**Zeitschrift:** Schweizer Archiv für Tierheilkunde SAT : die Fachzeitschrift für Tierärztinnen und Tierärzte = Archives Suisses de Médecine Vétérinaire ASMV : la revue professionnelle des vétérinaires

**Herausgeber:** Gesellschaft Schweizer Tierärztinnen und Tierärzte

**Band:** 135 (1993)

**Heft:** 11-12

**Artikel:** Clinical signs, diagnosis and treatment of duodenal ileus in cattle

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**DOI:** https://doi.org/10.5169/seals-593106

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# Clinical signs, diagnosis and treatment of duodenal ileus in cattle

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**Symptomatik, Diagnostik und Behandlung des duodenalen Ileus beim Rind**

Bei 23 Kühen, die an einer duodenalen Obstruktion bzw. Kompression erkrankt waren, werden die klinischen Erscheinungen, die Veränderungen in Blut und Pansensaft, die Befunde der Laparotomie, die Therapie und der anschliessende Krankheitsverlauf beschrieben. Bei 14 Kühen wurde eine Obstruktion des Duodenums, verursacht durch einen Phytobezoar, bei 8 Kühen eine Kompression des Duodenums, verursacht durch eine Adhäsion des Duodenums an einem Leberabszess und bei 1 Kuh eine durch ein Blutkoagulum verursachte Duodenumobstruktion festgestellt. Die wichtigsten krankhaften Befunde waren ein mittel- bis hochgradig gestörtes Allgemeinbefinden, eine starke Beeinträchtigung der Magen-Darm-Funktion, ein stark verminderter oder aufgehobener Kotabsatz und ein abomasales Refluxsyndrom. 10 Kühe wurden nach der Untersuchung bzw. nach einer Probelaparotomie geschlachtet. Bei 13 Kühen wurde der Phytobezoar während der Laparotomie entweder manuell zerdrückt und im Darm weiterbefördert oder, falls dies nicht möglich war, durch Enterotomie entfernt. Die postoperative Therapie bestand in der Verabreichung einer NaCl-Glukoselösung, Kaliumchlorid, Metoclopramid, Procain-Penizillin und Flunixin-Meglumin während 3–5 Tagen. Zwei der behandelten Kühe mussten innerhalb von wenigen Tagen geschlachtet werden. Bei den restlichen 11 Kühen kam es innerhalb von kurzer Zeit zu einer raschen Besserung und zur Normalisierung von Allgemeinbefinden, Futteraufnahme und Kotabsatz.

*Schlüsselwörter:* **Ileus – Duodenum – Rind**

**Summary**

The clinical signs, changes in blood and rumen fluid, findings at laparotomy, therapy and course of disease of 23 cows with obstruction or compression of the duodenum are described. The duodenum was obstructed by a phytobezoar in 14 cows and by a blood clot in one cow. In eight cows, the duodenum was compressed by and adhesed to a liver abscess. The most important clinical findings included moderate to severe disturbance in the general behaviour and attitude, markedly reduced gastrointestinal activity, no or greatly reduced defaecation and abomasal reflux with metabolic alkalosis. Ten cows were slaughtered after clinical examination or exploratory laparotomy. In 13 cows, the phytobezoar was compressed manually to facilitate normal elimination, and if this was not possible, the phytobezoar was removed by enterotomy. Postoperative therapy consisted of intravenous administration of a solution containing sodium chloride and glucose, potassium chloride and intramuscular administration of metoclopramide, procaine penicillin and flunixin meglumine for three to five days. Two of the treated cows were slaughtered a few days postoperatively. There was a rapid improvement in the remaining 11 cows, and general condition, appetite and defaecation returned to normal within a short time.

*Key words:* **duodenal ileus – cattle**

## Introduction

Duodenal obstruction is seldom observed in cattle (Garry et al., 1988) and until recently could only be diagnosed by exploratory laparotomy or at post mortem examination. The causes of duodenal obstruction are varied and include both mechanical and functional etiologies. Obstruction of the proximal duodenum by a food mass has been described in 6 cows (Garry et al., 1988). Inflammation of the duodenal wall caused by trauma from a foreign body that had perforated and migrated out of the reticulum resulted in duodenal obstruction in a cow (Mullowney and Whitlock, 1978). In 18 cows, ileus caused by functional stenosis of the duodenum was reported (Van der Velden, 1983).

Obstruction of the duodenum was induced experimentally in cows to determine changes in blood and rumen fluid chemistry (Papadopoulos et al., 1985a,b; Avery et al., 1986) and in the electromyographical activity of the duodenum (Rutgers et al., 1988). Experimental obstruction of the duodenum resulted in rapid abomasal reflux of chloride into the rumen and metabolic alkalosis with hypochloraemia and hypokalaemia. In addition, there was an abrupt disorganisation of the myoelectrical complexes. After elimination of the obstruction, a rapid reorganisation of the cyclical myoelectrical pattern occurred, indicating normalisation of intestinal activity.

