Treating Postpartum Hemorrhage and Invasive Placenta

Endovascular techniques to improve outcomes in patients with abnormal invasive placenta.

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Postpartum hemorrhage is associated with a significant risk of maternal morbidity and mortality. The American College of Obstetricians and Gynecologists recently defined primary postpartum hemorrhage as blood loss ≥ 1,000 mL or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours after birth.[1] Poor uterine tone accounts for 70% to 80% of primary postpartum hemorrhage.[1,2] Other causes of primary hemorrhage include lacerations, retained placental tissue, invasive placenta, uterine inversion, and coagulation defects. Secondary postpartum hemorrhage may be caused by subinvolution of the placental site, retained products of conception, infection, and coagulation defects.[1] Clinically, primary postpartum hemorrhage is the most common and most frequently encountered form of postpartum hemorrhage seen in interventional radiology.

Risk factors for postpartum hemorrhage include prolonged labor, chorioamnionitis, high parity, polyhydramnios, multiple gestations, prolonged use of oxytocin, obesity, and fetal macrosomia. Other risk factors are related to genital tract trauma, retained placental tissue, and coagulation abnormalities.[1] Successful treatment relies on early recognition of blood loss, accurate assessment of the severity of bleeding, and determination of the etiology.

Active management of the third stage of labor comprises prophylactic administration of an uterotonic drug, controlled cord traction, and uterine massage. Escalating treatments include intrauterine balloon tamponade, surgical placement of uterine compression sutures, vascular ligation or embolization of pelvic arteries, and, ultimately, hysterectomy.[1] Although abnormal invasive placenta (AIP) is a less common cause of postpartum hemorrhage, the incidence is increasing, and endovascular techniques have demonstrated utility in reducing blood loss.

ABNORMAL INVASIVE PLACENTA

The AIP disease spectrum is defined by the depth of placental invasion into the uterine wall. *Placenta accreta* refers to trophoblastic attachment to the myometrium, whereas *placenta increta* occurs when there is penetration into the myometrium. *Placenta percreta* is the most severe form, with invasion into the serosa and surrounding viscera.[3] Increasing rates of uterine interventions, particularly cesarean deliveries, are resulting in a rapidly increasing incidence of invasive placenta, which is now occurring in approximately 1 in 533 pregnancies.[4]

AIP imparts a high risk of obstetric hemorrhage, surgical injury, morbidity, and mortality. The invasive placenta does not typically separate from the uterine wall and may invade surrounding structures, resulting in a complex operation with massive blood loss. Placenta percreta carries the greatest risk of maternal hemorrhage and death.[5] When AIP is prospectively identified, scheduled cesarean hysterectomy is the preferred management approach. Despite delivery in a controlled operative setting by a skilled multidisciplinary team, perioperative blood loss averages > 3,000 mL.[6,7]

MULTIDISCIPLINARY TEAM MANAGEMENT

In patients with placenta previa and a history of cesarean delivery, practitioners must maintain a high suspicion for AIP, as prenatal diagnosis improves maternal and neonatal outcomes through treatment at tertiary centers with experienced multidisciplinary teams.[8,9] The multidisciplinary team approach permits a controlled operation with earlier recognition of blood loss and fewer attempts to remove the adherent placenta. The treatment team typically consists of maternal–fetal medicine, gynecologic oncology, urology, anesthesia, interventional and diagnostic radiology, neonatology, pathology, and nursing.

A multidisciplinary team also provides a structured approach to case planning. The team meets to review patient history and imaging while formalizing management plans. This includes the details of hospital admission, operative scheduling and procedure planning, blood bank requirements, and endovascular balloon placement or arterial embolization. In a comparison of cases treated before and after the establishment of multidisciplinary teams, Smulian et al demonstrated a reduction in blood loss and transfusions with longer surgical times, more ureteral stents, and more uterine artery embolization (UAE) procedures in the multidisciplinary team group.[9]

DIAGNOSTIC IMAGING

Ultrasound examination at 18 to 20 weeks of gestation is the primary diagnostic modality for invasive placenta (Figure 1). Sensitivity of diagnosis is 90.7%, with 96.9% specificity.[10] Grayscale ultrasound findings include multiple placenta lacunae, loss of the retroplacental clear space, loss of an echolucent line between the uterus and bladder, and a focal exophytic mass extending into the bladder.[8,11] Color Doppler ultrasound findings include chaotic intraplacental blood flow, the presence of altered blood flow in the retroplacental space, and aberrant vessels crossing between placental surfaces.[8] Color Doppler ultrasound has the best combination of sensitivity and specificity.[10] An ultrasound placenta accreta index consisting of a 9-point scale may be useful to predict placental invasion in high-risk populations.[12]

