How to Repair an Abdominal Body-Wall Hernia in the Horse Using a Mesh Implanted Subcutaneously

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1. Introduction

Large abdominal hernias are traditionally repaired by implanting a synthetic mesh. and small hernias are usually closed using the hernial ring with sutures. Using common techniques of implantation, the mesh is placed retroperitoneally, either by separating the hernial sac into two layers between which the mesh is placed or more commonly, by separating the peritoneum from the internal sheath of the rectus abdominis muscle and creating a fascial flap from the hernia sac.[1] The mesh lies separated from the viscera by the dorsal layer of the sac or the peritoneum and from the skin by the ventral layer of the sac or the fascial flap created from the hernial sac. Even when dissection is meticulous, these techniques often result in defects in the hernial sac that expose a portion of the peritoneal cavity to the mesh, which increases the risk of adhesions developing between a viscus and the mesh.[2] According to some authors,[1,3] implanting mesh external to the hernial ring imparts a high risk of inducing infection at the surgical site and does not provide as much biomechanical support as implantation internal to the hernial ring.[1,3] Although most abdominal incisional hernias can be repaired with sutures alone, the healed abdominal wall often contains small gaps that can be seen or palpated by the owner. We believe that abdominal body-wall hernias can be repaired with mesh using a simple technique that is described below; this technique provides secure repair and good cosmetic results.

2. Materials and Methods

We recommend waiting at least 3 mo after celiotomy to perform herniorrhaphy to provide time for a strong, fibrous hernial ring to form and for infection and inflammation to resolve. Ultrasonographic evaluation of the abdomen may aid in determining if a viscus is adhered to the hernial sac. The horse is fasted for 24 h before surgery, and a non-steroidal, anti-inflammatory drug (e.g., flunixin meglumine[a]) and a combination of antibiotics that provides activity against a broad spectrum of microbes (e.g., gentamicin[b] and cefazolin[c]) are administrated ~1 h before induction of anesthesia. The horse is anesthetized and positioned in dorsal recumbency; then, the ventral aspect of the abdomen is prepared for abdominal surgery.

NOTES

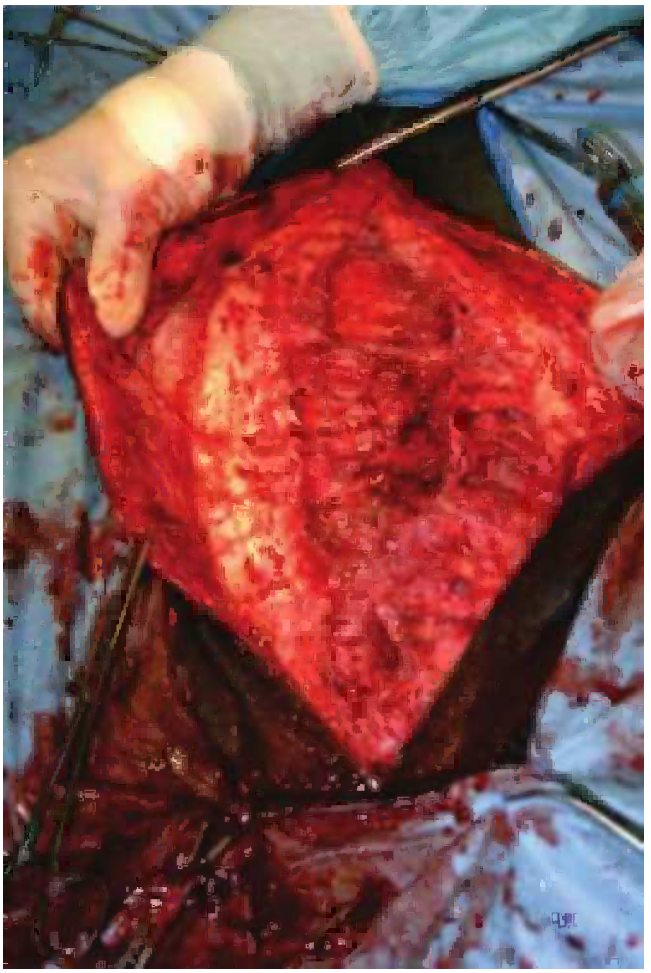

Fig. 1. A defect in the body wall covered by a hernia sac is viewed after the SC tissue was dissected to achieve adequate exposure.