The purpose of this paper was to describe the clinical, haematological, biochemical and pathological findings in 23 cows with duodenal obstruction. In addition, diagnostic approach, therapy and outcome are reported.

## Animals, materials and methods

### Animals

From January 1, 1985 to December 31, 1991, 2510 cattle with internal diseases were referred to our clinic. In 23 of these animals, duodenal obstruction was diagnosed during surgery or at post mortem examination. All cows were examined and treated once to several times by the referring veterinarian because of decreased appetite, reduced or no defaecation or signs of colic. However, their condition did not improve, and they were admitted to our clinic with either no specific diagnosis or with suspected right side displacement of abomasum or ileus.

Of the 23 cattle, there were 15 Swiss Braunvieh, six Simmentals and two Holsteins. Their ages ranged from nine months to 15 years (mean ± sd = 5.3 ± 3.0 years); one heifer was nine months old, 14 cows were three to six years old, seven cows were six to nine years old and one cow was 15 years old. The last parturition had occurred less than nine weeks prior to admission in four cows and either more than nine weeks before admission or the date was not known in the remainder of the cows. Twelve cows were diagnosed as non-gravid and the rest were between 12 and 34 weeks pregnant. During the last two months prior to the onset of illness, no signs of disease were observed by the owners of the animals. The average duration of disease before admission was 43.8 ± 28.6 hours. According to the owners, signs of disease were observed less than one day in 11 animals, a maximum of two days in six animals, three days in four animals, four days in one cow and five days in another cow. Nine owners noticed clinical signs of colic in their cows.

### Clinical examination, haematological and biochemical findings in blood and rumen fluid

All cows were clinically examined according to the method of Rosenberger (1979). Blood samples were collected for determination of haematocrit, leukocyte count, total protein, fibrinogen, urea, potassium, chloride, bilirubin, aspartate aminotransferase (AST), gamma glutamyl transferase (γ-T), calcium, inorganic phosphorus and magnesium. The concentration of chloride and bile acids were determined in samples of rumen fluid. In addition, a venous blood sample was obtained for blood gas analysis. Examination of blood and rumen fluid was performed as previously described (Braun et al., 1989a, b). In four cows, samples of rumen fluid were obtained each day for six days postoperatively to study the changes in chloride and bile acid concentrations.

### Ultrasonographic examination of the abdomen

The abdomen of cow 21 was examined ultrasonographically on the right side. The hair was shaved on the right side of the cow between the tuber coxae and the shoulder, and this area was examined using a 3.5 MHz linear transducer.

### Statistics

Statistical analyses were performed by means of the calculation program SPSS/PC+ (Norusis, 1988). Frequencies, means and standard deviations were calculated. Additionally, a Paired-samples t-test was carried out.

## Results

### Results of the clinical examination

The most important clinical findings (Table 1) were moderately to severely disturbed general behaviour and attitude, anorexy, reduced or absent intestinal motility, and reduced or no defaecation.

The oral mucous membranes were abnormal, the sclera injected and the body surface, distal extremities, horns and ears cooler than normal. The animals were frequently apathetic with droopy ears, sunken eyeballs and dry muzzles. Six cows had clinical signs of colic including treading and kicking with the hindlimbs and frequent

