risk. In certain cases of PAS the placenta may surround vessels and prevent safe cross clamping. Therefore, the decision to use REBOA versus cross clamp needs to be individualised in each patient.

Poor fetal Apgar scores were noted in our series. All five neonates required intubation and ventilation. Time from induction to delivery was over 1 h. This was due to insertion of ureteric stents. Prolonged exposure to anesthetic agents could contribute to poor fetal Apgar scores. In Wei *et al.*,^[5] all cases had Apgar scores of more than seven at one minute. Their mean induction to delivery time was approximately four minutes in the GA group. The vascular sheath was inserted before induction under local anesthesia. No ureteric stents were placed. This is a consideration for future practice.

We suggest that the benefits of REBOA may not supersede the risk. Use should be critically analyzed before implementation. A retrospective study comparing matched REBOA and no-REBOA groups in the trauma setting re-iterated this concern.^[10] These authors highlighted an increase in overall mortality and complication rate (AKI and lower limb ischemia) in the REBOA group.^[10] No difference in four and 24 h transfusion rates, ICU and hospital stay occurred between the groups.^[10] This suggests that REBOA may not provide the beneficial effects previously reported.

With balloon development and improved placement technique, better outcomes and reduction in complications can be anticipated. We recommend that patients with PP are referred to a tertiary center where expertise and appropriate equipment are available to provide optimal multidisciplinary care. Future training and protocol development are recommended in order to improve the management of patients with REBOA use.

CONCLUSION

With the introduction of this novel technique in the management of the patients with PP, the benefits and complications have been documented. We suggest each case should be assessed by an MDT and the appropriate procedure planned. With the use of REBOA in our setting, vascular monitoring and time from induction to delivery needs to be improved. Training and experience in this technique will contribute to improved outcomes. In a resource-constrained

environment, the cost and risk-benefit must be considered.

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Conflicts of interest

There are no conflicts of interest.

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