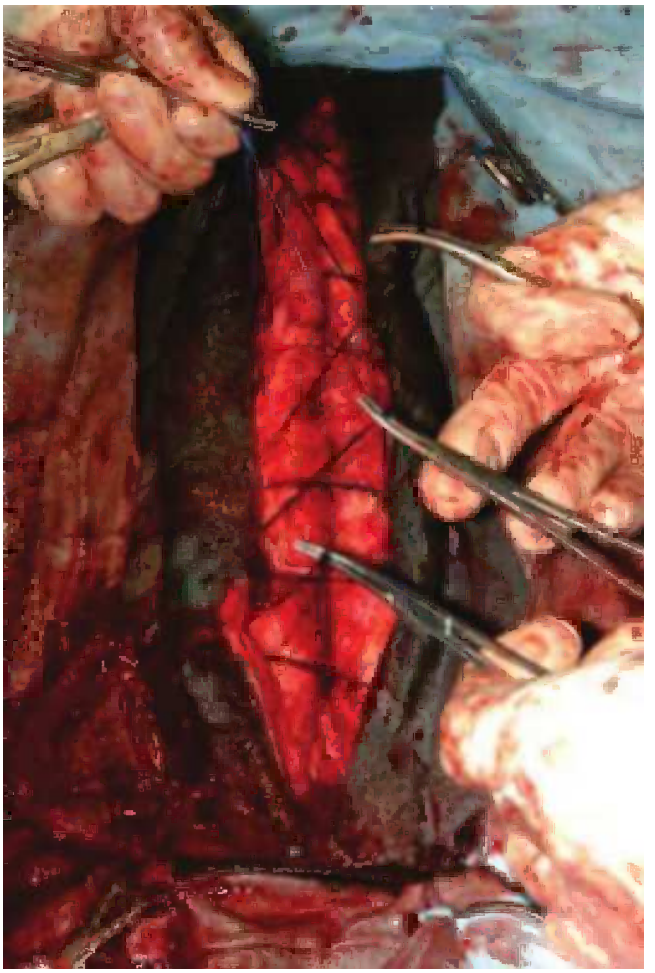

Fig. 2. Primary closure of the body wall in a pre-placed inverted cruciate pattern using double 2 PDS suture material on a hernia needle.

To expose the hernial sac, a fusiform skin incision is made that spans the length of the hernia and extends 4–6 cm beyond the cranial and caudal margins of the ring. The margins of the incision should extend no further laterally than 3 cm axial to the hernial ring to ensure that sufficient skin is available to close the skin incision at the completion of surgery. Electrocautery can be used to control SC hemorrhage but is usually not necessary. The hernia sac is dissected from overlying skin using scissors. Dissection is continued laterally to expose the hernial ring and the external rectus sheath abaxial to it (Fig. 1). The isolated hernial sac is inverted into the abdomen unopened and pre-placed; cruciate or inverted cruciate sutures of large, synthetic, absorbable suture material, such as doubled #2 polydoxionone (PDS), placed on a hernia needle are used to close the hernial ring. Sutures are pre-placed at least 1.5 cm from the edge of the hernia at 1.5- to 2.5-cm intervals (Fig. 2). While the abdominal wall is being closed, the mesh (e.g., woven polypropylene[d] or knitted polypropylene[e] is soaked in a physiological saline solution containing an antibiotic, such as cefazolin (5 g/l). The hernial sac inverts into the peritoneal cavity when the pre-placed sutures are tightened and tied (Fig. 3). The mesh is folded into two layers and placed over the sutured ring. If the hernia is longer than the mesh, two folded meshes, placed end to end, must be used. The edge of the closed side of the folded mesh is sutured to the abdominal tunic using synthetic absorbable sutures of 1 or 0 PDS that are placed in a simple interrupted pattern (Fig. 4). Sutures bites are 1- to 1.5-cm wide, and sutures are placed at 1-cm intervals.