*Table 1: Results of the clinical examination of 23 cows with duodenal ileus*

| Characteristic | Finding | Number of animals |
|---|---|---|
| General behaviour and attitude | Slightly disturbed | 2 |
| | Moderately disturbed | 12 |
| | Severely disturbed | 9 |
| Visual adspection | No abnormalities | 20 |
| | Barrel-shaped abdomen | 3 |
| Rectal temperature (°C) | Normal (38.4–38.9 °C) | 13 |
| | Decreased (<38.4 °C) | 8 |
| | Slightly increased (39.0–39.4 °C) | 1 |
| | Moderately increased (39.5–40.0 °C) | 1 |
| Heart rate/minute | Normal (61–80) | 14 |
| | Slightly increased (81–90) | 2 |
| | Moderately increased (91–100) | 3 |
| | Severely increased (>100) | 4 |
| Respiratory rate/minute | Normal (15–25) | 16 |
| | Slightly increased (26–35) | 6 |
| | Moderately increased (36–45) | 1 |
| Mucous membranes | Pink | 3 |
| | Pale pink | 11 |
| | Pale | 4 |
| | Cyanosed | 2 |
| | Injected and muddy | 3 |
| Episcleral vessels | Normal | 1 |
| | Slightly injected | 5 |
| | Moderately injected | 9 |
| | Severely injected | 8 |
| Body surface temperature | Normal | 4 |
| | Moderately reduced | 16 |
| | Severely reduced | 3 |
| Rumen motility | Normal | 1 |
| | Reduced | 13 |
| | No motility | 9 |
| Rumen filling | Normal | 7 |
| | Reduced | 8 |
| | Excessively filled | 8 |
| Rumen tympany | No tympany | 20 |
| | Mild tympany | 2 |
| | Moderate tympany | 1 |
| Tests for foreign bodies | All tests negative | 10 |
| | Pain on percussion only | 6 |
| | Pain on back grip only | 3 |
| | Several tests positive | 4 |
| Swinging auscultation and percussion auscultation on the right side | Both tests negative | 10 |
| | Swinging auscultation only positive | 6 |
| | Both tests positive | 7 |
| Intestinal motility | Normal | 2 |
| | Reduced | 11 |
| | No motility | 10 |
| Defaecation | Normal | 3 |
| | Reduced | 10 |
| | No defaecation | 10 |
| Consistency of faeces | Normal (pulpy) | 5 |
| | Softer than normal | 1 |
| | Fluid | 3 |
| | Disc-shaped | 4 |
| Colour of faeces | Normal | 7 |
| | Dark | 5 |
| | Black | 1 |
| Abnormal contents in the rectum | None | 6 |
| | Mucus | 7 |
| | Fragments of fibrin | 2 |
| | Blood | 2 |
| Rectal examination | No palpable abnormalities | 9 |
| | Extremely dilated rumen | 9 |
| | L-shaped rumen | 2 |
| | Dilated intestinal loops | 3 |

lying down followed by standing up. Usually there was reduced or no rumen motility. Filling of the rumen, judged by visual adspection of the left flank, varied from reduced to normal to excessive. There was mild to moderate tympany of the rumen in three cases. In the majority of animals, one or more tests for foreign bodies were positive. Swinging and percussion auscultation performed on the right side of the patient were negative in ten cases and positive in seven animals. In six animals only swinging auscultation was positive. In 21 cows intestinal activity was markedly reduced or absent, and accordingly there was no or very little faecal output. The consistency of the faeces varied from watery to soupy and to porridge-like. Occasionally the faeces were very firm. The faeces usually were dark in colour or black and contained mucus, fibrin or blood. Rectal examination revealed no abnormal findings in nine cases, an extremely dilated or L-shaped rumen in 11 animals and dilated loops of small intestine in three cases.

*Table 2: Concentrations of chloride and bile acids in rumen fluid of 22 cows with duodenal ileus (mean ± sd values and distribution)*

| Measurement | Classification | Number of animals |
|---|---|---|
| Chloride | Normal (<25 mmol/litre) | 4 |
| (50.6±21.0 mmol/litre) | Slightly increased (26–35 mmol/litre) | 1 |
| | Moderately increased (36–45 mmol/l) | 3 |
| | Greatly increased (<45 mmol/litre) | 14 |
| Bile acids | Normal (not measurable) | 3 |
| (54.2±49.6 µmol/litre) | 0.1–1 µmol/litre | 1 |
| | Slightly increased (2–10 µmol/litre) | 5 |
| | Moderately increased (11–50 µmol/l) | 2 |
| | Greatly increased (>50 µmol/litre) | 11 |

*Table 3: Haematological and chemical analyses of blood from 15 to 21 cows with duodenal ileus (mean ± sd values and distribution)*