MRI provides additional diagnostic information when ultrasound findings are ambiguous or when there is a posterior placenta.[11] MRI better defines the degree of invasion, assists with surgical planning, and is best performed at 24 to 30 weeks of gestation.[13] Gadolinium-based contrast is not typically administered. MRI findings include uterine bulging, rounded edges with lumpy contour, heterogeneous signal intensity within the placenta, and the presence of dark intraplacental bands on T2-weighted imaging.[11,13]

Although imaging cannot always differentiate placenta accreta from increta, it is important to accurately identify cases of placenta percreta. Imaging reports should be specific when describing the depth of invasion and not use the term accreta as a general term for all forms of AIP. In cases of placenta percreta, tissue may be seen extending through the myometrium. Placenta percreta may invade surrounding structures and result in tenting of the bladder.[11] MRI demonstrates a full-thickness gap of myometrial signal with loss of fat plane between adjacent organs and intermediate placental signal disrupting the hypointense line of the bladder, bowel, or musculature.[13]

SURGICAL MANAGEMENT

If not detected on prenatal imaging, AIP is suspected during delivery if the placenta does not easily detach. In such cases, patients should be transferred to the operating room and preparations made for resuscitation, blood transfusion, and hysterectomy if bleeding is not adequately controlled. Delivery in a hybrid operating room allows access to fluoroscopy if urgent embolization is required. Profuse life-threatening hemorrhage may occur when attempting to extract the placenta from the lower uterine segment.

The best outcomes occur with accurate prenatal imaging and multidisciplinary team planning, with delivery commonly performed at 34 to 36 weeks of gestation with an elective cesarean hysterectomy. Delivery may be performed under epidural or spinal anesthesia with the option of conversion to general anesthesia as needed for hysterectomy. Emerging

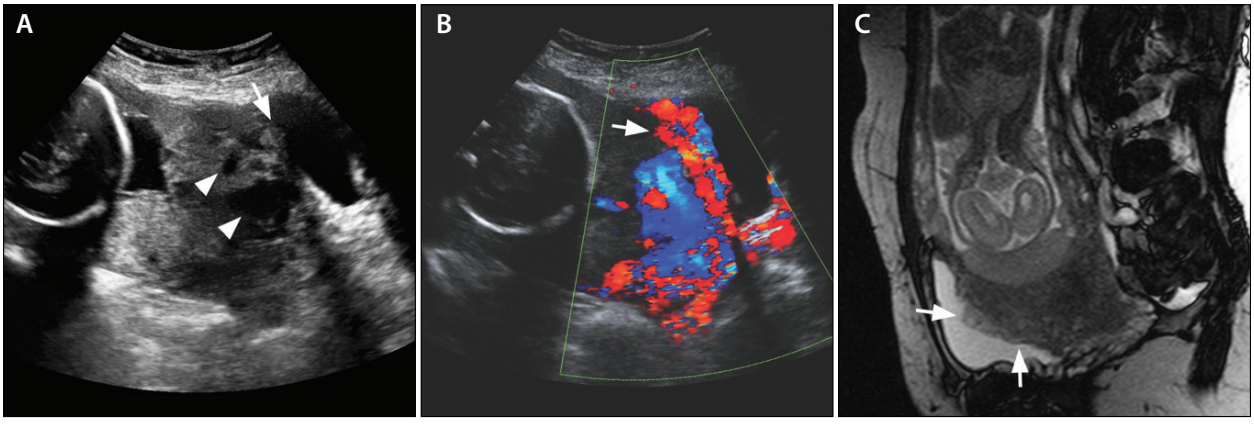

Figure 1. A 38-year-old woman with imaging diagnosis of placenta percreta. Ultrasound image shows hypoechoic placental lacunae (arrowheads) and loss of the myometrial-bladder interface with protrusion into the bladder wall (arrow) (A). A color Doppler ultrasound image shows abnormal blood vessels at the myometrium-bladder interface (arrow) and flow within the placenta lacunae (B). Sagittal T2-weighted MRI image shows a heterogeneous-appearing placenta with uterine bulging, tenting of the urinary bladder, and invasion into the bladder (arrows) (C).