The open side of the folded mesh is sutured to the abdominal tunic using pre-placed sutures of the same suture material. Sutures are placed using a Mayo mattress pattern so that when the sutures are tightened and tied, tension is placed on the mesh; this reduces tension on the sutured hernial ring (Fig. 5). The cranial and caudal edges of the mesh are sutured first so that tension is applied both longitudinally and abaxially to the mesh. Excess

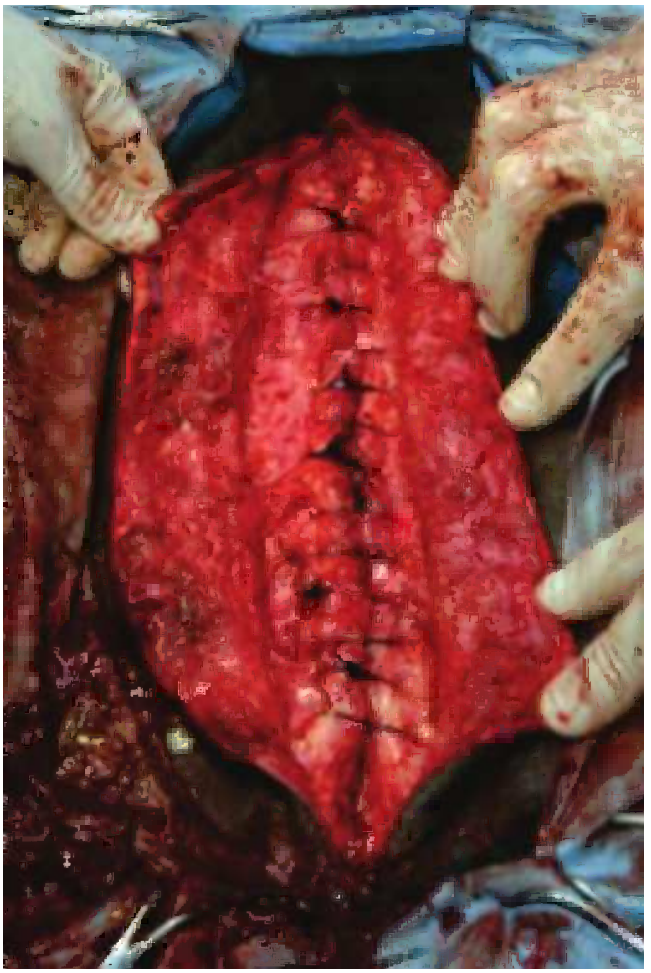

Fig. 3. Complete closure of the body wall defect before mesh implantation. The hernial sac has been completely inverted into the abdomen.

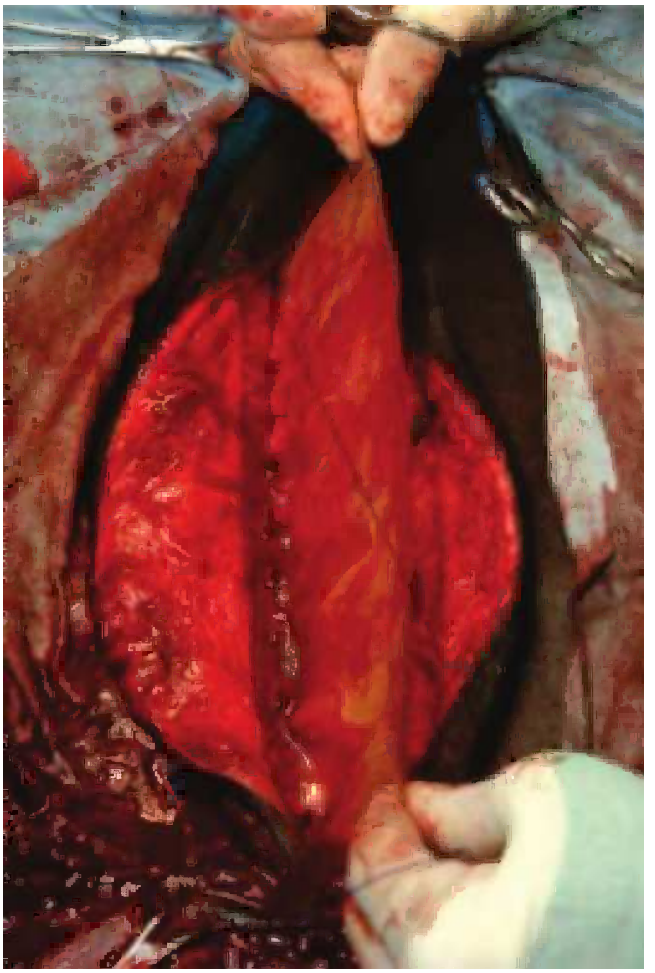

Fig. 4. The folded side of the mesh is secured to one side of the hernia with simple interrupted sutures using 0 PDS.

mesh abaxial to the sutures is trimmed with scissors. Two more rows of simple interrupted sutures to secure the mesh are placed axial to each sutured edge of the mesh (Fig. 6).