| Measurement | Classification | Number of animals |
|---|---|---|
| Haematocrit | Normal (28–38%) | 13 |
| (38.2±4.9%) | Increased (>38%) | 8 |
| Leukocyte count | Normal (4000–10000/µl) | 16 |
| (8647±3136/µl) | Increased (>10000/µl) | 5 |
| Total protein | Normal (60–80 g/litre) | 3 |
| (89.4±8.9 g/litre) | Increased (>80 g/litre) | 18 |
| Fibrinogen | Normal (5–7 g/litre) | 10 |
| (7.1±3.3 g/litre) | Reduced (<5 g/litre) | 4 |
| | Increased (>7 g/litre) | 7 |
| Urea | Normal (<7.5 mmol/litre) | 5 |
| (11.8±5.8 mmol/litre) | Increased (>7.5 mmol/litre) | 16 |
| Potassium | Normal (3.5–5.5 mmol/litre) | 3 |
| (2.9±0.7 mmol/litre) | Moderately reduced (3.1–3.5 mmol/l) | 4 |
| | Severely reduced (1.9–3.0 mmol/litre) | 14 |
| Chloride | Normal (96–110 mmol/litre) | 5 |
| (88.3±11.2 mmol/litre) | Slightly reduced (86–95 mmol/litre) | 9 |
| | Moderately reduced (76–85 mmol/litre) | 3 |
| | Severely reduced (<75 mmol/litre) | 4 |
| Bilirubin | Normal (0.8–8.6 µmol/litre) | 15 |
| (6.5±4.2 µmol/litre) | Increased (>8.6 µmol/litre) | 4 |
| AST | Normal (40–80 iu/litre) | 10 |
| (98±55.0 iu/litre) | Increased (>80 iu/litre) | 11 |
| Gamma-GT | Normal (6–17 iu/litre) | 10 |
| (26.3±23.7 iu/litre) | Increased (>17 iu/litre) | 11 |
| Calcium | Normal (2.0–2.6 mmol/litre) | 8 |
| (2.03±0.48 mmol/litre) | Reduced (<2 mmol/litre) | 6 |
| | Increased (>2.6 mmol/litre) | 1 |
| Inorganic phosphate | Normal (1.30–2.25 mmol/litre) | 7 |
| (2.01±0.97 mmol/litre) | Reduced (<1.30 mmol/litre) | 3 |
| | Increased (>2.25 mmol/litre) | 5 |
| Magnesium | Normal (0.70–1.10 mmol/litre) | 7 |
| (1.21±0.28 mmol/litre) | Increased (>1.10 mmol/litre) | 8 |

*Table 4: pH, $pCO_2$, bicarbonate and base excess of venous blood in 16 cows with duodenal ileus (mean ± sd values and distribution)*

| Measurement | Classification | Number of animals |
|---|---|---|
| pH | Normal (7.35–7.50) | 12 |
| (7.44±0.06) | Reduced (<7.35) | 1 |
| | Increased (>7.50) | 3 |
| $pCO_2$ | Normal (35–45 mmHg) | 6 |
| (50.4±10.1 mmHg) | Slightly increased (46–55 mmHg) | 5 |
| | Moderately increased (56–65 mmHg) | 3 |
| | Greatly increased (>65 mmHg) | 2 |
| Bicarbonate | Normal (20–30 mmol/litre) | 6 |
| (34.7±10.7 mmol/litre) | Slightly increased (31–40 mmol/litre) | 4 |
| | Moderately increased (41–50 mmol/l) | 4 |
| | Greatly increased (>50 mmol/litre) | 2 |
| Base excess | Normal (–2 to +2 mmol/litre) | 2 |
| (10.2±10.2 mmol/litre) | Reduced (<–2 mmol/litre) | 1 |
| | Slightly increased (2–10 mmol/litre) | 7 |
| | Moderately increased (11–20 mmol/l) | 3 |
| | Greatly increased (>20 mmol/litre) | 3 |

## Haematological and biochemical findings in blood and rumen fluid

The main clinical finding in 18 patients was reflux of abomasal chloride which manifested as elevated rumen chloride concentrations (Table 2) and reduced serum chloride and potassium concentrations (Table 3). As a result, many animals had metabolic alkalosis with compensation or even decompensation characterised by a positive base-excess, elevated $pCO_2$ and bicarbonate concentrations and in 3 cows an elevated blood pH (Table 4). Duodenal reflux of bile acids into the rumen occurred in 19 cows (Table 2).

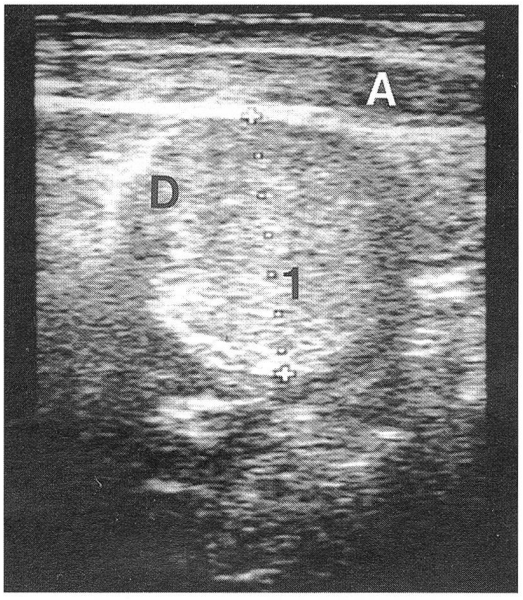


*Figure 1: Ultrasonographic examination of a cow with duodenal ileus due to compression of the duodenum by a liver abscess. A = abdominal wall; D = duodenum; 1 = diameter of duodenum (6.5 cm).*

## Ultrasonographic findings

Dilatation of the duodenum was diagnosed via abdominal ultrasonography in cow 21 (Fig. 1). The duodenum in the tenth, eleventh and twelfth intercostal spaces was 6.5 cm in diameter and was filled with an echogenic ingesta; the jejunum was empty.

