

Does laparoscopy have a place in the management of horses with colic?

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Despite the progress in diagnosis, surgery and intensive care colic remains a major cause of mortality and morbidity in horses. Therefore, a timely decision of either medical or surgical treatment is critical. With an in-depth work-up including physical examination, gastric intubation, rectal palpation, routine blood work (WBC, biochemistry, blood lactate) as well as abdominal ultrasonography, in most cases of acute colic, a general diagnosis of small intestinal obstruction, non-strangulating colon obstruction (displacement, impaction) or large colon volvulus can be obtained. Nevertheless, some cases may not respond to medical treatment but present insufficient signs of obstruction or indication for surgical intervention and can therefore be candidate for laparoscopic evaluation (1). Due to the large abdomen in horses, a complete evaluation by one access is not possible. In the standing sedated horse, laparoscopy allows to visualize the complete dorsal part of the abdominal viscera but a left and right flank approach are necessary (2). In order to visualize the ventral part of the abdomen an approach in dorsal recumbency under general anaesthesia is performed, with Trendelenburg position for the examination of the pelvic and caudal viscera or reverse Trendelenburg position for the cranial part of the abdomen (3).

In cases of acute colic, important abdominal discomfort may not allow laparoscopy in the standing patient for the exploration of the dorsal part of the abdomen. Furthermore, distension of viscera by gaz, fluid or impaction reduce considerably the working space and the visualization of the abdominal cavity and make the introduction of the cannula at risk for organ puncture. Good case selection for potential candidates for laparoscopy is essential. Laparoscopy is most interesting in doubtful cases, when other investigation techniques do not permit a clear diagnosis (differentiation between proximal enteritis and small intestinal strangulating obstruction, diagnosis of infarction lesions not easily recognizable by external exams). Nevertheless, in many cases ventral midline coeliotomy will still be needed e.g. for intestinal resection or massage of small intestine and repositioning of colon. Communication to horse owners is essential that laparoscopy may not allow the complete treatment. Furthermore, laparoscopy is technically more challenging in set-up and needs an experienced surgeon and assistant, so that the technique may not be feasible in many clinics as an emergency procedure.

The most documented application of laparoscopy in the management of colic cases is preventive closure of the nephro-splenic (NS) space to avoid entrapment of the left colon. Several techniques are described in experimental settings as well as in clinical cases (4) (5) (6). The most used technique proving efficient with a low complication rate is a continuous suture pattern (7). Good apposition of the most dorsal border of the spleen with the ligament all through the NS space is essential. Otherwise recurrent entrapment can occur. Cranially, near to the stomach courses the splenic artery and vein that should be avoided, at the risk of seeing profuse haemorrhage to occur. Too deep biting in the NS ligament should also be avoided as the kidney can be hurt, especially in very thin horses. In order to obtain good apposition of the most caudal part of the NS space, the last suture bite can be in the ligament from medial to lateral and then finished by an extracorporeal knot. More recently, a barbed suture that does not need knotting at the end of the suture shows a secure closure of the NS space (5) (8). The use of a polypropylen mesh is also reported (9) (6) but has not gained popularity due to the possible adhesion formation, the less secure closure and the higher costs (10). In case of nearly permanent LDDLC, suturing the NS space may be hindered by the displaced intestine. One study shows that a mini-laparotomy in the flank can permit reduction of the displacement and subsequent NS closure (11). Also, the distension with CO₂, normally not necessary for the NS space closure, can be

sufficient to reduce the displacement keeping the minimal invasive nature of laparoscopy and allowing closure in the same procedure.

