Traumatic Ventral Herniation in Foals as a Complication of Dystocia

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ABSTRACT: Traumatic failure of the abdominal wall (ventral herniation) may occur in foals as a complication of assisted or controlled vaginal delivery. A diagnosis can be readily made based on clinical signs (abdominal discomfort, subcutaneously located intestine, a palpable defect in the abdominal wall). If surgical intervention will be pursued, it should take place immediately. The primary goal of surgery is to reinstate the integrity of the abdominal wall. Equal attention should be given to maximizing the strength of the repair and minimizing the likelihood of intraabdominal adhesion formation. Extensive defects may be repaired successfully, allowing athletic ability in affected horses. Four cases of traumatic ventral herniation in foals are described.

In adult horses, acquired defects in the abdominal wall, known as ventral hernias, often result from previous surgery (e.g., ventral midline celiotomy, umbilical herniorrhaphy) or from trauma.1-7 Although acute dehiscence after abdominal surgery or intestinal incarceration requires immediate surgical attention, ventral hernias tend to develop slowly in most affected horses, and 2 to 3 months are usually allowed to elapse before surgical correction of the condition is attempted.1,8 This delay allows fibrous tissue to form at the hernial ring, thereby increasing the likelihood that closure will be successful.9 In patients with acute dehiscence after abdominal surgery or intestinal incarceration, suture herniorrhaphy is possible only when there is minimal tension on the suture line.9 Placement of synthetic mesh may be necessary to augment and strengthen the repair,10 which may be guided by laparoscopy.11

“Closed” trauma–induced herniation is most common secondary to kicking, jumping, strain- ing associated with parturition, hydrallantois, or excessive edema of the ventral abdomen.1,7,9 If immediate intervention is not necessary, surgical correction is delayed for months.

In contrast, herniation in foals is generally congenital, with the most commonly affected sites being the inguinal canal and the umbilicus.
Key Points

- Traction with a foal in anterior presentation is often successful in delivering the thorax. Continued progress may be interrupted by the interlocking of the foal's pelvis with that of the dam (hiplock). Excessive traction should be avoided in favor of rotation of the foal within the birth canal.
- Excessive traction may result in trauma to the dam's reproductive tract and to the foal. Traumatic ventral herniation in the foal is an uncommon complication.
- A diagnosis of traumatic ventral herniation can be made quickly because affected foals may display signs of colic, large defects in the ventral abdominal wall can be readily palpable, and intestinal loops may be evident in a subcutaneous location.
- Laparoscopy may be valuable in planning and facilitating repair of abdominal wall defects.
- Ventral herniation can be successfully managed with surgical intervention.

Inguinal herniation has been documented in foals (primarily colts) that lacked a history of trauma. In these cases, it may be associated with an increase in the foal's abdominal pressure during parturition. This type of hernia is further classified as direct or indirect, with the distinction between the two types having an important effect on subsequent management of the condition. In indirect inguinal herniation, the small intestine passes through the vaginal ring and remains contained within the vaginal tunic. Hernias of this nature frequently resolve spontaneously as the patient ages and grows. In contrast, direct inguinal herniation, the small intestine generally passes through a rent in the common vaginal tunic. In the latter instance, intestinal loops often dissect their way into a subcutaneous location adjacent to the prepuce. Because of the risk for incarceration and adhesion formation associated with direct herniation, surgical intervention is often necessary.

Umbilical hernia is a common abdominal defect in foals and is associated with hereditary failure of normal development and closure of the umbilicus. Umbilical hernia may also result from omphalophlebitis, or the umbilicus may simply open due to increased abdominal pressure caused by excessive straining. An umbilical defect may be so large that it causes evisceration of segments of the foal's intestinal tract at parturition (a form of ventral herniation). Depending on the size of the defect, entire loops of small intestine or varying portions of the intestinal wall (Richter's hernia) may be contained within the hernial sac. These hernias rarely result in strangulating intestinal lesions.