## Tentative diagnosis

Disease of the proximal small intestine or abomasum was suspected in 19 cows based on the clinical findings. The main rule-outs included duodenal or proximal jejunal ileus, acute pyloric stenosis and right-side displacement of the abomasum. Jejunal ileus was suspected in three cows (3, 4, 23) in which dilated loops of small intestine could be palpated rectally. In cow 21, which underwent ultrasonographic examination, duodenal ileus was diagnosed.

## Findings on exploratory laparotomy or at slaughter and intraoperative treatment

The owners of two cows (10, 11) opted for slaughter immediately after the clinical examination. An exploratory laparotomy was performed in the right flank of the remaining cows. Anaesthesia consisted of a distal paravertebral block, and surgery was performed with the patient standing. An approximately 25 cm long incision was made halfway between the last rib and the tuber coxae to open the abdomen for manual exploration. A diagnosis of duodenal ileus was made during surgery and/or at post mortem when it was determined that transport of ingesta was mechanically abolished due to obstruction or compression of the duodenum. A differential diagnosis of acute pyloric stenosis, right-side

*Table 5: Description, surgical findings, surgical procedure and outcome of 23 patients with duodenal ileus*

| Case No. | Description | Surgical and/or slaughter findings | Surgical procedure | Outcome |
|---|---|---|---|---|
| 1 | 3-yr-old cow | Phytobezoar in the ascending duodenum | Removal of the phytobezoar by enterotomy | Lived |
| 2 | 3.5-yr-old cow | Phytobezoar in the ascending duodenum | Removal of the phytobezoar by enterotomy | Lived |
| 3 | 4-yr-old cow | 2 liver abscesses (15 cm in diameter). Adhesion and compression of the duodenum and the proximal part of the jejunum at two sites by one of the two liver abscesses. | None | Slaughtered |
| 4 | 8-yr-old cow | Adhesions between rumen, omasum and abomasum. Abscess between reticulum and omasum. Large liver abscess. Adhesion and compression of the duodenum and the ascending colon by the liver abscess. | None | Slaughtered |
| 5 | 6-yr-old cow | Abscess (15 cm in diameter) between rumen, liver and duodenum, resulting in compression of the duodenum. | None | Slaughtered |
| 6 | 9-mo-old heifer | Phytobezoar in the descending duodenum. | Removal of the phytobezoar by enterotomy | Lived |
| 7 | 6-yr-old cow | Phytobezoar in the descending duodenum. Localised perforation of the intestine wall. Local peritonitis. | Resection of the altered part of the intestine | Slaughtered |
| 8 | 4-yr-old cow | Liver abscess (15 cm in diameter). Duodenum adhered to and compressed by the liver abscess. | None | Slaughtered |
| 9 | 4-yr-old cow | Extensive adhesions between reticulum, liver and peritoneum. Reticulum abscess. Piece of wire, 4 cm long, penetrating the wall of the reticulum. Obstruction of the ascending duodenum by a phytobezoar. | None | Slaughtered |
| 10 | 15-yr-old cow | Slaughter without preceding laparotomy. Phytobezoar in the cranial part of the duodenum. Two abomasal ulcers. | None | Slaughtered |
| 11 | 5-yr-old cow | Laparotomy and slaughter. Fibrous adhesions between the reticulum and the diaphragm due to traumatic reticuloperitonitis. Obstruction of the cranial part of the duodenum for a length of 20–30 cm by a phytobezoar. | None | Slaughtered |
| 12 | 9-yr-old cow | Phytobezoar with several stones in the descending duodenum. Similar mass in the caecum. | Removal of the ingesta mass by enterotomy of the duodenum and the caecum | Lived |
| 13 | 4-yr-old cow | Phytobezoar in the cranial part of the duodenum. | Removal of the phytobezoar by enterotomy after resection of the last rib. | Lived |
| 14 | 7-yr-old cow | Phytobezoar in the descending duodenum. | Removal of the phytobezoar by enterotomy | Lived |
| 15 | 5-yr-old cow | Phytobezoar in the descending duodenum. | Removal of the phytobezoar by enterotomy | Lived |
| 16 | 3.5-yr old cow | Phytobezoar in the descending duodenum. | Removal of the phytobezoar by enterotomy | Lived |
| 17 | 3-yr-old cow | Liver abscess (8 cm in diameter). Duodenum adhered to and compressed by the liver abscess. | None | Slaughtered |
| 18 | 3.5-yr-old cow | Blood clot in the cranial part of the duodenum. | Removal of the blood clot by enterotomy after resection of the last rib | Lived |
| 19 | 10-yr-old cow | Adhesions between rumen, abomasum and liver. Phytobezoar in the descending duodenum. | Manual compression of the phytobezoar without enterotomy | Lived |
| 20 | 8-yr-old cow | Phytobezoar in the ascending duodenum. Adhesions between rumen and diaphragm. | Manual massage of the phytobezoar from the ascending to the descending duodenum, enterotomy and removal of the phytobezoar | Lived |
| 21 | 3-yr-old cow | Duodenum adhered to a liver abscess (8 cm in diameter), compressed and strangulated, forming a pouch. Strangulated pouch of intestine filled with bile. | None | Slaughtered |
| 22 | 5.5-yr-old cow | Phytobezoar in the descending duodenum. | Manual compression of the phytobezoar without enterotomy | Slaughtered due to recumbency |
| 23 | 5-yr-old cow | Liver abscess (8 cm in diameter). Duodenum and distal jejunum adhered to and compressed by a liver abscess. | None | Slaughtered |

