

Louisa Rahilly, DVM, Diplomate ACVECC, Cape Cod Veterinary Specialists, Buzzards Bay, Massachusetts, & Lori S. Waddell, DVM, Diplomate ACVECC, University of Pennsylvania

Placement of an Abdominal Wrap to Control Hemodynamics

Application of pressure to the abdomen via an abdominal wrap is a management technique often used in veterinary medicine to improve blood pressure and slow or arrest bleeding in patients suffering from abdominal hemorrhage and hemodynamic instability.¹ Abdominal wraps incorporating the pelvic limbs, pelvis, and abdomen can also be used to immobilize and slow hemorrhage associated with femoral or pelvic fractures.

Hemoabdomen & Shock

Intraabdominal hemorrhage can occur in companion animals due to trauma, neoplasia, coagulopathies, liver lobe torsion, or splenic volvulus.² In cats, most cases of spontaneous hemoabdomen are attributable to hepatic neoplasia or pathology, whereas dogs typically suffer from splenic disease.^{2,3} Animals presenting with hemoabdomen are often in hypovolemic shock.

In early stages of hemorrhagic shock, dogs are often still compensating with tachycardia, pale mucous membranes, and normal or even elevated blood pressure. As the shock persists, or if it is initially severe, the animal may progress to decompensatory shock and develop hypotension as well as indices of poor perfusion, such as cold extremities, depressed mentation, and elevated lactate levels. Stabilization of these animals requires replacement of volume with crystalloids, colloids, and potentially blood products.

Indications & Complications

In general, abdominal hemorrhage secondary to neoplasia is less likely to ultimately resolve without surgical intervention, while traumatic

or coagulopathic causes of hemoabdomen frequently resolve with medical management alone. Any cause of bleeding, however, may be slowed or even stopped by an abdominal wrap and the counterpressure may provide stabilization while preparing for surgery.

Although the incidence of adverse events is relatively low, abdominal wraps have been associated with complications in humans due to decreased perfusion to abdominal organs and pressure necrosis of skin and muscle beds under the pressure garment.^{4,5} Therefore, we consider using abdominal counterpressure in veterinary patients suffering from abdominal, pelvic, or femoral hemorrhage that do not initially stabilize with adequate fluid administration or are in decompensatory shock at presentation.

How the Wrap Works

Theoretically, abdominal counterpressure can both decrease hemorrhage and increase systemic blood pressure. According to Poiseuille's Law, flow within the vessels is directly proportional to the radius raised to the 4th power as well as the pressure gradient across the vessel wall.⁶ A small decrease in radius will have

a significant effect on flow within the vessel and may reduce hemorrhage.

Counterpressure, either within or outside the abdomen, will decrease the pressure gradient across the wall of all the vessels it affects, additionally decreasing flow. Furthermore, the reduction in vessel diameter that has been demonstrated with the application of abdominal counterpressure causes an overall increase in systemic vascular resistance and ultimately an increase in mean arterial pressure.⁶

Numerous experimental studies in dogs and retrospective analysis of pressure garments or wraps in people have been performed with conflicting effects on cardiac output.^{2,6-8} However, these studies have demonstrated fairly consistent increases in systemic vascular resistance and blood pressure. Abdominal wraps have been shown to decrease tidal volume, cause tachypnea, and compromise ventilation; therefore this intervention is contraindicated in cases with respiratory compromise, such as pulmonary contusions, pleural space disease, or diaphragmatic hernia.



What You Will Need

- Cast padding, rolled cotton, or towels
- Adhesive bandage material
- Bandage scissors or a scalpel blade



2 Once the initial layer has been placed, wrap a second layer of adhesive bandage in barber pole fashion with approximately 50% overlap of each turn. Repeat both layers on the contralateral limb.

STEP BY STEP HOW TO PLACE AN ABDOMINAL WRAP



1 Correct application of abdominal counterpressure requires wrapping the hindlimbs from the toes up, including the pelvis and the abdomen, with elastic bandages, Vetrap (3M.com/animalcare), Elastikon (jnj.com), or duct tape. An initial layer of cast padding, rolled cotton, or towels is recommended to more evenly distribute pressure and to facilitate removal of adhesive materials.