Herniorrhaphy is indicated if clinical signs consistent with intestinal incarceration are evident or an umbilical hernia does not resolve spontaneously as the foal approaches 1 year of age. Although umbilical hernia has been corrected by application of a rubber band at the base of the external hernial sac, simple open or closed surgical techniques are more widely accepted. Closure of larger defects can be more involved and can necessitate imbrication of the hernial sac, the use of sliding fascial flaps, or incorporation of prosthetic mesh products.

Clinical cases

Traumatic ventral herniation occurs rarely in foals. The following cases describe the cause, management, and outcome of ventral herniation secondary to dystocia in four Thoroughbred foals.

Case 1

Case 1 involved a filly that had been delivered by assisted vaginal delivery on a farm. Although the filly had an anterior presentation and dorsosacral position with both forelimbs available to provide traction, the filly was large (141 lb [64.1 kg]) and required moderate manipulation for successful delivery. The filly was born alive, and because of the potential compromise sustained during delivery, the mare and foal were referred to the medical facility for monitoring. The foal appeared to be in good health, except for a slight flexural deformity of the left hind metatarsophalangeal joint. Several hours later, the foal began showing signs of abdominal discomfort, and loops of small intestine were evident subcutaneously on the right side of the caudoventral abdomen, adjacent to the umbilicus. The foal was referred to a surgical facility for evaluation and correction of the abdominal wall defect. The filly was anesthetized using diazepam (0.1 mg/kg IV) and ketamine (2.2 mg/kg IV), and anesthesia was maintained with isoflurane delivered in 100% oxygen. With the filly dorsally recumbent, the ventral abdomen was prepared using routine, aseptic surgical technique and was draped. A 20-cm skin incision was made directly over a palpable 15-cm transverse, full-thickness tear in the abdominal musculature. After it was determined that there was no damage to the abdominal organs, the muscle layers were sutured individually with 2 polyglycolic acid absorbable sutures.
acid in a simple interrupted pattern. The skin was sutured using 2-0 poliglecaprone 25. The foal recovered uneventfully from anesthesia and was returned to the stall, where it remained isolated from the mare with close supervision and sedation.

The next day, the filly again displayed signs of abdominal discomfort. Because of the presence of ventral edema, it was impossible to determine whether there was partial dehiscence of the suture line. The use of laparoscopy was elected to evaluate the integrity of the abdominal cavity. The filly was anesthetized in a manner similar to that used in the first procedure, and the ventral abdomen was prepared for surgery and draped. The abdominal cavity was insufflated using carbon dioxide, and a 15-mm skin incision was made for a laparoscope portal approximately 10 cm cranial to the umbilicus and 3 cm to the left of the midline. After the abdomen was entered with the trocar/cannula unit, the laparoscope was introduced and directed caudally. Bilateral transverse tears of the abdominal wall were evident. A 15-cm skin incision was made directly contralateral to that made previously on the foal’s right side, and the sutures were removed from the first incision. The skin was elevated to reveal the full extent of the tear. The defect measured approximately 20 × 15 cm. Attempts were again made to suture the individual muscular layers using 2 polydioxanone followed by 2 polyglycolic acid in simple continuous suture patterns. Once satisfactory apposition of the torn musculature had been achieved, a double-thickness piece of polypropylene mesh was sutured over both defects using additional pieces of 2 polydioxanone in interrupted mattress sutures (Figure 1).

The surgical site was copiously lavaged with sterile saline, and the subcutaneous tissue and skin were apposed using 2-0 poliglecaprone 25 in simple continuous fashion. The filly recovered uneventfully from anesthesia and was returned to the medicine facility for postoperative care.

The filly responded well to physiotherapy of the left hindlimb during convalescence and was discharged approximately 14 days later. Despite broad-spectrum antibiotic use that was later tailored to culture and sensitivity results, the superficial layers of the surgical site containing the abdominal mesh had a persistent, purulent discharge.

