

Case Report

Laparoscopic repair of a traumatic ventral abdominal hernia using a mesh

A. B. M. RIJKENHUIZEN

Institute of Equine Science, University of Utrecht, Yalelaan 12, 3584 CM Utrecht, The Netherlands.

Keywords: horse; traumatic hernia; ventral hernia; laparoscopic surgery; mesh repair

Introduction

Ventral herniation in horses is most frequently seen in the form of incisional hernias after colic surgery (Gibson *et al.* 1989; van der Velden and Klein 1994) and in pregnant mares (Kawcak and Stashak 1995), but may also occur after trauma (Hilbert *et al.* 1978; Hanson and Todhunter 1986). In the latter category, there may be a perforation of the skin, but after blunt trauma this is most often not the case. The peritoneum may be ruptured, and entrapment of viscera in the hernia can occur.

In most cases of ventral herniation there is extensive oedema, making palpation of the traumatised area difficult. Therefore, rectal examination and ultrasonography are frequently necessary to make a definitive diagnosis. Surgical repair is typically undertaken after the oedema has resolved unless visceral incarceration has occurred. Support bandaging of the area may help reduce oedema and support the body wall during this period. The conventional approach is by herniorrhaphy via an open technique. If the defect is too large for closure with sutures alone, mesh herniorrhaphy is necessary.

In man, laparoscopic hernia repair has developed into a viable alternative for herniorrhaphy (Reddick 1994; Vargo *et al.* 1996; Frantzides and Carlson 1997; Franklin *et al.* 1998; Chowbey *et al.* 2000; Szymanski *et al.* 2000; Thoman and Phillips 2002). Patients appear to have less pain and can return to activities more quickly than with conventional surgery. The technique has also been described in the pig, because this animal serves as a model for human surgeons to train in laparoscopic ventral hernia repair (Garcia-Ruiz *et al.* 1998). In the horse, closure of inguinal hernias using laparoscopy has been described (Fischer *et al.* 1995; Marien 2001). However, although the diagnostic use of laparoscopic techniques in abdominal trauma has been described previously (Peroni 2002; Rijkenhuizen and van Dijk 2002), no reports of laparoscopic repair of a ventral hernia in the horse have been published so far. **This report describes the successful laparoscopic repair of a traumatic ventral hernia in a foal with the use of a polypropylene mesh.**

Case details

History

A 6-month-old Friesian filly foal (approximately 300 kg bwt) was referred to the Department of Equine Sciences having jumped on a fence; a preliminary diagnosis was made of a ventral hernia due to blunt trauma.

Clinical findings

On arrival the foal was alert and no abnormalities were observed during routine clinical examination, except for unilateral purulent nasal discharge. A distinct oedematous and painful swelling was present in the caudoventral part of the left flank and left inguinal area. A soft area could be palpated approximately 10 cm cranial to the inguinal ring. The foal showed no signs of colic and there was no skin defect. Due to excessive oedema, no abdominal wall defect could be palpated. On auscultation, gastrointestinal sounds could be heard in both flanks, but were not more evident in the affected area. Haematology (PCV 36%, white blood cells $10.2 \times 10^9/l$) was within normal values. It was decided to wait until the following day for further evaluation.

The next morning the oedema had increased. Ultrasonography revealed a ventral hernia with viscera inside the hernial sac. The borders of the hernia could not completely be visualised. There were still no signs of abdominal discomfort. With the owner's consent, it was decided to attempt laparoscopic repair in this case.

Treatment

The foal was sedated with detomidine (0.1 mg/100 kg bwt i.v.). General anaesthesia was induced with midazolam (0.06 mg/kg bwt i.v.) and ketamine (2.2 mg/kg bwt i.v.) and maintained with a combination of inhalation anaesthesia using isoflurane (1.0%) and detomidine infusion (0.1 µg/kg bwt/min i.v.). The foal was ventilated mechanically (20–25 cmH₂O). Anaesthesia was monitored by recording electrocardiography, capnography,

