Nephrosplenic space closure significantly decreases recurrent colic in horses: a retrospective analysis

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Abstract

Background Nephrosplenic space closure is commonly used to reduce relapse of nephrosplenic space entrapment in cases of left dorsal displacement of the left colon (LDDLC). Nevertheless, studies documenting the effectiveness of this surgery are sparse in the literature. The aim of this study was to analyse clinical data of horses presented for LDDLC and evaluate the effect of nephrosplenic space closure on the incidence of colic recurrence.

Methods Medical records of 156 horses diagnosed with LDDLC at the Equine Clinic of the University of Liège between 2004 and 2016 were retrieved for analysis. Extracted data included horse breed, sex, age and weight, initial treatment, and if a subsequent preventive surgical closure of the nephrosplenic space was carried out or not. Follow-up information was obtained by telephone interview. Statistical analyses were performed using a chi-squared test with significance set at $P<0.05$.

Results Follow-up data were available for 65 per cent of horses. The mean follow-up was 35 months. There was a significant decrease in the total incidence of colic after closure surgery compared with non-operated horses. No horse was diagnosed with LDDLC after closure of the nephrosplenic space.

Conclusion Closure of the nephrosplenic space significantly decreases recurrent colic in horses compared with non-operated horses.

Introduction

Colic is an important cause of mortality in horses.[1] Recurrence is frequently reported[2] and is considered a difficult and frustrating problem to manage.[3] Several studies have shown that horses with a history of colic are predisposed to suffer other episodes of colic.[4–6] Left dorsal displacement of the left colon (LDDLC) with entrapment into the nephrosplenic space is a common cause of colic in horses of different age, sex and breed. The cause is unknown, but colonic motility dysfunction, accumulation of gas and depth of the nephrosplenic space have been proposed as main contributors.[7 8] The diagnosis is usually made by rectal palpation[9] and ultrasonography.[10]

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The incidence of LDDLC in equine referral centres ranges from 6 per cent to 20.3 per cent,[11 12] with an excellent survival rate of up to 97 per cent.[13] According to the severity of the colic signs, several therapeutic approaches have been described, including medical treatments, rolling of the horse, and ventral or standing left flank laparotomy.[9 14]

Despite the good prognosis associated with this type of large colon displacement, reported recurrence rates range from 3.2 per cent to 23 per cent.[7 12 13] To prevent the recurrence of LDDLC, several techniques have been proposed, such as colopexy,[15–17] resection of the large colon,[18 19] and closure of the nephrosplenic space under general anaesthesia or standing laparoscopy or hand-assisted laparoscopy.[20–24]

The laparoscopic closure of the nephrosplenic space has been widely performed since the publication of a novel technique by Mariën *et al* in 2001.[21] However, only one study[13] has assessed the frequency of recurrent colic in horses with and without closure of the nephrosplenic space.

The aim of this study was to analyse clinical data of horses presented for LDDLC and evaluate the effect

of nephrosplenic space closure by laparoscopy on the incidence of recurrent colic.

Materials and methods

Medical records of horses diagnosed with LDDLC in the Equine Clinic of the University of Liège between January 2004 and December 2016 were included. Cases included in the study had a diagnosis of LDDLC by rectal examination (palpation of the large colon into the nephrosplenic space), transabdominal ultrasonography (presence of gas or intestine that obscured left kidney visualisation) and/or exploratory laparotomy. Horses suspected to have displacement of the large colon lateral to the spleen or uncertain LDDLC were excluded.

Specific data collected for the purpose of the study were age, weight, breed, sex, colic history (one or more previous episodes, including specifically previous LDDLC), type of treatment received (medical or surgical) and whether preventive closure of the nephrosplenic space had been performed or not.

Decision for medical versus surgical treatment was based upon evaluation of clinical information and financial constraints. Medical treatment included withholding feed and exercise (hand-walking and/or lunging) combined with either enteral (electrolytes and/or paraffin oil administered by nasogastric intubation) and/or parenteral (Ringer's solution) rehydration. Intravenous fluids and electrolytes were adapted to clinical (heart rate, mucous membrane colour, capillary refill time, reflux losses) and laboratory parameters (packed cell volume, total protein, creatinine and ions) parameters. In some cases, medical treatment also included intravenous administration of adrenaline hydrochloride (5 μg/kg) at a rate of 1 μg/kg/minute followed by forced exercise (mainly lunging) for 15 minutes. Success of medical treatment was defined as the absence of large colon in the nephrosplenic space by rectal palpation and ultrasonography. Surgical treatment included coeliotomy when concomitant disease to LDDLC could not be excluded or when abdominal distension or pain was severe. In cases in which the displacement persisted for several days without significant signs of pain or cardiovascular compromise, a standing hand-assisted laparoscopy was performed to reposition the large colon and was followed by manual closure of the nephrosplenic space.