*Table 6: Cause and localisation of duodenal ileus*

| Cause of duodenal ileus | Localisation of duodenal ileus | | | |
|---|---|---|---|---|
| | Cranial part | Descending duodenum | Ascending duodenum | Not recorded |
| Phytobezoar (n=14) | 3 | 7 | 4 | - |
| Phytobezoar with perforation of intestinal wall (n=1) | - | 1 | - | - |
| Obstruction by a blood clot (n=1) | 1 | - | - | - |
| Adhesion to and compression by a liver abscess (n=7) | 2 | 2 | 1 | 2 |

abomasal displacement or ileus of another part of the intestine had to be ruled-out.

In all cows, the rumen, reticulum, omasum, abomasum and duodenum up to the point of the ileus were markedly dilated and filled with feed because of the retrograde build-up of food.

Obstruction of the duodenum attributable to a phytobezoar was diagnosed in 14 cows (Tables 5, 6). The phytobezoar was situated in the cranial part of the duodenum in three cows, in the descending duodenum in seven cows and in the ascending duodenum in four cows. In cow 7, the wall of the descending duodenum was perforated in the area of the phytobezoar as a result of pressure necrosis. In cow 18, the cranial part of the duodenum was obstructed by a blood clot probably originating from the abomasum. In seven cows, the duodenum was adhesed to a liver abscess situated on the visceral surface of the liver and thereby compromised. The liver abscess compressed the cranial part of the duodenum in two cows, the descending duodenum in two cows and the ascending duodenum in one cow. In two cases, the location of compression of the duodenum was not recorded during laparotomy. The distal jejunum of two cows (3, 23) and the ascending colon of cow 4 was also compressed by adhesions in the area of a liver abscess.

Extensive adhesions caused by traumatic reticuloperitonitis were observed in the area of the reticulum and rumen and/or diaphragm, omasum, abomasum or peritoneum in four cows (9, 11, 19, 20).

All cows with compression of the duodenum by a liver abscess and one cow (9) with a reticular abscess and massive adhesions between the reticulum, liver and peritoneum were slaughtered immediately after surgery.

In two cows (19, 22), the phytobezoar was compressed by careful manual kneading to fascilitate further intestinal transport. In ten cows (1, 2, 6, 12–16, 18, 20), the phytobezoar could not be compressed manually and was removed by enterotomy. A second laparotomy was performed in two cows (13, 18) with obstruction of the cranial part of the duodenum; this entailed resection of the last or second last rib to gain access to the affected part. Routine closure of the incision was performed and routine antibiotic therapy was initiated.

Partial resection of the ascending duodenum was carried out in cow 7 because of perforation of the intestinal wall caused by a phytobezoar. This case has been previously described (Steiner et al., 1989).

## Postoperative treatment

Postoperative therapy was performed in 13 animals. The dosage and frequency of administration of the various medications are listed in Table 7. At first, 10–20 litres of a solution containing 50 g glucose and 9 g sodium chloride/litre were infused via an indwelling intravenous catheter placed in the external jugular vein; according to the case, an additional 80–600 mmol of potassium chloride was administered. Ten litres of a solution containing

*Table 7: Treatment of 13 cows with duodenal ileus*

| Characteristic | Finding | Number of animals |
|---|---|---|
| Total amount of sodium chloride and glucose solution infused (liters) | 30 | 7 |
| | 40 | 2 |
| | 50 | 4 |
| Number of metoclopramide doses, 30 mg each | 9 | 10 |
| | 12 | 2 |
| | 15 | 1 |
| Total amount of potassium chloride infused (mmol) | 80–100 | 1 |
| | 101–200 | 3 |
| | 201–300 | 2 |
| | 301–600 | 2 |
| Duration of intensive care and treatment (days) | 3 | 9 |
| | 4 | 1 |
| | 5 | 2 |
| | 6 | 1 |

50 g of glucose and 9 g of sodium chloride/litre were administered intravenously on the first and second days following laparotomy. Intensive intravenous fluid therapy lasted an average of 3.6 ± 1.04 days and varied from three to six days. In addition, the patients received 30 mg of metoclopramide, intramuscularly usually 9 times at eight hours interval and $3 \times 10^6$ iu of procaine penicillin, intramuscularly every eight hours for three days and 500 mg flunixin meglumine, intramuscularly every 24 hours for three days.

