EDITORIAL

Postpartum hemorrhage: Aortic compression to reduce pelvic bleeding

Although aortic compression generally is not taught to obstetricians as a maneuver to control major pelvic hemorrhage, anesthesiologists are aware of its value and may ask you to initiate this maneuver in the setting of severe postpartum hemorrhage

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You are performing a repeat cesarean delivery on a 37-year-old G3P2 woman with placenta previa. Immediately after delivery, a postpartum hemorrhage occurs. You order additional uterotonic medications and blood products and prepare for standard surgical interventions including uterine devascularization, uterine compression sutures, and intrauterine balloon tamponade. As the hemorrhage continues, you begin to consider the need to perform a hysterectomy.

Instant Poll

What is your best approach to treating a severe case of postpartum hemorrhage?

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Suddenly the anesthesiologist reports that the patient's blood pressure and heart rate have decreased. She asks you to initiate aortic compression to slow the pelvic bleeding and permit initiation of interventions to restore intravascular volume and optimize cardiovascular status. You have not previously performed this maneuver, and you wonder how to respond to her request.

Preoperative preparation

Anticipating possible adverse outcomes is a key task for every clinician. In the above case, in the setting of a repeat cesarean delivery in a woman with placenta previa, there is an increased risk of postpartum hemorrhage. Therefore, appropriate blood products and equipment should be made available before the operation is initiated. It also may be helpful to review the sequential steps you have found most useful in managing a postpartum hemorrhage prior to starting the procedure.

Rapid response to obstetric hemorrhage

When postpartum hemorrhage occurs during a cesarean delivery, there are many interventions that may successfully control the excessive blood loss, including uterotonics, massive transfusion of blood products, uterine massage, tranexamic acid, uterine devascularization, uterine compression sutures, intrauterine balloon tamponade, uterine artery embolization, uterine tourniquet, internal iliac artery ligation, hysterectomy, and pelvic packing.[1] Rapid response to obstetric hemorrhage is important to avoid depletion of coagulation factors and subsequent development of a coagulation disorder. Once a coagulation disorder occurs, it can be very difficult to resolve the problem and complete the surgery.

Abdominal compression

The potentially benefial role of abdominal compression to help

reduce blood loss caused by trauma or obstetric hemorrhage has been studied extensively in healthy volunteers. The theory is that abdominal compression will decrease blood flow in the distal aorta, helping to control bleeding in the pelvis and extremities. In one report, 80 to 140 lb of pressure applied to the epigastrium in 9 healthy male participants in a supine position on a rigid surface resulted in decreased blood flow in the common femoral artery as determined by pulsed-wave Doppler ultrasound.[2] Abdominal pressure applied above the umbilicus also has been reported to reduce blood pressure in the legs.[3] Abdominal compression and tourniquets used on the extremities are not meant to be definitive treatments for traumatic hemorrhages but rather are used to stabilize severely injured patients during transport to emergency surgical care facilities.[4]

One approach to performing manual abdominal aortic compression involves first gaining a mechanical advantage by positioning yourself above the epigastric area with arms extended. Using one closed fist with the opposite hand providing additional pressure, the equivalent of 80 to 140 lb can be applied to the patient's upper abdomen.[4] To estimate the pressure you can achieve using this method, cover a scale with a towel and use your arms to exert maximum pressure on the scale. What equivalent weight can you reach when applying maximum pressure? What weight can you sustain for a few minutes? Using manual compression, it is difficult for a clinician to exert the equivalent of 140 lb on the epigastrium for the extended period of time needed to transport an injured person to an emergency facility.[5] Therefore, mechanical devices such as the abdominal aortic tourniquet (AAT) and the nonpneumatic antishock garment (NASG) have been developed to aid in providing continuous abdominal compression.

FIGURE 1 Nonpneumatic antishock garment

The neoprene device's panels reduce blood flow to the pelvis and extremities

Abdominal aortic tourniquet. The AAT is a corset-like device with an interior pneumatic bladder that is designed to provide sustained compression over the abdomen, therefore compressing the abdominal aorta and reducing blood flow to the pelvis and extremities. In one study with human volunteers, a median pressure of 180 mm Hg (range, 150–230 mm Hg) was associated with cessation of blood flow in the common femoral artery in 7 of 9 volunteers and a decrease in blood flow in all participants as determined by pulsed-wave Doppler ultrasound.[6] Participants reported moderate to severe discomfort when the AAT was inflated to a pressure sufficient to stop blood flow in the femoral artery. The AAT device may not be as effective in individuals with an elevated body mass index and excessive abdominal girth.[7] In obstetric postpartum hemorrhage, abdominal pressure also has been reported to reduce hemorrhage and femoral artery blood flow. Using a corset-like abdominal binder with an internal spring to provide continuous pressure over the anterior abdomen, Soltan and Sadek reported a beneficial effect of abdominal pressure in the management of severe postpartum hemorrhage in a large observational study in Egypt.[8,9]

Nonpneumatic antishock garment. The NASG has been studied extensively as a method to help safely transport a woman with severe postpartum hemorrhage to an emergency

facility. The NASG is a neoprene and Velcro device with panels for the lower extremities, pelvis, and abdomen (**FIGURE 1,** page 11). The device also has an abdominal segment that includes a compression ball to provide continuous abdominal pressure. When the panels are closed, blood flow to the extremities and pelvis is reduced. In a study of 10 postpartum volunteers, application of the NASG caused decreased blood flow in the internal iliac artery as measured by Doppler ultrasound, but blood flow did not stop completely.[10] In an observational study of women with postpartum hemorrhage, use of the NASG device in combination with usual interventions resulted in a decrease in blood loss.[11]