Criteria for proposing a laparoscopic closure of the nephrosplenic space were horses diagnosed with LDDLC (current episode) at the referral clinic that had a history of recurrent colic and horses with a single known episode of LDDLC needing coeliotomy. Recurrent colic was described as the presence of one or more episodes of abdominal pain in the medical history. For a large proportion of horses presenting colic episodes before the hospitalisation, a definitive diagnosis was not made. Therefore, all these previous colic episodes could not be attributed to LDDLC only.

Nephrosplenic closure was performed by two slightly different surgical techniques: as described by Mariën *et al*[21] and using a minor modification of Mariën *et al*'s technique using just two portal sites. Before surgery, horses were premedicated using penicillin G sodium (22,000 iu/kg intravenously every six hours), gentamicin sulphate (6.6 mg/kg intravenously every 24 hours), flunixin meglumine (1.1 mg/kg intravenously every 12 hours) and acepromazine (0.1 mg/kg intramuscularly). Horses were sedated with a combination of detomidine hydrochloride (0.01 mg/kg intravenously) and morphine (0.1 mg/kg intravenously). A constant-rate infusion drip was used during laparoscopic procedure (detomidine-morphine: 0.022–0.05 mg/kg/hour). Occasionally, ketamine was added (0.6 mg/kg/hour) to the infusion in uncooperative patients. The left paralumbar fossa was clipped, surgically prepared (povidone iodine and alcohol) and draped adequately. The two portal sites were infiltrated subcutaneously and intramuscularly with lidocaine and/or mepivacaine 2 per cent. A 15-mm vertical skin incision was created for the laparoscopic portal between the 17th and 18th ribs at the level of the ventral aspect of the tuber coxae. An EndoTIP cannula (10 mm in diameter; 15 cm in length) was inserted through the stab incision into the abdomen with a twisting motion. The surgeon monitored entry with the telescope (10 mm in diameter; 33 cm in length) in the cannula during insertion. A second vertical incision of 5 cm was created in the paralumbar fossa midway between the 18th rib and the tuber coxae, starting just dorsal to the ventral border of the tuber coxae and extending ventrally. The abdominal cavity was approached using a modified-grid or grid technique. The peritoneum was manually penetrated and a 15-cm long, 40-mm diameter stainless-steel, custom-made cannula was inserted into the intraperitoneal space under direct observation. No abdominal insufflation was used for the procedure. The large-diameter cannula allows insertion and retrieval of the 48-mm needle, in an appropriate position only with the needle holder. The nephrosplenic space was closed in a cranial to caudal direction using a simple continuous pattern (USP2 Polyglactin 910). The needle was inserted intra-abdominally, through the cannula, with a laparoscopy needle holder. After the first passage through the ligament and the spleen, the needle was retrieved and the suture was secured by passing the needle through a small loop created at the end of the suture. The needle was then inserted again through the laparoscopic cannula and the closure was continued using a continuous pattern. After each throw, the suture was extra-abdominally tightened and held in that position by the surgeon or the assistant surgeon. When the nephrosplenic space was completely sutured, an extracorporeal surgeon's knot was made. The suture ends were then transected using laparoscopic scissors. When the large colon was entrapped at the time of

the surgery, the instrumental portal was converted to a left flank laparotomy for manual correction of the displacement and manual suture of the nephrosplenic space. The internal and external abdominal oblique muscles were closed using size-2 Polyglactin 910 in an interrupted cruciate or continuous pattern. The subcutaneous tissue was apposed using size-0 poliglecaprone in a simple continuous pattern, and the skin was apposed using 0 polypropylene in an interrupted cruciate or horizontal mattress pattern or skin staples. Only the skin and the subcutaneous tissue of the laparoscopic portal were closed, using the same material and patterns. Abdominal wall bandaging with an elastic adhesive material and a non-adherent wound dressing was performed at the end of the surgery.

