

Endovascular balloon occlusion of the aorta for placenta percreta during cesarean hysterectomy

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ABSTRACT

The potential massive hemorrhage from placenta percreta requires large volumes of blood products to be transfused which are often not readily available for resuscitation and surgery, especially at rural centers. Multiple foreign case studies report the successful use of endovascular balloon occlusion of the aorta (EBOA) for the management of maternal hemorrhage. We present the first case of placenta percreta in India which was managed successfully by pre-operative placement of a balloon-tipped catheter in the aorta. Her hemodynamic status was well-controlled intraoperatively, and there were no post-operative complications. The surgical field was bloodless on balloon inflation allowing for surgical dissection and hemostasis; occult bleeders could be visualized and ligated by transiently deflating the balloon. Importantly, the transfusion requirements of this patient were drastically reduced. The authors propose that EBOA can be a staple modality in the pre-operative management of placenta percreta, especially in rural areas.

Key words: *Aorta, Balloon-tipped catheter, Hemorrhage, Occlusion, Percreta, Transfusion*

Management of peripartum hemorrhage consumes large volumes of blood products during resuscitation and surgery. Placenta percreta, in particular, remains a challenge due to the simultaneous involvement of the surrounding organs which can complicate surgery and add to already substantial mortality and morbidity rates [1]. Aortic balloon occlusion has been well described in literature for the management of obstetric hemorrhage [2-4]. The authors present the first known use of endovascular balloon occlusion of the aorta (EBOA) in India to successfully manage a case of placenta percreta.

CASE HISTORY

36 year old G6P3A2 at full term with no previous co-morbidities. She was previously diagnosed by magnetic resonance imaging as having placenta percreta with bladder involvement, and cross-consultation between the obstetric, cardiology, and anesthesiology teams was done to plan her peri-operative management. The decision was taken to perform an EBOA with the aims of reduce intra- and post-operative hemorrhage, reducing the need for blood and blood-component therapy, and maintaining stable peri-operative hemodynamics.

After obtaining written consent, she was taken into our catheterization laboratory where central and arterial lines were inserted under local anesthesia. We placed a quadri-luminal central venous catheter in the right internal jugular vein and

arterial lines for blood pressure (BP) monitoring in the left radial and right posterior tibial arteries.

She was then prepared for EBOA insertion. She was placed on a tiltable table, and a Cardiff wedge was used to provide a 20° left lateral tilt. Fetal monitors and maternal electrocardiograph monitors were attached, and fetal protection by lead shielding was provided. Under local anesthesia, the right femoral artery was cannulated and an 8-French femoral sheath inserted. This was followed by a 40 ml balloon-tipped catheter (Tyshak II^R Percutaneous Transluminal Valvuloplasty Catheter, NuMed Inc) (Figs. 1 and 2) under fluoroscopic guidance. The position and integrity of the balloon were tested by injecting 9 mL of saline mixed with dye and placement was confirmed in zone three of the abdominal aorta just above the bifurcation of the common iliac arteries. On inflation, the balloon was noted to take on the shape of the aortic lumen (Fig. 3), with associated loss of posterior tibial pulse. The balloon was then immediately deflated to prevent fetal compromise. The sheath was secured with sutures and 1000 units of IV heparin administered. Pre-operative arterial blood gas (ABG) analysis was within normal limits. The patient was then moved to the operating theater.

Standard monitoring and pre-oxygenation were achieved before induction of anesthesia. Separate arterial BP monitoring was done through the left radial and right posterior tibial arteries. Pulse oximeters were also attached to limbs. Standard anesthesia, intubation, and confirmation were performed before the surgery commencing. Urine output was monitored through a urinary



Figure 1: Balloon-tipped catheter



Figure 2: Balloon inflated

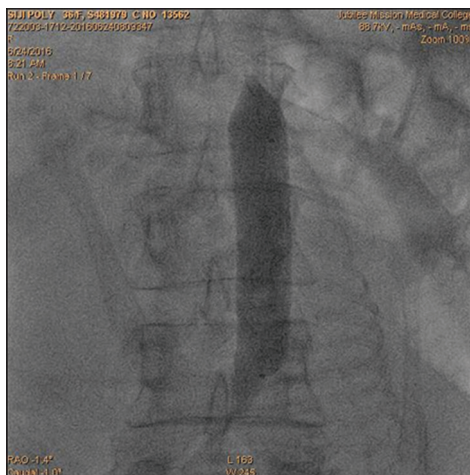


Figure 3: Fluoroscopic image of the balloon-tipped catheter within the aorta. Note how the balloon takes on the shape of the aortic lumen

catheter as an indicator of possible renal artery occlusion due to undesired proximal balloon migration intraoperatively.