Place the initial layer of cotton by wrapping the hindlegs in a “barber pole” fashion. Including the hindquarters in the wrap is important as application of an abdominal wrap alone results in decreased venous return and a potentially detrimental reduction in cardiac output.

PROCEDURE PEARL

An initial layer of cast padding, rolled cotton, or towels is recommended to more evenly distribute pressure and to facilitate removal of adhesive materials.

PROCEDURE PEARL
In general, abdominal hemorrhage secondary to neoplasia is less likely to resolve without surgical intervention, while traumatic or coagulopathic causes of hemoabdomen frequently resolve with medical management alone.



3 Wrap the pelvis circumferentially, again with an initial cotton or towel layer followed by an expansive adhesive material. Continue the wrap cranially to include the caudal abdomen.

PROCEDURE PEARL

Including the hindquarters in the wrap is important as application of an abdominal wrap alone results in decreased venous return and a potentially detrimental reduction in cardiac output.



4 Monitor heart rate, blood pressure, respiratory rate and effort, mucous membrane color, and other indices of oxygenation and ventilation (such as pulse oximetry or arterial blood gas analysis) while placing the wrap. While exerting the desired tamponade effect to control bleeding, the secondary increase in blood pressure provided by the wrap may actually exacerbate hemorrhage. Continue the wrap to just caudal to the 13th rib. Inclusion of the 13th rib in experimental models resulted in unacceptable compromise of ventilation.^{1,8} The target pressure achieved by the wrap is 2 pounds per square inch, which corresponds to approximately 40 to 60 mm Hg of external counterpressure. The wrap should be snug but not overly constrictive. One should be able to place a finger between the bandage and the skin.¹



5 Once hemodynamic stability has been achieved and indices of perfusion have stabilized, the wrap can be removed with bandage scissors or a scalpel blade. The wrap is removed very slowly from the cranial edge to the caudal extremities, releasing a few centimeters every 15 to 20 minutes. Heart rate, mucous membrane color, capillary refill time, and blood pressure should be monitored with each subsequent release.

If there is a drop of blood pressure of more than 5 mm Hg, an increase in heart rate by more than 5%, or development of pale mucous membranes, removal of the wrap should be discontinued until hemodynamic stability is again achieved. Rapid removal of the wrap can result in a severe hypotensive episode and should be avoided. If placement of the wrap results in respiratory compromise or worsening of hemodynamic status, it should be removed more quickly.

PROCEDURE PEARL

We recommend leaving the wrap in place for no longer than 12 hours.

Monitoring

Diligent monitoring of the respiratory system while placing an abdominal wrap is necessary as abdominal counterpressure may exacerbate previously undiagnosed respiratory pathology and may bring about respiratory decompensation. This is particularly true in cases of diaphragmatic hernia as abdominal organs are pushed into the thoracic cavity.

Clinicians should also be aware of systemic effects of the wrap because abdominal counterpressure causes increased intraabdominal pressure. Intraabdominal hypertension of greater than approximately 25 cm H₂O can result in compromise of the renal, cardiovascular, visceral, hormonal, pulmonary, and neurologic systems. Decreased glomerular filtration rate, urine production, venous return, pulmonary compliance, and splanchnic perfusion, as well as increased risk of bacterial translocation have been documented in both human patients and experimental scenarios of intraabdominal hypertension.

Additionally, catecholamine, antidiuretic hormone, renin, and aldosterone release have been shown to be increased. Therefore, abdominal wraps should be used with caution and left in place only as long as necessary to achieve acceptable indices of perfusion, control of hemorrhage, and cardiovascular stability. We recommend leaving the wrap in place for no longer than 12 hours. If cardiovascular stability has not been achieved with the use of abdominal counterpressure and adequate fluid and blood product resuscitation by this time, one should consider surgical exploration to control bleeding. ■

See Aids & Resources, back page, for references, contacts, and appendices

Article archived on cliniciansbrief.com