Horses were administered penicillin G sodium (22,000 iu/kg intravenously every six hours), gentamicin sulphate (6.6 mg/kg intravenously every 24 hours) and flunixin meglumine (1.1 mg/kg intravenously every 12 hours) for two to five days. When horses needed a flank laparotomy, the antimicrobial treatment was prolonged. Postoperative monitoring included physical examination and assessment of the portal sites for swelling, pain and discharge. Routine postoperative recommendations were a minimum of four weeks of stall rest (hand-walking allowed after the first week) for horses undergoing only nephrosplenic space closure, and 8–10 weeks of stall rest (with hand-walking allowed after two weeks) for horses that had undergone a ventral midline coeliotomy during the same hospitalisation period. When a surgical site infection occurred (ventral midline or flank laparotomy), the stall rest was prolonged until complete healing of the wound. Wood shavings bedding and free-feeding grass hay were recommended during convalescence.

Horses treated medically were discharged with general management instructions (eg, alimentary/bedding recommendations, standard dental cares and deworming programme) to limit the risk of recurrence.

Follow-up

Telephone interview of owners was conducted. Questions were designed to identify the presence or absence of recurrent colic after discharge, and when information was available the nature and frequency of colic presented. When the horse underwent a closure of the nephrosplenic space, the opinion of the owners on the welfare and/or performance of the horse after the surgery was also requested.

Analysis of data

Descriptive statistics were expressed in per cent and mean±sd. Statistical comparisons were performed on SAS (V.9.3) using chi-squared tests or Fisher's exact tests with statistical significance at $P<0.05$.

Results

A total of 2498 colic cases were presented at the Equine Clinic of the University of Liège between 2004 and 2016. From these, 6.2 per cent (n=156) had a diagnosis of LDDLC. Geldings were over-represented (60 per cent) when compared with both mares (35 per cent) and stallions (5 per cent). The mean age of the horses on presentation was 10.7±5.7 years (range: 2–28 years), and the mean weight was 543±84 kg (range: 340–775 kg). The majority of horses included in this study were Warmblood and its crosses (85 per cent, n=132). For statistical comparisons, horses were divided into two groups: closure and control group. The closure group included horses that underwent standing closure of the nephrosplenic space and the control group those that did not. Population description and colic history are summarised in table 1.

Table 1 Population description and colic history before hospital presentation of horses diagnosed with LDDLC

	Total LDDLC		Closure group		Control group	
	n	%	n	%	n	%
	156	100	42	46	50	54
Breed						
Warmblood	132	85	36	86	42	84
Others	24	15	6	14	8	16
Sex						
Gelding	93	60	30	71	31	62
Mare	55	35	12	29	17	34
Stallion	8	5	0	0	2	4
	Mean±sd		Mean±sd		Mean±sd	
Weight (kg)	543±84		536.2±88		562±75.5	
Age (years)	10.7±5.7		9.32±4.95		10.98±5.66	
	Yes*	No*	Yes	No	Yes	No
Recurrent colic before admission (number of horses)	73 (51%)	70 (49%)	37 (88%)	5 (12%)	24 (48%)	26 (52%)
Previous diagnosis of LDDLC (number of horses)	29 (20%)	114 (80%)	16 (43%)	21 (57%)	5 (21%)	19 (79%)

*Data from previous colic history was not available for 13 of 156 horses.
LDDLC, left dorsal displacement of the left colon.

Hospitalisation and short-term survival

Ninety per cent (n=141) of horses survived to hospital discharge. Ten per cent (n=15) were subjected to euthanasia on admission under the owner's request due to financial constraints and/or poor prognosis (primary concomitant disease, severe cardiovascular compromise or peritonitis). Fifty-four per cent (n=84) of horses were treated medically and 46 per cent (n=72) needed a surgical treatment either immediately or after failure of the medical treatment.

Response to the survey

Follow-up information obtained by telephone interview was available in 65 per cent (92 of 141) of cases surviving hospital discharge. Data could not be obtained in 35 per cent (49 of 141) of cases due to unknown contact number, lack of response or refusing to answer the survey. The mean follow-up was 35.1 months (range 6–137).

Population description and colic history before hospitalisation

There was no significant difference between sex, age or weight between the two groups. The characteristics of these horses are summarised in table 1. Recurrent colic rate in the period before hospitalisation was higher in the closure group than in the control group (P<0.0001; odds ratio (OR): 8.02; confidence interval (CI): 2.71 to 23.75). Of the 42 horses operated for closure of the nephrosplenic space, two had surgical site infection and two had jugular vein phlebitis.