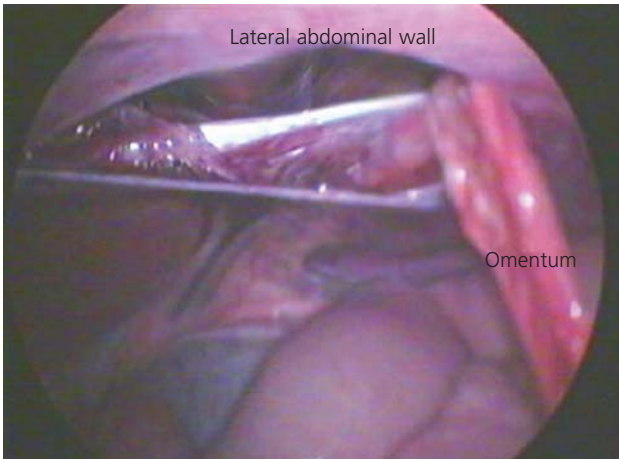


Fig 1: Laparoscopic view of the defect in the abdominal wall showing the margins of the defect with a portion of omentum running into the hernial sac.

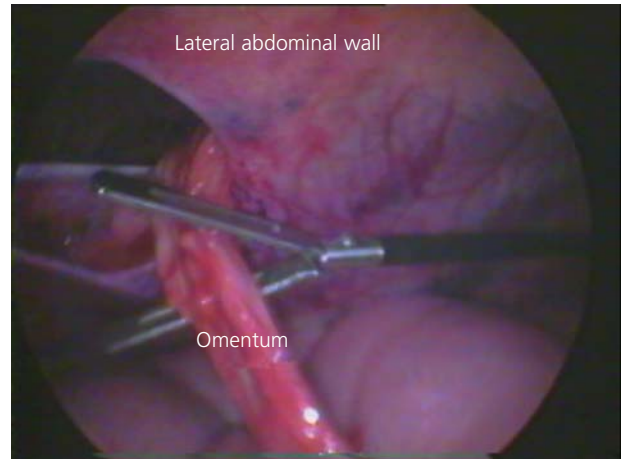


Fig 3: The omentum is retracted from the hernia with atraumatic bowel grasping forceps.



Fig 2: Laparoscopic view in the hernial sac with a portion of omentum located in the hernial sac.

pulse oximetry, arterial blood pressure, arterial pH, PaO₂ and PaCO₂ (arterial oxygen and carbon dioxide partial pressure, respectively) and physiological parameters.

The foal was positioned in dorsolateral recumbency and in the Trendelenburg position (approximately 30°) in order to reallocate the viscera as much as possible in the cranial part of the abdomen. The surgical field was prepared routinely for aseptic surgery. The surgeon stood initially at the ventral side of the patient, but changed position with the camera operator, who had stood at the dorsal side, during the stapling procedure. The monitor was positioned at the patient's caudal side.

The portal for the laparoscope was made in the left flank with a 12 mm guarded disposable trocar with reducer¹, just caudal to the last rib, halfway between the *tuber coxae* and femoropatellar joint and directed ventrally and caudally. The laparoscope² (diameter 10 mm, length 57 cm, 30°) was introduced, and the abdomen insufflated using a CO₂ insufflator² (flow rate 7–8 l/min) until a maximal intra-abdominal pressure of 20 mmHg was reached, in order to

achieve necessary exposure of the hernia. The abdomen was inspected for possible intestinal lesions and to localise the hernia. No trauma to the viscera could be detected and the amount of abdominal fluid was normal. A defect of approximately 4 x 11 cm was identified in the ventrolateral abdominal wall, cranial and dorsal to the vaginal ring (**Fig 1**). There was no intact peritoneal sac. At the moment of inspection no viscera were present; however, a portion of the omentum was located in the hernial sac (**Fig 2**). Along the edges of the defect there was a haematoma underneath the peritoneum. After introduction of the laparoscope into the hernial sac, it became clear that the peritoneum, fascia of the transverse abdominal muscle, internal abdominal oblique muscle and aponeurosis of the external abdominal oblique muscle were torn, the tear in the external abdominal muscle being the smallest (diameter 3 cm).