The cesarean section was uneventful, but there was significant bleeding during the hysterectomy, as anticipated. The intra-aortic balloon was immediately inflated with 9 mL of saline mixed with dye, and the right posterior tibial arteriogram flattened out with

the disappearance of the associated pulse oximeter waveform. The surgical field became bloodless after suctioning and remained so for the duration of the procedure. The balloon was deflated periodically at the surgeon's request to look for errant bleeders within a bloodless field, making it easy for ligation or cauterization. There was an increase in mean arterial pressure (MAP) due to increased afterload from the inflated balloon. This was managed with a titrated Glyceryl Trinitrate infusion to maintain a MAP of 65–75 mm Hg.

Serial ABG analysis revealed an acidotic trend which was corrected with a sodium bicarbonate infusion and hyperventilation. After 43 min of total occlusion time, the balloon was deflated, leading to a noted decrease in BP which was managed with low dose dopamine and adrenaline infusions. The arterial and pulse oximetry waveforms in the affected lower limb returned to normal. Urine output remained adequate throughout the surgery.

The estimated blood loss was 500 ml, and a total of 1000 ml of crystalloid (Ringer lactate) and 1 unit of packed red cells were used intraoperatively. After the procedure, the femoral sheath and catheter were removed, and the pressure was applied for 30 min over the site with good hemostasis and no hematoma formation. The patient was extubated on the operating table and shifted to the intensive care unit (ICU) for post-operative and cannulation site monitoring. Frequent lower limb pulse checks were done which were confirmed by Doppler flow to be normal and patent. The patient remained stable throughout her ICU stay and did not require hemodynamic support or further blood transfusions. She was discharged to the ward the next morning and subsequently discharged from the hospital.

DISCUSSION

Abnormality of placental implantation can lead to significant maternal mortality in the parturient period and managing such cases of potential or actual maternal hemorrhage poses a daunting challenge to even the most well equipped obstetric and anesthesia units. Placenta percreta is the most severe form of the disease wherein the invading chorionic villi penetrate the uterine myometrium and involve the serosa, sometimes even involving the surrounding abdominal or pelvic structures, such as the bladder, as this case revealed [5]. The EBOA technique was first described by Lieutenant Colonel Carl W. Hughes in a case series of three critically injured Korean Soldiers in the 1950s [6]. Since then, the technique has been adapted and modified to effectively control exsanguination in multiple cases especially in the emergency setting.

During the 2000s, the benefits of resuscitative EBOA (REBOA) were studied using porcine models of hemorrhagic shock and found to be superior to resuscitative thoracotomy, with the equal carotid flow, but less acidosis and less fluid and vasopressor requirement [7-9]. More recently, Brenner *et al.* described a case series of six patients from two Level I trauma centers in which REBOA was effective in all six patients. After balloon occlusion, patients had improved BPs and were stabilized

sufficiently for definitive management of traumatic injuries. Four patients survived to discharge, while two succumbed due to neurological deterioration [10].

Newer studies have demonstrated that EBOA has a good scope of application in both resuscitative as well as intra-operative emergency hemostasis, in such life-threatening conditions as severe thoracoabdominal trauma, gastrointestinal surgery, vascular hemorrhage, and abdominal aneurysm rupture. Results were promising whether it was performed in the emergency department or in the operating theater [11-13]. This is a temporizing technique, designed to keep the severely injured patient alive until he or she receives operative or interventional therapies to control the hemorrhage.

EBOA is performed either by blind insertion or fluoroscopic guidance. Recently, use of ultrasound guidance both for insertion of the catheter, as well for accurate placement in the aorta at the desired level has been studied and used in clinical practice [14] in western populations, the aorta is approximately 2 cm in diameter, tapering to 1.5 cm at the bifurcation. The balloon can also be pulled until resistance is felt, signifying hinging on the aortic bifurcation, although this is not a reliable technique in clinical practice and is discouraged.

Our hospital is a tertiary care referral center for all surrounding districts for obstetric emergencies. There is a high consumption of blood and components per case, and it is not uncommon for each case to require more than 15 blood products. Postoperatively, we have had several transfusion-related complications with the usage of large volumes of blood and components. We found three main advantages to using pre-emptive EBOA in this case, namely, (1) the balloon can be inflated at the time of hemorrhage to provide a clear, bloodless field for the surgeon, (2) the balloon can be deflated at any time to allow visualization of an occult bleeding vessel, and (3) use of intravenous fluids and blood products were significantly reduced, as only 1000 mL of crystalloid and 1 unit of packed cells were used in this case, as compared to our usual average.

Throughout the application of EBOA, urine output and serial ABGs must be monitored, with vasodilator support during inflation and inotropic or vasopressor support during deflation to prevent swings of arterial BP. It should be noted that despite using a 40 mL balloon, only 9 mL was sufficient to cause occlusion which was visualized fluoroscopically. This could be explained by the smaller aortic dimensions of Indian populations compared to the cohorts in the west.

CONCLUSION

EBOA is a quick and effective method to control peripartum maternal hemorrhage and provides rapid and effective

hemodynamic control, reduction in the use of blood and component therapy as well as the added benefit of a clear surgical field. Hence, it should be made available in more centers worldwide as part of a standardized approach to resuscitation or hemorrhage control in actual or potential maternal hemorrhage.

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