Long-term follow-up

After discharge, recurrent colic rate was lower in the closure group than in the control group (chi-squared test P=0.0183; OR: 0.325; CI: 0.125 to 0.84). The number of horses displaying colic signs following closure of the nephrosplenic space was significantly lower than before closure (chi-squared test P<0.0001; OR: 0.03; CI: 0.01 to 0.11), while no significant difference was observed (P=0.546) in the control group (table 2).

In order to assess if recurrence of colic after hospitalisation could be influenced by the initial treatment of the case (medical or surgical), data were analysed comparing these two subpopulations. There was no significant decrease in the number of recurrent colics in horses treated medically (Fisher's exact test P=0.066) or surgically (Fisher's exact test P=0.40) in the control group. In the closure group, a significant decrease was observed in horses treated medically (Fisher's exact test P=0.007) and surgically (Fisher's exact test P<0.00001) (table 2).

Table 2 Summary of recurrent colic in the control and closure group and subgroups according to the initial treatment performed for correction of nephrosplenic entrapment

	Before hospitalisation		After hospitalisation	
	No recurrent colic	Recurrent colic	No recurrent colic	Recurrent colic
Control group	26 (52%)	24 (48%)	29 (58%)	21 (42%)
Medical	6	16	13	9
Surgical	20	8	16	12
Closure group	5 (12%)	37 (88%)	34 (81%)	8 (19%)
Medical	0	8	6	2
Surgical	5	29	28	6

Owner satisfaction

Ninety per cent (38 of 42) of owners choosing to close the nephrosplenic space were satisfied. Most horse owners indicated that the main reasons behind this satisfaction were reduction or absence of colic signs and good condition of horses after closure of nephrosplenic space (35 of 42). Additionally, some interviewees reported performance improvement after closure (3 of 42). Four owners were dissatisfied because of phlebitis (1 of 4), wound infection (1 of 4) and death for other types of colic (2 of 4).

Discussion

LDDLC is a common cause of colic in horses. Similar to previous studies, in which a frequency between 3 per cent and 9 per cent of LDDLC was established,[12 13 25 26] the proportion of colics presented in this work was 6.24 per cent.

In this study's LDDLC population, the sex and breed distribution agrees with previous studies,[12 13 25] with approximately two-thirds being geldings and 90 per cent being Warmblood horses. The nephrosplenic space tends to be deeper and larger in heavy breeds.[7 21 27] Further, the size of the nephrosplenic space has been associated with an increased risk of LDDLC.[12 21]

Horses predisposed to this type of colic might show recurrent episodes of colic separated by a period of remission from several days to years. A large number of horses included in this study had shown mild colic signs that were treated medically or resolved spontaneously without definitive diagnosis. LDDLC has also been associated with chronic weight loss and inappetence.[28 29] Furthermore, a previous study by Röcken *et al*[12] reported cases of LDDLC with none or very mild clinical signs. Therefore, LDDLC might be more frequent than expected and probably underdiagnosed. In this study, determining whether these recurrent episodes were exclusively related to LDDLC or not was difficult due to inaccurate clinical information provided by horse owners in the interviews. Consequently, the use of the general term 'recurrent colic' was preferred as inclusion criteria.

LDDLC is usually treated conservatively with fasting, laxatives, fluids, exercise and phenylephrine. In this study, the success rate of medical treatment (54 per cent) was considerably lower than reported previously (75 per cent).[9 30] This approach might have been already attempted several times by referring veterinarians before referral, which might have been prompted as a

result of poor response to this medical treatment and/or deterioration of clinical signs, hence reducing the positive outcome of this group in this study.

However, differences in medical treatment used among studies could contribute to these results. In contrast to other studies,[9 30] in this study horses received adrenaline instead of phenylephrine. Injectable phenylephrine was not available during the study period, with adrenaline being the only available alpha-adrenergic agent. Due to the significant side effects of adrenaline administration, such as facial twitching, second-degree atrioventricular block, profuse sweating and tachycardia,[31] adrenaline is rarely used as first-choice alpha-adrenergic drug in LDDLC cases.

A significant difference was observed in the number of horses presenting recurrent colic before hospitalisation between the two groups. Most horses in the closure group (88 per cent) had presented with at least one episode of colic in the past, in contrast to only 48 per cent horses in the control group. Laparoscopic closure of the nephrosplenic space is usually recommended after two episodes of nephrosplenic entrapment corrected medically or one corrected surgically.[12] In the present study's population, this surgical procedure was recommended in horses with colic history and at least one episode of LDDLC.