A second trocar (12 mm guarded disposable with a reducer)³ was inserted through the umbilicus and directed caudally and a third (5.5 mm) introduced 10 cm dorsally. When the abdominal cavity was dilated, insufflating pressure was reduced to 6 mmHg and maintained at this level. The omentum was retracted from the hernia with the help of an atraumatic bowel grasping forceps (**Fig 3**). A knitted polypropylene mesh⁴ (7.6 x 15.6 cm) was then introduced into the abdomen through the umbilical portal using a laparoscopic Péan forceps (**Fig 4**). The mesh was unrolled and positioned over the defect. The periphery of the mesh was anchored tension-free to the peritoneum, underlying abdominal fascia and internal abdominal oblique muscle with 18 staples using a multifeed stapler³ (staple dimensions 5.3 x 3.7 mm), covering 2.0–2.5 cm of tissue beyond the border of the defect (**Fig 5**). Proper anchorage of the mesh was checked by placing pressure at the centre of the mesh. The abdomen was deflated and the skin portals closed with simple interrupted sutures (poliglecaprone USP2-0)⁵. Total surgical time was 120 mins.

Antibiotics had been administered preoperatively (sodium ampicillin 10 mg/kg bwt i.v. and procaine penicillin

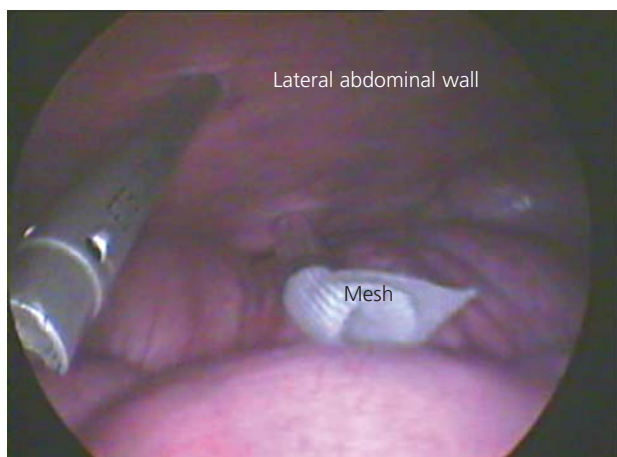


Fig 4: Introducing the mesh into the abdominal cavity. The mesh is enrolled in the instrumental trocar.

20,000 iu/kg bwt i.m.) and were continued for 10 days (trimethoprim sulphadiazine 30 mg/kg bwt *per os* b.i.d.). Additionally, clenbuterol (0.8 mg/kg bwt *per os* b.i.d.) was given because of nasal discharge and coughing observed post operatively. The foal recovered uneventfully. No support abdominal bandage was applied. Four days after surgery some accumulation of fluid in the hernial sac was noted, but no action was deemed necessary. The oedema had decreased considerably on the fifth post operative day and disappeared fully within 2 weeks. The foal remained under observation for 3 weeks and was discharged with instructions to box-rest for an additional 4 weeks. Three months after surgery, there was no swelling at the surgical site. Ultrasonography revealed no adhesions to the mesh, and formation of fibrous tissue between the mesh and muscles was visible. One and 3 years after surgery, the owner indicated that the mare was clinically normal with no visible signs of the previous surgery.

Discussion

Traumatic ventral hernias are usually caused by blunt trauma, with the skin, having elastic properties, usually remaining intact. While this may prevent penetration of the abdominal wall, because the forces are distributed over a large area (Malangoni and Condon 1983; Vargo *et al.* 1996), it also results in relatively widespread tissue damage. The relatively large affected area is one of the main reasons why the recurrence rate after immediate conventional surgery (primary closure with sutures) is high. The high tension of the sutures on the compromised tissues surrounding the actual wound can easily lead to dehiscence (Malangoni and Condon 1983). Conventional surgery carries a high risk of infection in the acute phase when much oedema is present, especially when the application of a mesh is considered. Postponing surgery until oedema has subsided and fibrosis of the hernial borders has occurred is a viable option (Meek *et al.* 1977); however, this procedure might increase the risk of intestinal incarceration or adhesion to extra-abdominal structures because hernias of this type often lack a serosal lined hernial



Fig 5: Anchoring the mesh to the abdominal wall with the stapler.

sac. Each abrasion of the mesothelial lining can result in peritoneal inflammation initiating adhesion formation (Hardy and Rakestraw 1999). Delayed surgery also allows retraction of the wound margins, making the use of a mesh to close the defect necessary (Wood *et al.* 1988). Occasionally, depending on the size of the defect, the formation of fibrous tissue underlying the skin is useful for achieving a sound abdominal wall closure by conventional closure with native tissue.