While implanting the mesh, the surgical site should be lavaged periodically with a physiological saline solution containing an antimicrobial drug, such as cefazolin (5 g/l). Excess skin is sharply excised, and SC tissue is closed in two layers using 2–0 PDS placed in a simple continuous pattern. When suturing the first layer of SC tissue, the suture needle should penetrate the mesh every second or third bite to decrease the dead space between the mesh and the SC tissue (Fig. 7). The skin is closed with staples, and a Stent bandage is secured tightly over the incision using #1 or #2 polypropylene suture placed in an interrupted or continuous horizontal mattress pattern.

The Stent bandage may sufficiently protect the incision from environmental contamination and may provide sufficient compression at the surgery site to avoid substantial postoperative edema, but application of a tight abdominal bandage, in place of or in addition to the Stent bandage, may provide more protection and may be more effective in minimizing post-operative edema. An abdominal bandage can be applied by placing one pad over the incision and another over the horse's back; these pads are secured with rolled elastic gauze (e.g., 6-in brown gauze) and elastic adhesive tape.[c] The bandage can be replaced as needed until the cutaneous incision has healed. A commercially available abdominal bandage[d] functions similarly but is more easily applied and maintained by owners; additionally, it is cost-effective. The Stent bandage is removed in 4–5 days (sooner if it becomes wet), and the skin staples are removed at ~14 days. The horse should be confined to a stall for ~2 mo before it is allowed unrestricted activity. The horse can be walked daily during the period of stall confinement.

3. Results

One of the authors (JS) has used this technique on over 40 horses. The technique was used for repair

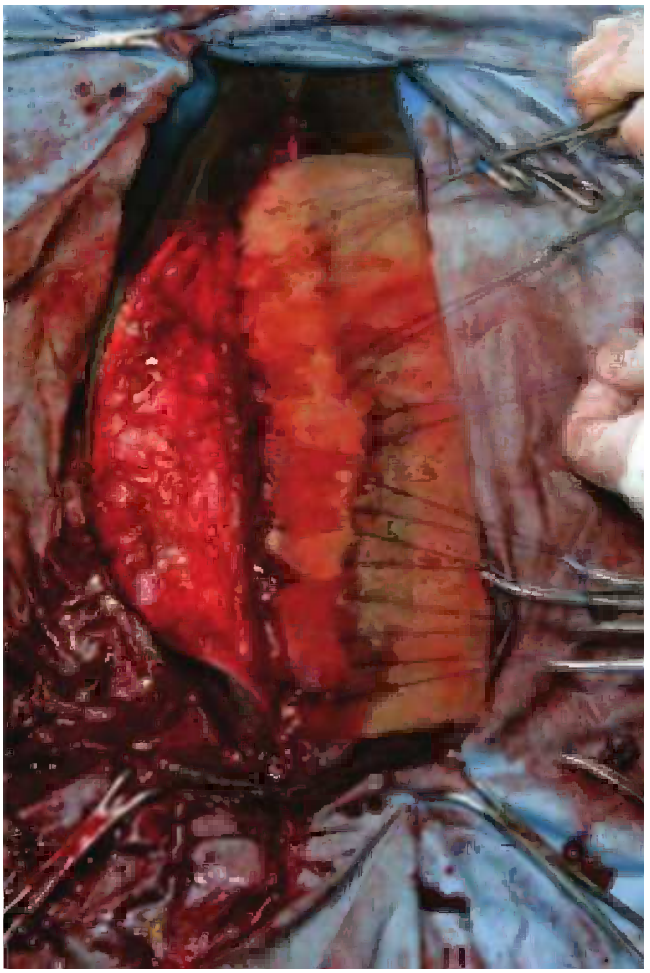

Fig. 5. The open side of the mesh is pulled tightly and a Mayo mattress suture pattern using 0 PDS is used to provide tension to the mesh to prevent sagging mesh and decreased tension on the sutures holding the body wall.