The patients were monitored for 72 hours after surgery. General behaviour and condition, heart and respiratory rates, forestomach and intestinal activity, urination and defaecation were recorded in a detailed protocol. The patients were monitored every hour for the first 12 hours following surgery and then every two and later every four hours. If necessary, the animals were examined more often. The patients were fasted for a minimum of 48 hours postoperatively. After this time, feeding was initiated by offering small quantities of hay.

## Progress after treatment

Two of the 13 cows that received postsurgical treatment had to be slaughtered. Cow 7 was slaughtered two days after surgery because of obstruction of the ascending colon. Cow 22 was slaughtered six days postoperatively because of trauma-induced recumbency. The postsurgical treatment was successful in 11 cows. The general attitude and behaviour of these patients was usually only severely altered for one day and rarely for two days (Table 8). During this time the cows were apathetic and anorexic. A distinct improvement in the general attitude and behaviour usually occurred the first day after surgery; the animals showed renewed interest in their surroundings, and the body surface was warm again. Rumination was often observed, and when a handful of hay was offered to monitor appetite, the cows usually tried to eat it. After this time, ruminal motility resumed and the cows passed large amounts of faeces. Complete normalisation of attitude and behaviour, appetite, urination, defaecation and emptying of the rumen occurred within four days after surgery in nine cows. Return to normal attitude and behaviour took five days in one cow and seven days in another.

The average heart rate decreased to within normal range within one day after surgery (difference from day 1 to day 0 $P<0.05$, Paired-samples t-test, Table 9) and did not subsequently increase. The respiratory rate did not change significantly during this time. The average rectal temperature increased from 38.6 to 39.0 °C.

Rumen fluid samples were obtained from cows 13, 14, 19 and 20 each day for six days following surgery. In these cows, the chloride concentration in the rumen decreased on the first and second days following laparotomy (Table 10). On the third day and after completion of the metoclopramide treatment, the chloride concentration of the rumen increased again transiently and then once again decreased. Six days after surgery, the rumen chloride concentration was within normal range or only slightly elevated in all cows (difference day 6 to day 0 $P<0.05$, Paired-samples t-test). The bile acid concentration in the rumen fluid continued to decrease throughout the six days. Three days after surgery, the bile acid concentration in the rumen fluid was significantly lower than the basal value (difference day 3 to day 0 $P<0.05$, Paired-samples t-test). In individual cows, three to six days were required before the bile acids decreased to barely measurable levels.

*Table 8: Course of the disease in 11 cows with obstruction of the duodenum by a phytobezoar*

| Characteristic | Finding | Number of animals |
|---|---|---|
| Duration of moderately to severely disturbed general condition (days) | 1 | 9 |
| | 2 | 2 |
| Period until general condition returned to normal (days) | 1–2 | 5 |
| | 3–4 | 4 |
| | 5–7 | 2 |

*Table 9: Changes in heart rate, in respiratory rate and in rectal temperature in 11 cows with obstruction of the duodenum by a phytobezoar*

| Number of animals | Days after initiation of treatment | Heart rate/minute Mean ± sd | Respiratory rate/minute Mean ± sd | Rectal temperature (°C) Mean ± sd |
|---|---|---|---|---|
| 11 | 0 | 86.0±12.6* | 23.1±6.3 | 38.6±0.4 |
| 11 | 1 | 73.3±12.6 | 24.4±9.9 | 38.6±0.3 |
| 11 | 2 | 69.8±18.2 | 23.3±5.4 | 38.8±0.4 |
| 11 | 3 | 69.8±18.1 | 24.9±7.3 | 38.9±0.5 |
| 10 | 4 | 73.4±18.6 | 27.8±4.1 | 39.0±0.4 |

* Difference to day 1 $P<0.05$, t-test.

