



## Internal herniation of the small and large intestines in 18 cattle



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### ABSTRACT

Internal intestinal hernia was diagnosed during laparotomy in 18 cattle with a tentative diagnosis of ileus; the diagnosis was made during a second laparotomy in two cases. In 14 cattle, the hernial orifice was in the visceral layer of the greater omentum and the intestines had herniated into the caudal recess of the omental bursa. In two animals both the visceral and parietal layers had an opening; in one, the orifice was in the mesoduodenum, and in the other in the mesojejunum. The length of the hernial orifice ranged from 3 to >25 cm and the length of the herniated intestine ranged from 30 cm to the entire length of the small and large intestines. The omental rents were located near the caudal flexure of the duodenum ( $n = 9$ ), ventrally near the rumen ( $n = 6$ ) or in both of these locations ( $n = 1$ ).

Seven cattle were euthanased intraoperatively because of incarceration of the jejunum; three of these had ruptured intestines and localised peritonitis; another animal was euthanased following a second laparotomy because of peritonitis. Ten animals, two of which underwent jejunal resection–anastomosis, recovered and were discharged. Nine of these survived a 6-month-postoperative period (mean  $\pm$  SD:  $27 \pm 18$  months) and remained free of colic, and one was slaughtered 3 months postoperatively because of rupture of the mammary suspensory ligament.

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### Introduction

Internal herniation in cows can occur through rents in the mesentery or greater omentum (De Moor et al., 1962; Pardon et al., 2009), through the mesentery of the spermatic cord in castrated male cattle (Scott et al., 1997; Lores et al., 2006) or the round ligament of the liver (Robertson, 1979; Coetzee, 2000), between fibrotic bands (Pearson, 1973) or through congenital openings (Koller et al., 2001). Similar intestinal complications can also occur after strangulation by persistent urachal remnants (Baxter et al., 1987; Mesaric and Modic, 2003). In contrast to horses, incarceration of the jejunum in the epiploic foramen is rare in cattle (Deprez et al., 2006). Similarly, omental hernias have only rarely been described in cattle (De Moor et al., 1962; Dirksen, 2002; Matsui and Nukata, 2003) and in a recent study (Pardon et al., 2009) there were only four cases of omental herniation among 712 cases of mechanical ileus in cattle. Omental hernias are also rare in horses (Kelmer et al., 2008) and humans (Blachar and Federle, 2002; Armstrong et al., 2007); in the latter they are most often seen in older patients or following abdominal surgery (Blachar and Federle, 2002).

In the present study, the medical records of 18 cattle that had undergone surgery because of internal herniation between January

2004 and March 2012 were analysed with respect to factors predisposing to herniation, diagnostic signs, surgical findings and outcome and long-term success of treatment.

### Materials and methods

#### Case selection

The medical records of 18 dairy cattle diagnosed with internal herniation during surgical exploration were analysed. All animals belonged to the Brown Swiss breed and were between 13 and 120 months (median, 64; mean  $\pm$  SD,  $55 \pm 24$  months) of age. All except one of the animals were female. Twelve came from tie stalls and two from free stalls (cubicle yards); the type of housing was not recorded for the remaining animals. The mean milk production of the 13 herds of origin ranged from 6000 to 8750 kg ( $7232 \pm 949$  kg) per year.

#### Clinical, laboratory and ultrasonographic examination

All cattle underwent a complete clinical examination (Rosenberger, 1990) as well as haematological, serum biochemical and blood gas analyses. The right side of the abdomen and in some cases also the left side were examined ultrasonographically (Braun, 2009) using a 3.5-MHz convex or linear probe (Logiq 7 BT09 (GE Healthcare) or EUB-8500 and EUB-7500A (Hitachi)).

#### Laparotomy

Seventeen animals underwent right flank laparotomy through a ~25 cm vertical incision in the paralumbar fossa after proximal paravertebral anaesthesia. One cow underwent laparotomy under general anaesthesia in dorsal recumbency through an incision in the ventral midline. In two cattle, paralytic ileus was diagnosed during

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the initial operation. Right flank laparotomy was repeated after signs of ileus had recurred postoperatively in these two animals, and an internal hernia was detected in both. Intestinal resection and end-to-end anastomosis were carried out in two animals undergoing right flank laparotomy. Omental rents were closed using a continuous suture pattern whenever possible.

#### Perioperative treatment

The patients received 12,000 IU/kg IM procaine penicillin (Procacillin, Veterinaria) twice daily for 4 days starting on the day of surgery. The antibiotic treatment was changed to 1.25 mg/kg IV danofloxacin (Advocid 2.5%, Pfizer, Zürich) once daily in one cow that had a fever after a second operation during which an internal hernia was diagnosed and treated by means of intestinal resection and anastomosis. All but one patient received flunixin meglumine (1.1 mg/kg, IV, once daily; Flunixinim, Dr. E. Graeb) for 3 days. Metamizole (40 mg/kg, IV, once daily; Vetalgin N, Veterinaria) was used in one patient, and another received the same dose of metamizole as well as flunixin meglumine. NaCl–glucose solution (NaCl 9 g/L and glucose 50 g/L, Cantonal Pharmacy) was administered over 4 days via an indwelling jugular catheter. Additionally, 42.5 mg neostigmine (Konstigmin, Vétoquinol), diluted in 5 L NaCl–glucose solution, was administered over 3 days in 9/11 patients in which the surgery was successfully completed. Electrolyte deficiencies were corrected via intravenous or oral substitution as indicated. The patients were fasted for 48 h after surgery, after which time the amount of feed was gradually increased to the previous amount. Two to three litres of rumen juice from a healthy cow were administered to patients with reduced appetite or anorexia.