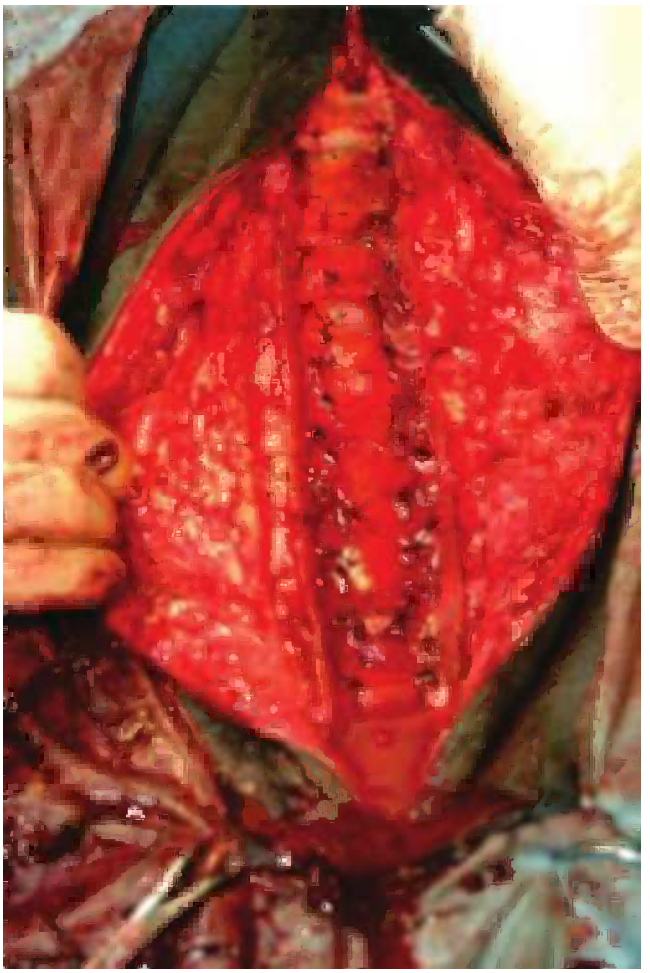

Fig. 6. The mesh is tightly adhered to the body wall with two parallel rows of sutures along each side of the mesh.

of ventral midline incisional hernias as well as traumatic hernias off midline at the muscular portion of the body wall. Thirty-seven of forty horses healed with little or no complications. One horse was euthanized, because it suffered a fractured radius during recovery from general anesthesia. A mule developed an infection at the surgical site after experiencing an apparent allergic reaction to nylon mesh. Four days after surgery, this mule developed a SC collection of fluid with a white blood cell population made up entirely of eosinophils. Subsequently, the surgical site became infected when pressure from accumulated SC fluid caused the cutaneous incision to open. This mesh was removed ~2 mo after surgery through a stab incision. Sufficient fibrous tissue had formed around the mesh so that the mule no longer appeared to have an incisional hernia, although the body wall at the site of surgery looked thin on ultrasonographic examination of the region. No further treatment was undertaken. Intestinal penetration with a needle occurred during one surgery, and a particle of feed was attached to the suture material after insertion of a suture to close the body wall. Sutures to close the abdominal wall of this horse were placed using a swaged-on, taper-point needle rather than a hernia needle. The suture was replaced, and the surgery was completed; however, the horse developed signs of peritoneal inflammation several days later. During exploration of the abdomen through a celiotomy performed cranial to the mesh, no abnormalities were found. The abdomen was lavaged, and the celiotomy was closed. Both surgical sites healed by primary intention. Other reported complications of hernia repair, such as recurrence, tearing of the internal abdominal oblique muscle, sloughing of overlying skin, and intestinal adhesions, were not encountered.[4,5] Clients were pleased with the cosmetic results of the procedure.