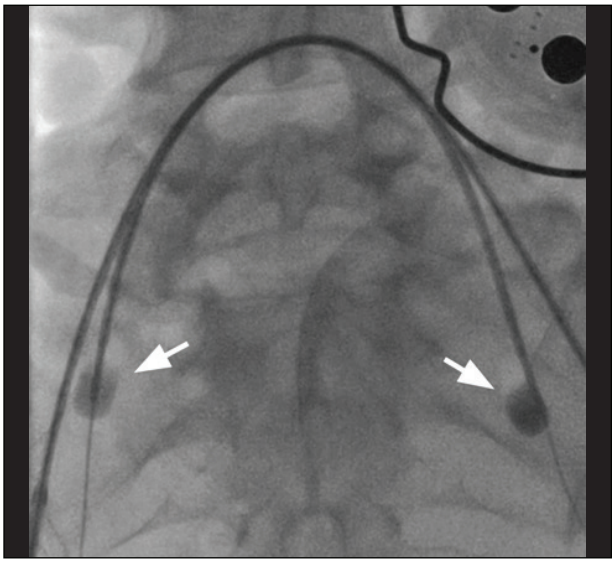

Figure 2. Angiogram shows occlusion balloons placed within the internal iliac arteries (arrows).

surgical techniques are described for uterine conservation in the setting of AIP. Patients with AIP who pursue uterine conservation have a higher risk of postpartum hemorrhage and adherent placenta in a subsequent pregnancy and should be counselled regarding the risks of this approach.[1,14] Arterial embolization may play a role in conservative management when bleeding is not controlled by surgical techniques.

PROPHYLACTIC OCCLUSION BALLOONS

Prophylactic occlusion balloons may be placed to decrease the arterial perfusion pressure and improve visualization of the surgical field.[15] Balloons are placed in the aorta, common iliac arteries, or internal iliac arteries before scheduled delivery in the interventional radiology suite or hybrid operating room (Figure 2). The technique remains a topic of debate due to conflicting results, a lack of prospective randomized studies, heterogeneous patient populations, small sample sizes, and differing balloon placement and inflation techniques. Thus, consensus has not been reached on the optimal balloon placement technique or even whether the proposed benefits of balloon catheters are realized in practice.

The timing and duration of balloon inflation significantly vary among published studies. Balloons are generally inflated during delivery after clamping the umbilical cord if the surgeon encounters diffuse bleeding. Theoretically, early inflation of the balloons can result in collateral vessel bleeding and can confound results regarding balloon efficacy.[8,15] However, in many studies, the balloons are inflated in all cases. This method results in balloon inflation in patients who otherwise would have minimal blood loss, introduces bias into the blood loss data, and exposes patients to undue risks of balloon inflation with complications reported in up to 15.8% of cases.[16-22] The optimal duration of balloon inflation is also not well defined and not clearly specified in many studies.

Several case studies demonstrated reduced blood loss and transfusion requirements after internal iliac artery balloon placement. A retrospective study described balloon placement in 90 patients with a decreased incidence of large volume blood loss (34% vs 61%) and red blood cell transfusion (21% vs 44%).[23] In this study, median blood loss was 2 L compared with 2.5 L in the control group of 61 patients with AIP without balloon placement. Cali et al compared 30 cases with balloon placement to a control group undergoing hysterectomy and demonstrated reduced blood loss in a placenta percreta subgroup (1,507 mL vs 933 mL).[24] Tan et al described 11 patients with invasive placenta and reported 39.4% less blood loss compared with the hysterectomy control group.[17]

A prospective randomized trial compared 13 women with internal iliac artery occlusion balloon placement to a control group and did not demonstrate a statistically significant reduction in blood loss.[18] Other retrospective studies also support these findings.[19,25] Caveats in these studies include balloon inflation in all cases independent of bleeding, small sample sizes, and lack of outcomes stratified by the depth of placental invasion. It is important to evaluate the number of placenta percreta cases in the treatment groups, as these cases are associated with a greater volume of blood loss and more complex surgery. These confounding factors may significantly limit the ability to determine the effectiveness of balloon occlusion in these studies.

Proximal occlusion with balloon placement in the common iliac artery or abdominal aorta may result in less collateral bleeding than with occlusion of the anterior division of the internal iliac artery.[26-28] Although there is some concern that proximal occlusion could result in more cases of limb ischemia and thromboembolism, this has not been clearly demonstrated, and several centers are adopting this approach.