#### Post-mortem examination and follow-up

Eight cattle were euthanased and a post-mortem examination was carried out at the Institute of Veterinary Pathology. Follow-up interviews of the owners of the 10 patients that were discharged from the clinic were carried out between 6 months and 2 years after surgery and during finalisation of the manuscript.

## Results

### History

Sixteen patients had a history of reduced appetite or anorexia, one animal had a normal appetite and no information was available for the remaining patient. Signs of colic including shifting of weight in the hind limbs, kicking at the belly and anxiety occurred in 12 animals, seven lay down more than usual and five were listless. At the time of admission, one animal had been ill for 3 days, six for 2 days, eight for 1 day and three others for a few hours.

### Clinical, laboratory and ultrasonographic examination

The vital parameters and abnormal clinical findings of the 18 cows with internal herniation are shown in Tables 1 and 2. The general appearance and demeanour were abnormal in most cows and all had signs of intestinal disease including reduced intestinal motility and lack of faeces. Dilated loops of intestine could be palpated transrectally in seven patients and a dorsal band-like structure in one other.

Haematological and serum biochemical findings are shown in Table 3. The haematocrit was generally increased and the concentration of total solids was normal in most cattle (75.1 ± 11.7 g/L, range 56–100 g/L; normal range 63–86 g/L). Total leukocyte count was in the high normal range or higher than normal in 16/18 patients. Mean bilirubin concentration was increased, and urea and creatinine concentrations were higher than normal in the same nine patients. Mean potassium and chloride concentrations were

**Table 1**  
Vital parameters of 18 cattle with internal herniation.

Vital parameter	Median	Minimum	Maximum
Heart rate (beats per minute)	84	52	120
Respiratory rate (breaths per minute)	24	16	60
Rectal temperature (°C)	38.6	36.3	39.5

**Table 2**  
Frequency of clinical abnormalities in 18 cattle with internal herniation.

Clinical sign	Number of animals
Abnormal general appearance and demeanour	16
Reduced skin turgor	12
Sunken eyes	13
Injected scleral vessels	15
Capillary refill time >2 s	13
Reduced or absent intestinal sounds	18
Weak/no rumenal contractions	11/7
Tense abdominal wall	10
Pain reaction to hardware tests	12
Pain reaction to percussion of the reticular area	0
Reduced amount of/no faeces	11/7
Mucus, blood or fibrin in rectum	11
Abnormal rectal findings	8

increased, and all other measured variables including the chloride concentration in the rumen fluid were within the normal ranges.

Ultrasonographic examination showed dilated small intestine (diameter >3.5 cm) and reduced or absent intestinal motility in 17 patients. In 12 animals, there was anechoic fluid between intestinal loops. Ultrasonographic signs indicating herniation or intestinal rupture were not seen, and a tentative diagnosis of ileus of the small intestine was made in all cases.

### Surgery

An internal hernia was identified during the initial surgery in 16 animals and during a second laparotomy 2 and 3 days after the initial surgery in the other two. Herniation had occurred through a rent in the visceral layer of the greater omentum (Fig. 1) in 14 patients, through the visceral and parietal layers in two others, and through the mesoduodenum and mesojejunum in one each. The omental rents ranged in size from 3 to >25 cm and were located near the ascending duodenum and anterior root of the mesentery in nine cattle, ventrally near the rumen in six cattle and in both these locations in one other. The length of the prolapsed intestine varied from 30 cm to several meters and involved the entire small and large intestines in three animals. To free the herniated intestines, the rents were enlarged by careful digital manipulation and manual traction. In 7/9 patients with haemorrhagic infarction of the jejunum, the operation was aborted and the patients euthanased. In three of these, the necrotic jejunum had ruptured within the omental recess, and in one other it ruptured during surgical manipulation. In the remaining two patients with haemorrhagic changes, end-to-end anastomosis of the jejunum was carried out; in one cow, this was achieved during a second operation. In the remaining nine cattle in which the operation was completed successfully, the herniated jejunal loops had only mild ( $n = 2$ ) or no ( $n = 7$ ) discolouration and only mild fluid distension and were reduced from the omental or mesenteric rent without further treatment.

In 5/11 successful operations, the omental rent (Fig. 2) was closed using resorbable suture material in a simple continuous suture pattern, and in two other cattle, the rent could only be partially closed. In four patients, closure of the rent was not possible because the affected part of the omentum could not be exteriorised; in these patients, the rent was bluntly enlarged in an attempt to minimise the risk of re-incarceration. The location of the rent – near the duodenum or the linea alba – was not correlated with the size of the rent or the occurrence of intestinal incarceration. The cow with the rent in the mesojejunum was euthanased because of incarceration of the jejunum. The rent in the mesoduodenum could be completely sutured.

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