4. Discussion

An incisional hernia is a complication of 6 -17% of emergency celiotomies performed in horses,[6] and

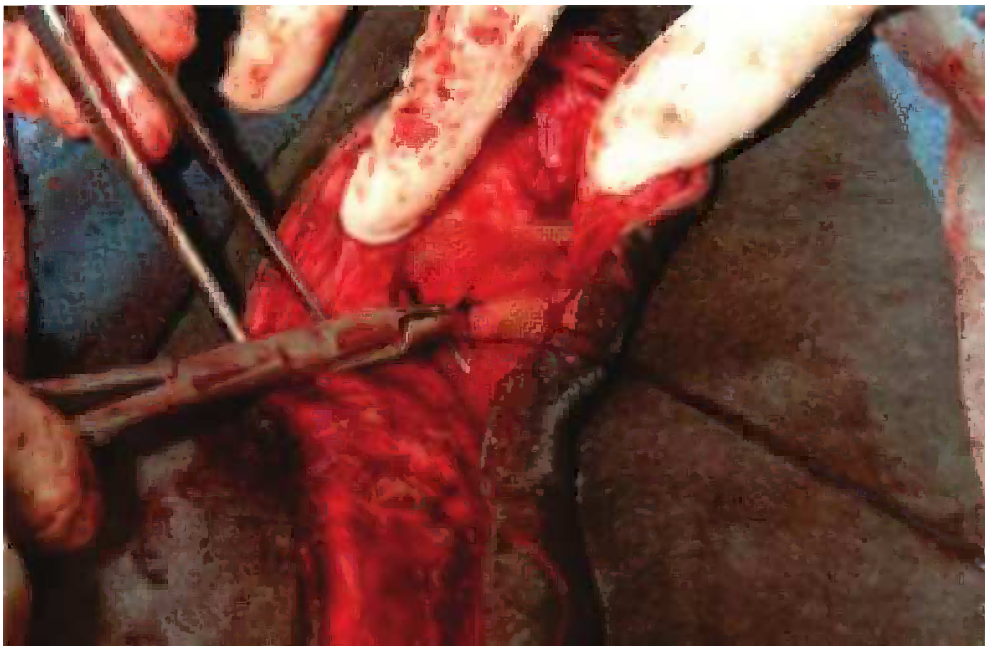

Fig. 7. The first of the two SC layers intermittently incorporates the mesh to prevent dead-space formation and fluid accumulation.

most are associated with infection at the surgical site.[7] Incisional herniation is usually preceded by drainage of purulent exudate typically first observed during the first week after surgery.[8]

Although most large incisional hernias can be closed with sutures alone, one of the authors (JS) has observed that multiple small hernias can often be palpated at the surgery site when healing is complete. The incidence of post-operative complications after retroperitoneal placement of the mesh during repair of incisional hernias, such as tears of the internal abdominal oblique muscle, incisional swelling, and drainage, is relatively high.[4] Closing the hernial ring before implanting a mesh strengthens the repair and may improve post-operative appearance. Placing the mesh subcutaneously, as described in our report, makes mesh repair less complicated, and based on our results, there should be less concern about development of SC infection around the mesh.[9] Recurrence is a relatively common complication of herniorrhaphy and has been reported to occur after herniorrhaphy using sutures alone and after herniorrhaphy using mesh implantation.[9–11] We have observed no recurrence of hernias on a large number of horses using our technique.

We believe that suture material used to secure the mesh should be absorbable so that if infection does occur, the mesh can be easily removed. Using non-absorbable suture material to secure to mesh may preclude removal of the mesh if removal becomes necessary, as in the case of infection.[f] Use of a hernia needle decreases the likelihood of penetrating a viscus with a needle during the repair. If adhesions of a viscus to the hernial sac are observed during ultrasonographic examination of the hernia, an open, rather than closed, technique of repair should be used to close the hernial ring. We believe that abdominal incisional hernias can be easily and successfully repaired by suturing the hernia using a synthetic mesh applied externally to the hernial ring.

References and Footnotes

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[a]Flunixijet, IVX Animal Health Inc., St. Joseph, MO 64503.
[b]Gentafuse, IVX Animal Health Inc., St. Joseph, MO 64503.
[c]Cefazolin, Orchid Healthcare, Irungattu Kottai, India 602/05.
[d]Marlex, C.R. Bard, Inc., Murray Hill, NJ 07974.
[e]Proxplast, Goshen Laboratories, Goshen, NY 10924.
[f]Schumacher J. Personal observation. 2007.