A laparoscopic approach appears to be a safe and accurate alternative for horses with a traumatic ventral hernia, as it has no requirement for a long incision or extensive tissue dissection. This can be expected to reduce the rate of wound complications, as the incidence of haematoma formation and infection is known to depend heavily on surgical technique (Klinge *et al.* 2002; Schumpelick *et al.* 2002). The technique can be used not only for determining location and size of the hernia, but also for implantation of a mesh. Ideally, the mesh should be placed retroperitoneally or retromuscularly in order to protect the abdominal organs from abrasion (Tulleners and Fretz 1983; van der Velden and Klein 1994; Schumpelick *et al.* 2002). This technique increases surgical time and, because of the peritoneal defect, a part of the mesh would have still been in contact with the abdominal organs in the present case; the mesh was therefore placed intra-abdominally, directly adjacent to the intestine. This position of the mesh has been proven, in both horses (van der Velden and Klein 1994) and man (Heniford and Ramshaw 2000), to cause no adhesions. The chance of adhesions is also reduced by the choice of the mesh, with a polytetrafluoroethylene mesh appearing to offer the most favourable outcome (Koehler *et al.* 2003; Matthews *et al.* 2003). In our clinic, results with the polypropylene mesh were good and a change in technique or choice of mesh was therefore not considered.

Vargo *et al.* (1996) described a peritoneal dissection, followed by placement of the mesh into the defect and reapproximation of the peritoneum in a man with a traumatic ventral hernia. This technique might have been an option in this particular foal. However, it would have been necessary not only to introduce the laparoscope into the hernial sac, but also

to have the instrumental portal there. This would have increased the risk of infection and of accidentally perforating structures inside the hernia. However, it would have been easier to place the staples, as the angle of stapling would have approximated the most desirable angle of 90°. In the method used, the angle was approximately 70°. This slightly unfavourable angle did not cause major problems because it was possible to exert sufficient contrapressure with the surgeon's hand on the abdominal wall to ensure accurate anchoring of the staples. Placing staples not only at the periphery of the mesh but also in its centre may have reduced the chance of fluid accumulation by obliterating the remaining space of the hernial sac. However, although the porous property of the mesh would have allowed peritoneal fluid from the abdominal cavity to accumulate in the hernial sac, in this case the anatomical situation of the muscles in the standing foal probably caused sufficient pressure to prevent fluid accumulation in the hernial sac. In fact, because of the localisation of the mesh, any increase in abdominal pressure tended to push it more tightly against the abdominal wall, thereby holding it in place. If the mesh was placed on the outside of the defect, any strain would tend to push the mesh away, increasing the likelihood of recurrence.

In human literature, a 4-point fixation with transabdominal sutures followed by intra-abdominal stapling has been described as a quick and adequate method (Larson 2000; Tagaya *et al.* 2000); total fixation of the mesh with sutures placed through the full-thickness of the abdominal wall circumferentially at 4–5 cm intervals has also been reported (Heniford *et al.* 2000). In the case presented here, staples placed through the peritoneum in the superficial layer of the transversal abdominal muscle were used. Because the foal had hardly any fat at this specific location, attachment of the mesh to the peritoneum and superficial layer of the underlying muscle was deemed sufficient. However, it is acknowledged that in older horses and more ventrally situated hernias, anchoring of the mesh using whole-thickness sutures through the abdominal wall at 4–5 cm intervals would be the correct technique. It would even have been more ideal in this case, as the mesh would be better secured and dead space reduced.

It is appreciated that, considering its size, the hernia in this case might not have required mesh repair. However, apart from its mechanical function, a mesh acts as a scaffold for fibroblasts, which eventually cover the defect (Hamilton *et al.* 1974). As such, a mesh can decrease the risk of recurrence. Through the use of a laparoscopic approach, traditional risk factors associated with the use of a mesh become less important, and this lowers the threshold for the use of alloplastic surgery.

The case presented here demonstrates that laparoscopic herniorrhaphy of a ventral traumatic hernia of the type described with a prosthetic mesh, such as Trelex, is feasible. The technique offers several advantages over conventional open techniques performed with or without mesh. It allows broad exposure of the hernia and definition of the hernia margins, has a reduced risk of infection due to its less invasive character and surgical intervention can be performed

immediately because the incisional portals are away from the defect and surrounding oedematous tissue (Park *et al.* 1996, 1998; Ramshaw *et al.* 1999; Berger *et al.* 2002). Conversion to an open technique is always optional, for example in those cases where reduction with atraumatic bowel grasping forceps is difficult due to the length of herniated intestine. Disadvantages include greater technical difficulty of the technique (including its learning curve) and the need for more sophisticated equipment. The method may be cost-effective, as the hospitalisation period and recovery time are generally shorter than with the classical approach, as in human medicine. The learning curve of the laparoscopy should be considered initially. This single case provides no evidence of these advantages and it is also realised that the use of this technique in the more frequent incisional hernias after colic surgery may be more complicated. Nevertheless, laparoscopic ventral herniorrhaphy appears to be an attractive alternative to conventional open repair and merits further exploration.