For acquired inguinal hernia in mature stallions laparoscopic technique is mainly preventive for recurrence as this pathology has a high recurrence rate of nearly 80 %. Laparoscopy in dorsal recumbency for reduction of incarceration, allowing evaluation of the viability of the intestine, is also performed by some authors followed by immediate closure of the internal inguinal ring (1). Others prefer in acute cases, external manipulation and massage under general anaesthesia to reduce the hernia (12). Most frequently, the reduction of the vaginal inguinal ring is performed in the sedated standing horse and should better be performed as a non-emergency procedure. Different techniques are described: One inserting a cylindrical mesh of polypropylene (13), the peritoneal flap (14) and cyanoacrylate glue (15) as well as suturing with barbed suture material (16). A polypropylene mesh apposed around the testicular cord is a more secure closure and may be performed in cases with a very large vaginal or inguinal ring (17). A compromise between secure closure of the inguinal/vaginal ring and sufficient vascularization of the testicle is important to keep fertility of the stallion. The case series published show excellent outcome with very low recurrence rates and good breeding performance, especially for the peritoneal flap technique. Several studies evaluating testicular perfusion and semen quality did not find deleterious effect of the peritoneal flap herniorrhaphy (18) (19) (20) whereas close contact of a mesh to the spermatic cord was associated with deleterious effects on the testicle in other species and should be avoided (21).

Most congenital inguinal hernias in foals are not strangulated and are self-resolving so that there is less need for surgery. Reduction of herniation and subsequent closure (testicle sparing or not) is necessary in case of enlarging hernia. In foals this is performed in dorsal recumbency under general anaesthesia with suture closure of the vaginal ring (1).

After a previous incarceration, laparoscopic evaluation of the epiploic foramen accompanied by mesh closure is a more recently reported technique and well documented in experimental horses and in clinical cases (22) (23). A special custom-made introduction cannula is used for this mesh closure. The technique allows a secure closure and is more straightforward than the closure of the EF securing the gastropancreatic fold and the right lobe of the pancreas to the caudate hepatic lobe using helical titanium coils (24). A mesh obliterating the EF can also be posed during the ventral midline coeliotomy (25) (26).

Diagnostic exploration for chronic / recurrent colic in the standing horse permits to take biopsies of liver (27), spleen, kidney (28) or small intestine, head of caecum or descending colon. Taking small intestinal biopsies is tricky with strict laparoscopic intra-abdominal technique (29) (30). Therefore, after laparoscopic exploration, enlarging an instrument portal allows extra-abdominal biopsy taking of good quality and of the region of interest (31) (32). For focal lesions, small intestinal resection can also be performed by the standing flank incision (especially for horses with poor general condition) (32). Intra-abdominal masses can have complementary diagnosis to trans-parietal or trans-rectal abdominal ultrasound. Large pedunculated lipomas with a short stalk can cause non-strangulating obstruction and their removal is possible after sectioning the stalk (1). If complete removal is not possible by laparoscopy, the mass can be freed by laparoscopy or HAL and removed in a subsequent ventral midline laparotomy.

Laparoscopy in the standing horse allows good visualization of the distal part of the small colon, the uterus and the pelvic region and post-foaling injuries can be assessed (33) (1).

Adhesiolysis is described in experimental cases in pony foals associated or not to instillation with hyaluronate to reduce the risk of reforming adhesions (34) (35) as well as in case reports (36) (1).

Monopolar/bipolar laparoscopic dissection probes are used for adhesiolysis to reduce bleeding (37). The lower peritoneal inflammation following laparoscopy compared to laparotomy may reduce the risk of *de novo* adhesion formation. Studies in human medicine show a high recurrence rate of adhesions after adhesiolysis (38). Only scarce information is available in equine cases based on case reports (36).

The repair of mesenteric or diaphragmatic rents causing small intestinal incarceration, is essential for long-term survival after initial correction performed by laparotomy. Very dorsal mesenteric rents may not be reached with ventral midline coeliotomy and successful repair by laparoscopy or hand-assisted laparoscopy is reported (39) (40) as well as for diaphragmatic rents (1).

One experimental study also reports suture of rectal lacerations in horses under general anaesthesia in sternal recumbency (41) and one clinical case is reported with a hand-assisted technique in a standing sedated mare (42).

Due to the large abdomen in horses, specific instruments have to be developed in order to allow more laparoscopic procedures to be performed in horses with colic (special trocars, long instruments) (43). The huge volume and weight of equine viscera does not permit as many procedures as described in human medicine (appendectomy with loop suture!).

In conclusion, laparoscopy has a place in the management of horses with colic, especially for preventive procedures like NS closure and inguinal herniorrhaphy as well as diagnosis of chronic, recurrent colic. The use of barbed suture may also enhance the feasibility of several techniques.

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