Aortic occlusion balloons are easy to place with low radiation exposure and potentially reduced collateral perfusion. Wu et al reported 230 patients with AIP treated with prophylactic infrarenal aortic balloon placement.[29] They demonstrated decreased blood loss and operative time, and hysterectomy was avoided in most cases. Wang et al compared aortic balloon placement with internal iliac artery placement in 105 patients and found decreased blood loss, transfusion requirements, and fluoroscopy time in the aortic occlusion group.[30]

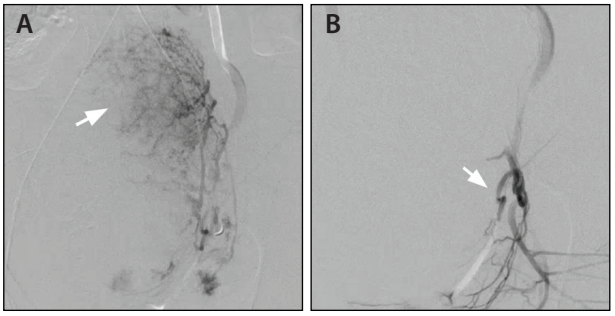

Figure 3. UAE for invasive placenta. A 33-year-old woman with complete previa and findings of placenta accreta on prenatal imaging. Embolization was performed with polyvinyl alcohol particles for a hypervascular mass arising from the left uterine artery (arrow) (A). The posttreatment angiogram showed static flow in the uterine artery and resolution of the hypervascularity (arrow) (B).

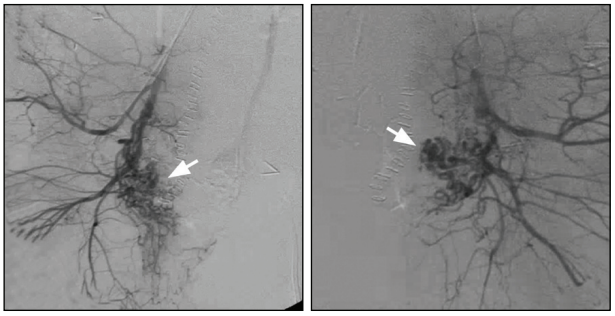

Figure 4. A 31-year-old woman with placenta percreta underwent occlusion balloon placement but experienced persistent bleeding after hysterectomy. Angiography showed hypervascularity from the right and left uterine arteries (arrows). Embolization was performed with gelatin slurry.

UTERINE ARTERY EMBOLIZATION

UAE may be performed after conservative measures fail and offers a low-risk, minimally invasive treatment option for acute hemorrhage (Figures 3 and 4). Absorbable gelatin sponge is the preferred embolic agent, as it is relatively inexpensive and provides temporary occlusion. UAE may also be performed in combination with balloon placement or as an alternative treatment strategy.[31-33] If resources are available, embolization is ideally performed in a hybrid operating room at the time of delivery. Izbizky et al performed preoperative pelvic angiography with uterine artery catheter placement before delivery and embolization if the placenta did not spontaneously detach.[34] The authors reported no major complications attributed directly to the endovascular procedure and an 86% clinical success rate.

Li et al performed UAE with gelatin pledgets after cesarean delivery. The placenta was then manually removed and hysterectomy was reserved for cases with persistent bleeding. Using this conservative technique, the uterus was preserved in 10 of 12 patients, with an average blood loss of 1,391 mL.[35] Duan et al placed an aortic occlusion balloon before cesarean section, which was inflated before placental dissection and followed by bilateral UAE with gelatin particles. The uterus was successfully saved in 97.6% of patients.[36]

In an alternative approach, Niola et al performed UAE with gelatin sponge before delivery in 50 patients with invasive placenta or previa.[37] Sixty-four percent of patients did not require transfusion; however, it is unclear how many of the patients had placenta percreta. It is unknown whether predelivery embolization provides benefit over postdelivery embolization. In addition, the potential long-term risks of oxygen deprivation and increased radiation exposure to the infant must be considered.

CONCLUSION

The incidence of AIP is increasing, with postpartum hemorrhage resulting in significant morbidity and mortality. Surgical management is complex, and outcomes can be optimized with accurate prenatal imaging diagnosis and coordinated management by a specialized multidisciplinary team. As more robust data become available, it is anticipated that prophylactic occlusion balloon placement and arterial embolization techniques will become an integral part of the management paradigm for patients with AIP. ■

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