Acknowledgements

The author would like to thank Dr van Weeren and Dr van der Velden for their positive comments on the article.

Manufacturers' addresses

¹Dr. Fritsch, Tuttlingen, Germany

²Storz GmbH & Co., Tuttlingen, Germany.

³Ethicon Endo-Surgery, Johnson & Johnson, Amersfoort, The Netherlands.

⁴Meadox Medicals, Oakland, New Jersey, USA.

⁵Johnson & Johnson, Amersfoort, The Netherlands.

References

- Berger, D., Bientzle, M. and Muller, A. (2002) A laparoscopic repair of incisional hernias. *Chirurg*. **73**, 905-908.
- Chowbey, P.K., Sharma, A., Khullar, R., Mann, V., Bajjal, M. and Vashistha, A. (2000) Laparoscopic ventral hernia repair. *J. Laparoendosc. Adv. surg. Tech.* **10**, 79-84.
- Frantzides, C.T. and Carlson, M.A. (1997) Minimally invasive ventral herniorrhaphy. *J. Laparoendosc. Adv. surg. Tech.* **7**, 117-120.
- Fischer, A.T. Jr, Vachon, A.M. and Klein, S.R. (1995) Laparoscopic inguinal herniorrhaphy in two stallions. *J. Am. vet. med. Ass.* **207**, 1599-1601.
- Franklin, M.E., Dorman, J.P., Glass, J.L., Balli, J.E. and Gonzalez, J.J. (1998) Laparoscopic ventral and incisional hernia repair. *Surg. Laparosc. Endosc.* **8**, 294-299.
- Garcia-Ruiz, A., Naitoh, T. and Gagner, M. (1998) A porcine model for laparoscopic ventral hernia repair. *Surg. Laparosc. Endosc.* **8**, 35-39.
- Gibson, K.T., Curtis, C.R., Turner, A.S., Mclwraith, C.W., Aanes, W.A. and Stashak, T.S. (1989) Incisional hernias in the horse. Incidence and predisposing factors. *Vet. Surg.* **18**, 360-366.
- Hanson, R.R. and Todhunter, R.J. (1986) Herniation of the abdominal wall in pregnant mares. *J. Am. vet. med. Ass.* **1**, 790-793.
- Hamilton, D.P., Nelson, D.R. and Hardenbrook, H.J. (1974) Repair of ventral abdominal hernia in a horse using tantalum mesh. *J. Am. vet. med. Ass.* **164**, 1204-1205.
- Hardy, J. and Rakestraw, P.C. (1999) Postoperative care and complications associated with abdominal surgery. In: *Equine Surgery*, Eds: J.A. Auer and J.A. Stick, W.B. Saunders Co., Philadelphia. pp 294-306.