Approximately 2 months later, the discharge ceased, and the surgical site appeared to heal well, although the right caudoventral aspect of the abdomen had an abnormal contour. After the filly was weaned, it was shipped to Florida. Approximately 8 months after surgery, persistent serous drainage was noted from the site where the mesh had been placed. The filly was anesthetized and the mesh removed. Recovery was uneventful, and the drainage stopped. The filly is currently in training.

Case 2

Case 2 involved a filly that had been delivered by controlled vaginal delivery. Vaginal examination of the mare on the farm had revealed that the foal was in anterior presentation and dorsopubic position. During presentation in the clinic, additional postural changes included a flexed neck and a hindlimb that extended into the pelvis. Following induction of anesthesia, these abnormalities were corrected through elevation of the mare’s pelvis. The mare was then lowered and rotated from side to side to permit delivery of the live foal from a hiplocked position. The foal received immediate medical attention but was referred back to surgery when loops of small intestine that extended cranially below the skin were noted on the ventral abdomen. A palpable abdominal wall defect that extended cranially from the right inguinal ring was identified. The foal was anesthetized with diazepam (0.1 mg/kg IV) and ketamine (2.2 mg/kg IV), and anesthesia was maintained with isoflurane delivered in 100% oxygen. The ventral abdomen was clipped and surgically prepared. The peritoneal cavity was insufflated using carbon dioxide, and a laparoscopic trocar/cannula assembly was placed through the abdominal wall, just off the midline (to avoid the umbilical vein), approximately 20 cm cranial to the umbilicus. The laparoscope was directed caudally to visualize the right inguinal region. A full-thickness tear of the abdominal musculature was clearly visible.

Figure 1. Suturing polypropylene mesh to a superficial location.

b Slone D. Personal communication, September 2005.
visible originating from the craniolateral aspect of the foal’s right inguinal ring. A laparoscopic stapler was introduced through a second portal (approximately 10 cm caudal to the laparoscope portal), and multiple staples were used to close the peritoneum over the defect (Figure 2). Once the peritoneum was apposed satisfactorily, the laparoscopic light source was used to guide a skin incision over the defect in the musculature (Figure 3). When the torn musculature was adequately exposed, each layer was sutured using simple interrupted sutures of 2 polyglycolic acid. The skin and laparoscopic portals were closed with 2-0 poliglecaprone 25 in interrupted horizontal mattress sutures. The filly recovered uneventfully and is currently training for racing.

**Cases 3 and 4**

In cases 3 and 4, both foals were fillies. The foal in case 3 presented to the clinic in anterior presentation and dorsoileal position with its head flexed ventrally between its forelimbs. The fetal maldisposition in case 4 was not recorded. The findings from palpation of both mares confirmed the need for controlled vaginal delivery. With the mares under general anesthesia and in dorsal recumbency, both foals were readily manipulated into the correct presentation, position, and posture. In both foals, application of obstetrical chains to both forelimbs resulted in rapid progress in delivering the fetal thorax. The foal in case 3 was delivered uneventfully. However, the foal in case 4 became hiplocked and required a greater degree of rotation and traction to complete delivery. Both foals were referred to the medical facility for evaluation; trauma to the musculature of the ventral abdominal wall and associated intestinal herniation became evident within hours. After confirmation of large transverse defects in the abdominal wall, the owners elected euthanasia because of a guarded prognosis (a complicated recovery was likely and a future athletic career unlikely).

**Discussion**

A mare in dystocia may require assistance to complete delivery of the foal. During assisted vaginal delivery (manipulation of the foal in a standing mare), traction on the foal should complement the propulsive efforts of the mare and should be applied judiciously, and only minimal effort should be required to complete the delivery. Application of traction with the foal in anterior presentation is often successful in delivering the thorax, but progress may be interrupted by the interlocking of the foal’s pelvis with that of the dam (hiplock). At this stage, excessive application of traction should be avoided and rotation of the foal within the birth canal attempted. In some instances, it may be necessary to anesthetize the mare and move it from side to side while the foal is being rotated.