The closure technique performed in the authors' clinic has been modified to use only two portals and a larger cannula. In the authors' opinion this simplifies the technique and allows the use of a longer needle, making larger bites and potentially decreasing the risk of tearing the spleen or ligament.

The study shows a significant decrease in the percentage of colic episodes following surgery in horses of the closure group, whereas it remained stable in horses of the control group. These results confirm the findings of Nelson *et al* in 2016,[13] in which recurrent colic rate decreased with the closure of the nephrosplenic space. The same results were observed in the subgroups, regardless of the initial management of the case (medical or surgical). Some authors suggest that recurrence rates of LDDLC are probably much higher than believed.[13] In the present study, several factors may have contributed to underestimating the diagnosis of LDDLC, such as the mild degree of colic pain in some cases (subclinical presentation), the lack of diagnostic precision by the referring veterinarian, as well as the incomplete reporting and subjectivity of the telephone interview-based design of the study. Only 19 per cent of horses of the closure group presented additional colic episodes after the intervention, but none of the episodes could be diagnosed as LDDLC. Recurrences in this group included other types of displacement or torsion of the large colon, a rectal prolapse, and some mild colic treated medically and generally associated with diet changes. This supports the conclusion already described in the literature that the closure of the nephrosplenic space is effective in the prevention of LDDLC, but not in other types of colic.[12 28 32]

The majority of owners (91 per cent) were satisfied with the intervention because of absence of recurrent colic signs. The high index might be proposed as a safe index to support surgery. The unsatisfied owners justify their position due to recurrent clinical signs and/or horse death. However, it is important to note that these complications were not related to the LDDLC per se. Consequently, the authors consider it necessary to discuss the benefits, limitations and the lack of effect of this surgical procedure in other types of colics.

The main limitations of this study were related to its retrospective nature. Incomplete medical records and owner-reported follow-up data might have determined some misclassification of cases. Moreover, changes in environment and management conditions of some horses after discharge might have influenced the number of colic episodes on its own. Finally, follow-up was different among cases and this could have affected the recurrence rate reported by horse owners.

In conclusion, the authors confirm that nephrosplenic space closure by laparoscopy reduces the incidence of colic compared with horses without preventive surgery. Furthermore, in horses with persistent or recurrent colic, examination of the nephrosplenic space should be considered.

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Data availability statement All data relevant to the study are included in the article.

References

1 Egenvall A, Penell JC, Bonnett BN, *et al*. Morbidity of Swedish horses insured for veterinary care between 1997 and 2000: variations with age, sex, breed and location. *Vet Rec* 2005;157:436–43.
2 Scantlebury CE, Archer DC, Proudman CJ, *et al*. Recurrent colic in the horse: incidence and risk factors for recurrence in the general practice population. *Equine Vet J* 2011;43:81–8.
3 Hart SK, Southwood LL, Aceto HW. Impact of colic surgery on return to function in racing thoroughbreds: 59 cases (1996-2009). *J Am Vet Med Assoc* 2014;244:205–11.
4 Hillyer MH, Taylor FGR, Proudman CJ, *et al*. Case control study to identify risk factors for simple colonic obstruction and distension colic in horses. *Equine Vet J* 2002;34:455–63.
5 Archer DC, Pinchbeck GL, French NP, *et al*. Risk factors for epiploic foramen entrapment colic in a UK horse population: a prospective case-control study. *Equine Vet J* 2008;40:405–10.
6 Scantlebury CE, Archer DC, Proudman CJ, *et al*. Management and horse-level risk factors for recurrent colic in the UK general equine practice population. *Equine Vet J* 2015;47:202–6.
7 Huskamp B, Kopf N. [Displacement of the ascending colon into the spleen-kidney space in the horse (2). Hernia spatii lienorenalis coli ascendentis]. *Tierarztl Prax* 1980;8:495–506.
8 Moll HD, Schumacher J, Dabareiner RM, *et al*. Left dorsal displacement of the colon with splenic adhesions in three horses. *J Am Vet Med Assoc* 1993;203:425–7.
9 Hardy J, Minton M, Robertson JT, *et al*. Nephrosplenic entrapment in the horse: a retrospective study of 174 cases. *Equine Vet J* 2000;32:95–7.
10 Santschi EM, Frank WM. Use of ultrasound in horses for diagnosis of left dorsal displacement of the large colon and monitoring its nonsurgical correction. *Vet Surgery* 1993;22:281–4.
11 Hassel DM, Hill AE, Rorabeck RA. Association between hyperglycemia and survival in 228 horses with acute gastrointestinal disease. *J Vet Intern Med* 2009;23:1261–5.
12 Röcken M, Schubert C, Mosel G, *et al*. Indications, surgical technique, and long-term experience with laparoscopic closure of the nephrosplenic space in standing horses. *Vet Surg* 2005;34:637–41.