- Heniford, B.T. and Ramshaw, B.J. (2000) Laparoscopic ventral hernia repair: a report of 100 consecutive cases. *Surg. Endosc.* **14**, 419-423.
- Heniford, B.T., Park, A., Ramshaw, B.J. and Voeller, G. (2000) Laparoscopic ventral and incisional hernia repair in 407 patients. *J. Am. coll. Surg.* **190**, 645-650.
- Hilbert, B.J., Slatter, D.H. and McDermott, J.D. (1978) Repair of a massive abdominal hernia in a horse using polypropylene mesh. *Aust. vet. J.* **54**, 588-590.
- Kawcak, C.E. and Stashak, T.S. (1995) Predisposing factors, diagnosis and management of large abdominal wall defects in horses and cattle. *J. Am. vet. med. Ass.* **206**, 607-611.
- Klinge, U., Junge, K., Stumpf, M., Oettinger, A.P. and Klosterhalfen, B. (2002) Functional and morphological evaluation of a low-weight, monofilament polypropylene mesh for hernia repair. *J. Biomed. Mater. Res.* **63**, 129-136.
- Koehler, R.H., Begos, D., Berger, D., Carey, S., LeBlanc, K., Park, A., Ramshaw, B., Smoot, R. and Voeller, G. (2003) Minimal adhesions to ePTFE mesh after laparoscopic ventral incisional hernia repair: reoperative findings in 65 cases. *J. Soc. Laparoendosc. Surg.* **7**, 335-340.
- Larson, G.M. (2000) Ventral hernia repair by the laparoscopic approach. *Surg. Clin. N. Am.* **80**, 1329-1340.
- Malangoni, M.A. and Condon, R.E. (1983) Traumatic abdominal wall hernia. *J. Trauma* **23**, 356-357.
- Marien, T. (2001) Standing laparoscopic herniorrhaphy in stallions using cylindrical polypropylene mesh prosthesis. *Equine vet. J.* **33**, 91-96.
- Matthews, B.D., Pratt, B.L., Pollinger, H.S., Backus, C.L., Kercher, K.W., Sing, R.F. and Heniford, B.T. (2003) Assessment of adhesion formation to intra-abdominal polypropylene mesh and polytetrafluoroethylene mesh. *J. surg. Res.* **114**, 126-132.
- Meek, D.G., DeGrofft, D.L. and Schneider, E.E. (1977) Surgical repair of similar parturition-induced midline ventral hernias in two mares: a comparison of results. *Vet. Med. small anim. Clin.* **72**, 1066, 1068, 1073-1074.
- Park, A., Gagner, M. and Pomp, A. (1996) A laparoscopic repair of large incisional hernias. *Surg. Laparosc. Endosc.* **6**, 123-128.
- Park, A., Birch, D.W. and Lovrics, P. (1998) Laparoscopic and open incisional hernia repair: a comparison study. *Surgery* **124**, 816-821.
- Peroni, J. (2002) Laparoscopic assessment of abdominal trauma in horses. *Comp. cont. Educ. pract. Vet.* **24**, 491-494.
- Ramshaw, B.J., Esartia, P., Schwab, J., Mason, E.M., Wilson, R.A., Duncan, T.D., Miller, J., Lucas, G.W. and Promes, J. (1999) Comparison of laparoscopic and open ventral herniorrhaphy. *Am. Surg.* **65**, 827-823.
- Reddick, E.J. (1994) Laparoscopic abdominal surgery: an update. Overview of recent publications. *Endoscopy* **26**, 493-501.
- Rijkenhuizen, A.B.M. and van Dijk, P. (2002) Diagnostic and therapeutic laparoscopy in the horse: experiences in 236 cases. *Pferdeheilkunde* **18**, 12-20.
- Schumpelick, V., Junge, K., Rosch, R., Klinge, U. and Stumpf, M. (2002) Retromuscular mesh repair for ventral incision hernia in Germany. *Chirurg.* **73**, 888-894.
- Szymanski, J., Voitk, A., Joffe, J., Alvarez, C. and Rosenthal, G.W. (2000) Technique and early results of outpatient laparoscopic mesh onlay repair of ventral hernias. *Surg. Endosc.* **14**, 582-584.
- Tagaya, N., Mikami, H., Nakano, S., Shimoda, M. and Kogure, H. (2000) The use of double-straight needle device in laparoscopic incisional and ventral hernia repair. *Surg. Laparosc. Endosc. Percutan. Tech.* **10**, 187-189.
- Thoman, D.S. and Phillips, E.H. (2002) Current status of laparoscopic ventral hernia repair. *Surg. Endosc.* **16**, 939-942.
- Tulleners, E.P. and Fretz, P.B. (1983) Prosthetic repair of large abdominal wall defects in horses and food animals. *J. Am. vet. med. Ass.* **1**, 258-262.
- Vargo, D., Schurr, M. and Harms, B. (1996) Laparoscopic repair of a traumatic ventral hernia. *J. Trauma* **41**, 353-355.
- van der Velden, M.A. and Klein, W.R. (1994) A modified technique for implantation of polypropylene mesh for the repair of external abdominal hernias in horses. A review of 21 cases. *Vet Quart.* **16**, 108-110.
- Wood, R.J., Ney, A.L. and Bubrick, M.P. (1988) Traumatic abdominal hernia: a case report and review of literature. *Am. Surg.* **70**, 648-651.