The risks associated with excessive traction include trauma to the dam’s reproductive tract and to the foal.

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**Figure 2.** Using an endoscopic stapler to close the peritoneal component of the hernia.

**Figure 3.** Using an intraabdominal laparoscopic light source to guide closure of the muscular component of the hernia.

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\*Thorpe P, Hunt R, Spirito M, Rodgerson R. Controlled vaginal delivery, unpublished findings. Controlled vaginal delivery was introduced by Dr. Thorpe approximately 20 years ago and has been used at Hagyard Equine Medical Institute and other clinics since. This is based on unpublished success with the technique.
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Two of the four foals in this report (cases 2 and 4) were delivered from a hip locked position, and the other two foals were delivered without complication once the foals had been rotated into the correct presentation, position, and posture. These findings suggest that while excessive traction on a “fixed” fetus will most likely result in trauma to its ventral abdominal wall, this may also occur after routine delivery.

Relative to the total number of cases of equine dystocia treated in our clinic, ventral herniation in foals is rare. Subjectively, four cases in 3 years is an uncharacteristically high number. During this period, 116 foals were born using assisted vaginal delivery. One of these foals (case 1) developed a ventral hernia, which represents only 0.86% of all foals delivered in this fashion. Seventy-six foals were delivered by controlled vaginal delivery, resulting in ventral herniation in three foals (cases 2 through 4)—a 3.9% chance of occurrence. Forty-one foals were delivered by cesarean section in the same time frame.

A diagnosis of traumatic ventral herniation can be made quickly because an affected foal may display signs of colic. Large defects in the ventral abdominal wall are readily palpable. Depending on the size of the defect, multiple loops of small intestine may be detected in a location more cranial to that common in foals with inguinal herniation. While inguinal herniation of the small intestine is commonly identified in colts, all four of the reported cases involved fillies. The extensive edema that obscures identification of affected structures in adult horses with ventral herniation is not a problem in foals with peracute abdominal muscular ruptures. Ultrasonographic examination may be useful in confirming the location and extent of an abdominal wall defect. In the cases summarized above, all full-thickness muscular tears were readily apparent, running more or less transversely adjacent to the midline (Figure 4).

In adult horses, several months are allowed to elapse after the development of abdominal wall hernias to allow the muscular hernial rings of abdominal defects to undergo fibrosis. In newborn foals, however, the high risk for incarceration and adhesion formation necessitates immediate surgical intervention. Initial attempts to suture the abdominal wall defect in case 1 were unsuccessful, primarily because the tear involved the abdominal musculature (i.e., it lacked a fascial component) and tissue damage made it difficult for sutures alone to support the ventral abdomen.

Successful surgical repair of large abdominal wall defects in adult horses has been achieved by bridging the defect with synthetic mesh. Lining an area of the abdominal cavity with mesh may cause postoperative complications due to adhesion of the intestine to the mesh, irritation of the bowel, and persistent drainage and infection. Therefore, mesh is usually placed on the inside of the defect in a retroperitoneal location. Implantation of mesh on the outside of the hernial ring has also been reported and may be easier. Bridging multiple herniation sites with one piece of mesh has been described and was performed in case 1 using a doubled sheet of polypropylene mesh. However, the superficial location of the implant may have predisposed the foal in case 1 to infection and persistent drainage, as dehiscence of the initial repair resulted in a clean-contaminated surgical field. Drainage ceased after the mesh was removed.

Polypropylene or plastic mesh materials have been advocated for mesh herniorrhaphy. Polypropylene mesh is easy to handle, the cut edges do not fray, and granulation tissue is able to grow through it. It is also less rigid and more elastic than woven plastic mesh, possibly preventing tearing of the muscles to which it is sutured. Commercial polyester fabric has been used to good effect, and absorbable mesh materials are also available.