13 Nelson BB, Ruple-Czerniak AA, Hendrickson DA, *et al*. Laparoscopic closure of the Nephrosplenic space in horses with Nephrosplenic colonic entrapment: factors associated with survival and colic recurrence. *Vet Surg* 2016;45:060–9.
14 Krueger CR, Klohnen A. Surgical correction of nephrosplenic entrapment of the large colon in 3 horses via standing left flank laparotomy. *Vet Surg* 2015;44:392–7.
15 Hance SR, Embertson RM. Colopexy in broodmares: 44 cases (1986-1990). *J Am Vet Med Assoc* 1992;201:782–7.
16 Trostle SS, White NA, Donaldson L, *et al*. Laparoscopic Colopexy in horses. *Vet Surgery* 1998;27:56–63.
17 Butt TD, Wilson DG. Laparoscopic colopexy in a horse. *Can Vet J* 2003;44:586–8.
18 Bertone AL, Stashak TEDS, Sullins KE, *et al*. Experimental large colon resection at the cecocolic ligament in the horse. *Vet Surgery* 1987;16:5–12.
19 Pezzanite LM, Hackett ES. Technique-associated outcomes in horses following large colon resection. *Vet Surg* 2017;46:1061–7.
20 Zekas LJ, Ramirez S, Brown MP. Ablation of the nephrosplenic space for treatment of recurring left dorsal displacement of the large colon in a racehorse. *J Am Vet Med Assoc* 1999;214:1361–3.
21 Mariën T, Adriaenssen A, Hoeck FV, *et al*. Laparoscopic closure of the renosplenic space in standing horses. *Vet Surg* 2001;30:559–63.
22 Muñoz J, Bussy C. Standing hand-assisted laparoscopic treatment of left dorsal displacement of the large colon and closure of the nephrosplenic space. *Vet Surg* 2013;42:595–9.
23 Albanese V, Hanson RR, McMaster MA, *et al*. Use of a barbed knotless suture for laparoscopic ablation of the Nephrosplenic space in 8 horses: knotless suture for laparoscopic Nephrosplenic space ablation. *Vet Surg* 2016;45:824–30.
24 Gandini M, Nannarone S, Giusto G, *et al*. Laparoscopic nephrosplenic space ablation with barbed suture in eight horses. *J Am Vet Med Assoc* 2017;250:431–6.
25 Lindegaard C, Ekstrøm CT, Wulf SB, *et al*. Nephrosplenic entrapment of the large colon in 142 horses (2000-2009): analysis of factors associated with decision of treatment and short-term survival. *Equine Vet J* 2011;43:63–8.
26 Mair TS, Smith LJ. Survival and complication rates in 300 horses undergoing surgical treatment of colic. Part 1: short-term survival following a single laparotomy. *Equine Vet J* 2005;37:296–302.
27 Karlsbeek HC. Die rektale Korrektur des am Milz-Nieren-Band eingeklemmten linken Colons. *Pferdeheilkunde* 1985;1:229–33.
28 Burke MJ, Parente EJ. Prosthetic mesh for obliteration of the Nephrosplenic space in horses: 26 clinical cases. *Vet Surg* 2016;45:201–7.
29 Banse HE, Tennent-Brown BS, Mueller POE. Case report: left dorsal displacement of the large colon manifested as increased γ-glutamyl transferase activity in a horse. *Compend Contin Educ Vet* 2012;34:E3.
30 McGovern KF, Bladon BM, Fraser BSL, *et al*. Attempted medical management of suspected ascending colon displacement in horses. *Vet Surg* 2012;41:399–403.
31 Deniau V, Depecker M, Bizon-Mercier C, *et al*. Influence of detomidine and xylazine on spleen dimensions and on splenic response to epinephrine infusion in healthy adult horses. *Vet Anaesth Analg* 2013;40:375–81.
32 Farstvedt E, Hendrickson D. Laparoscopic closure of the nephrosplenic space for prevention of recurrent nephrosplenic entrapment of the ascending colon. *Vet Surg* 2005;34:642–5.