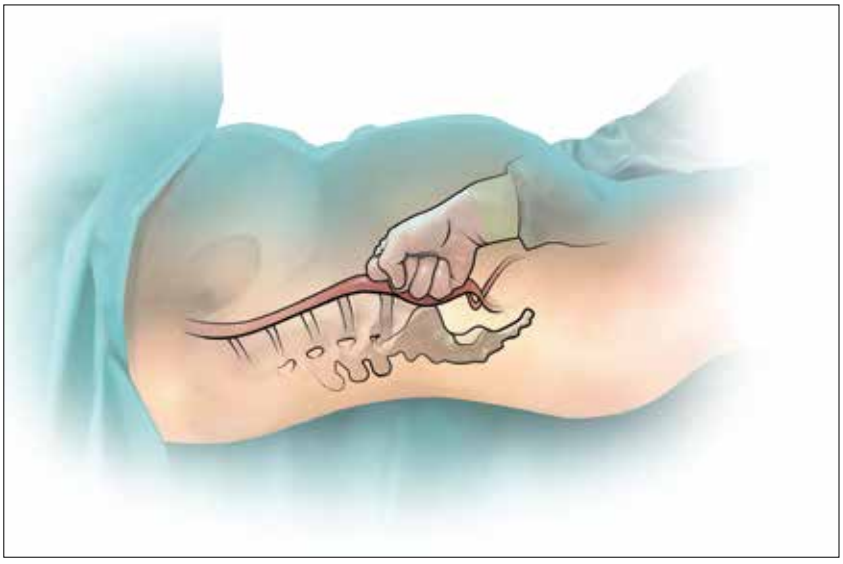
In a cluster randomized trial, 38 birth centers in Africa were randomly assigned to standard management of obstetric hemorrhage or the same protocol plus use of the NASG prior to transport to a regional emergency surgical center. Compared with the group receiving standard management alone, the women who received standard management plus the NASG device had a nonsignificant reduction in maternal mortality (odds ratio, 0.54; 95% confidence interval [CI], 0.14–2.05; $P = .37$) and a significantly more rapid recovery from hypovolemic shock (hazard ratio, 1.25; 95% CI, 1.02–1.52; $P = .03$).[12] The International Federation of Gynecology and Obstetrics has issued a guideline supporting the use of the device in the management of obstetric hemorrhage in appropriate settings.[13]

Aortic compression in the setting of an open abdominal incision

During cesarean delivery, the surgeon has access to the abdominal aorta via the open abdominal incision and can directly apply pressure to the aorta at sites ranging from above the sacral promontory to the subdiaphragmatic aorta. Although aortic compression is occasionally noted as a potential intervention to help with the management of postpartum hemorrhage, there is very little literature on this intervention.[1] In one case report of an emergency laparotomy in a Jehovah's Witness patient with a placenta previa, uterine rupture, massive hemorrhage (hematocrit nadir of 6%), and hypovolemic shock, direct pressure applied to the infradiaphragmatic aorta and pelvic organs permitted the anesthesiologist to stabilize the patient's cardiovascular status, facilitating the patient's recovery from shock.[14] The authors of the case concluded that compression of the aorta and pelvic organs can be lifesaving and is underutilized in the management of uncontrolled obstetric hemorrhage. Other case reports also recommend considering the use of aortic compression to permit the anesthesia team to resuscitate a bleeding patient.[15]

There is very little published guidance on how to perform aortic compression at cesarean delivery. Techniques for aortic compression include using a closed fist or the heel of the hand to compress the aorta against the lumbosacral spine. Alternatively, use a moist rolled-up surgical towel or laparotomy sponge to compress the aorta against the lumbosacral spine. With a low transverse abdominal incision, the aorta just above the lumbosacral promontory is closest to the surgeon (aorta zone III) (**FIGURE 2**). If a vertical abdominal incision has been made, the subdiaphragmatic aorta may be within reach of the surgeon (aorta zone II). If an anesthesiologist asks you to apply aortic compression, it is likely that the patient is hypotensive. In this setting, reducing blood flow through the aorta can be achieved

FIGURE 2 Aortic compression through an open abdominal incision



During cesarean delivery through a low transverse abdominal incision, the surgeon directly applies pressure to the aorta just above the lumbosacral promontory

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with less pressure than required for successful aortic compression in a healthy volunteer.

Prolonged aortic compression that completely obstructs blood flow may result in downstream ischemia. This is illustrated by leg ischemia and amputation that have occurred following the use of the resuscitative endovascular balloon occlusion of the aorta (REBOA) occlusion device.[16] Another strategy that has been used in the management of massive hemorrhage, when immediate replacement of clotting factors is not possible, is damage control surgery, a technique in which capillary and venous bleeding is controlled by placing pelvic packs or a pelvic umbrella pressure pack and sending the patient to the intensive care unit for resuscitation.[17] With damage control surgery, a second procedure is planned to remove the packs after the patient has been stabilized.

With knowledge and practice comes preparedness

Hopefully you will never be asked by an anesthesiologist to stop operating and initiate aortic compression. With effective preprocedure preparation and rapid institution of standard postpartum hemorrhage techniques, it is unlikely aortic compression ever will be needed. If an unusually difficult case triggers a request for aortic compression, you have the knowledge and skills to provide that service. ●

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