The advent of laparoscopy in human medicine has reduced the incidence of intraabdominal adhesion formation. The number of indications for the use of
laparoscopy in large animal surgery continues to increase. Successful laparoscopic inguinal herniorrhaphy has been described in treating inguinal hernias in adult stallions. Laparoscopic repair of a ventral hernia in an adult horse has recently been described. Laparoscopic evaluation is reportedly valuable in assessing the extent of abdominal trauma and was valuable in planning further intervention in case 1. In case 2, laparoscopic closure of the peritoneal defect before suturing the external musculature eliminated the need for more invasive procedures within the abdominal cavity, thereby reducing the likelihood of adhesion formation.

Both foals that underwent surgical intervention (cases 1 and 2) are currently in training and have had no further problems related to their hernia repair. Although ventral herniation is rare, it is a potential complication of assisted or controlled vaginal delivery in mares. This condition is readily diagnosed and can be successfully managed by surgical intervention. Surgery should be minimally invasive and should provide adequate support to the ventral abdomen.

REFERENCES

15. Sanders-Shamis M. Bilateral inguinal herniation in a foal. JAVMA 1988;192:1668.
1. Correction of acquired abdominal wall hernias in adult horses is delayed for 2 to 3 months because
   a. inflammation associated with the defect will decrease in this time.
   b. fibrous tissue will form at the hernial ring, increasing the likelihood of successful closure.
   c. horses are not surgical candidates following acute herniation.
   d. secondary infection is likely if the hernia is repaired within several days.

2. Which statement regarding indirect inguinal herniation in foals is correct?
   a. These hernias require immediate surgical intervention.
   b. These hernias typically result from trauma.
   c. The small intestine passes through the vaginal ring and remains within the vaginal tunic.
   d. There is a high risk for small intestinal incarceration.

3. In foals, umbilical hernias
   a. rarely occur.
   b. have not been reported to result from omphalophlebitis.
   c. are life-threatening and require immediate surgical intervention.
   d. are associated with hereditary failure of normal development and closure of the umbilicus.

4. Which statement regarding the diagnosis of traumatic ventral herniation in foals is correct?
   a. Ultrasonographic examination is a noninvasive method to detect the location and extent of the defect.
   b. Large abdominal defects are not readily palpable.
   c. Extensive edema generally obscures the identification of affected structures in cases of peracute herniation.
   d. Percutaneous abdominocentesis is considered the gold standard for diagnosing the hernia.

5. In the case series discussed in this article, ___% of foals that underwent assisted vaginal delivery developed ventral herniation.
   a. 0.86
   b. 3.9
   c. 10
   d. 23

6. Which technique is most likely to reduce the risk for intraabdominal adhesion formation after hernia repair?
   a. minimization of the length of the ventral midline celiotomy
   b. copious abdominal lavage using an antibiotic solution before closure
   c. a laparoscopic technique for herniorrhaphy
   d. the use of polypropylene mesh

7. Which statement regarding the use of synthetic mesh to surgically repair large abdominal hernial defects is correct?
   a. The edge of plastic mesh is more pliable than that of polypropylene mesh.
   b. Implantation of mesh on the outside of the hernial ring is more difficult.
   c. Location of mesh within the abdominal wall has no effect on the likelihood of infection or persistent drainage.
   d. Lining an area of the abdominal cavity with mesh may cause postoperative complications, the most serious of which is adhesion formation.

8. A common clinical sign of a foal with ventral herniation is
   a. fever.
   b. tachypnea.
   c. colic.
   d. ptyalism.

9. Which statement regarding traumatic ventral herniation in foals is correct?
   a. It is the most common type of herniation in foals.
   b. It is rare but represents a potential complication of assisted or controlled vaginal delivery in mares.
   c. The diagnosis is often difficult.
   d. Surgical correction is necessarily associated with a poor outcome.

10. Surgical correction of traumatic ventral hernias in foals is recommended ______ following diagnosis of the lesion.
    a. immediately
    b. 7 to 14 days
    c. 2 to 3 months
    d. none of the above