*Table 10: Changes in the chloride and bile acid concentrations of rumen fluid in four cows treated for duodenal obstruction caused by a phytobezoar.*

| Parameter | Cow | Days after laparotomy | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Chloride in rumen fluid (mmol/litre) | 13 | 61 | 68 | 54 | 57 | 20 | 46 | 32 |
| | 14 | 75 | 55 | 43 | 51 | 48 | 26 | 24 |
| | 19 | 42 | 42 | 32 | 50 | 46 | 36 | 28 |
| | 20 | 83 | 71 | 36 | 50 | 40 | 31 | 31 |
| | Mean±sd | 65.3±18.0 | 59.0±13.3 | 41.3±9.6 | 52.0±3.4 | 38.5±12.8 | 34.7±8.5 | 28.8±3.6 |
| Bile acids in rumen fluid (µmol/litre) | 13 | 16.0 | 18.5 | 10.8 | 0.5 | 0.6 | 0.4 | 0.4 |
| | 14 | 120.5 | 55.4 | 49.5 | 28.3 | 23.7 | 4.7 | 1.5 |
| | 19 | 137.6 | 157.2 | 72.5 | 13.9 | 0.8 | 2.0 | 1.5 |
| | 20 | 149.7 | 48.5 | 56.5 | 16.0 | 6.9 | 4.6 | 3.7 |
| | Mean±sd | 106.0±61.2 | 69.9±60.4 | 47.3±26.2 | 14.7±11.4 | 8.0±10.9 | 2.9±2.1 | 1.8±1.4 |

Eleven cows returned home after four to 13 days in the clinic (mean ± sd = 8.3 ± 2.3 days), depending on the time required for complete recovery. Cows 1 and 16 were slaughtered within one month after leaving the clinic because of relapse. According to the owners, the remainder of the cows (nine out of 23 admitted or 39%) were reported to be clinically healthy with good appetite and milk production a minimum of six months after leaving the clinic.

## Discussion

The majority of patients in this report had typical clinical signs of ileus of the small intestine: moderately to severely altered behaviour and attitude, cessation of gastrointestinal motility and no or markedly reduced defaecation. Similar clinical signs have been reported in cows with spontaneously occurring (Garry et al., 1988) or experimentally induced (Papadopoulos et al., 1985a, Avery et al., 1986) obstruction of the duodenum. The rapid deterioration in the general condition of cows with duodenal ileus is attributable to abomasal reflux with hypokalaemic metabolic alkalosis, which occurs within a short time (Papadopoulos et al., 1985b, Avery et al., 1986, Garry et al., 1988). In cows with duodenal ileus, abomasal reflux is associated in most cases with duodenal bile reflux.

Clinical signs of colic were observed in only six cows. This was because the phase of acute abdominal pain in cattle is short and disappears within two to six hours (Dirksen, 1970) or a maximum of eight to 12 hours (Dirksen, 1970, Blood and Radostits, 1989). A phase of depression then follows in which the cattle are anorexic and pass no faeces. Thus, clinical signs of colic are often missed and in many cases have already occurred before the cattle are admitted to the clinic. In addition, in our experience, cattle with duodenal ileus have milder signs of colic than cattle with jejunal ileus. These observations are in agreement with the findings of Papadopoulos et al. (1985a) who experimentally induced ileus in cows by obstructing the duodenum, jejunum or ileum. In that study, cows with obstruction of the duodenum had only transient signs of mild pain immediately after the obstruction. Cows with obstruction of the jejunum or ileum had signs of severe colic a few hours after experimental induction of the obstruction. These signs of pain also disappeared after some time. In contrast to cows with obstruction of the duodenum, cows with obstruction of the jejunum have more severe signs of colic because the jejunum is longer and therefore more intestine is under tension causing stronger stimulation of the sensitive nerve endings in the intestinal serosa. In addition, in contrast to duodenal ileus, the mesentery of the intestine of cows with jejunal ileus undergoes stronger traction and compression.

In this report, duodenal ileus was attributable to various causes. In 14 cases, ileus resulted from obstruction of the duodenum by a phytobezoar, and in 8 cows the cause was compression of the duodenum by a liver abscess. In one case ileus was attributable to obstruction of the duodenum by a blood clot. Compression of the duodenum by a liver abscess was favourable because of the anatomic relationship of these two organs and in some cases because of the attachment of the liver and duodenum via the hepatoduodenal ligament. Adhesions in the area of the reticulum attributable to a foreign body were observed during exploratory laparotomy in five of 14 cows with duodenal obstruction by a phytobezoar. It is conceivable that these lesions caused impairment of the reticular sorting mechanism so that larger than normal food masses reached the omasum, abomasum and duodenum. It can be assumed that these food masses got stuck in the duodenum and sometimes in the proximal jejunum because of the sudden narrowing of the intestinal lumen after the pylorus. In cows without adhesions, it is probable that other causes of transient impairment of the reticular sorting mechanism were responsible for phytobezoar formation. A functional stenosis in the region of the sigmoid curve of the duodenum described by Van der Velden (1983) was not observed in any of the cows in this study.

In contrast to other areas of the intestine, ileus of the duodenum and proximal jejunum is the most difficult to diagnose. Palpable changes can usually be detected on rectal examination when there is ileus of the middle or distal jejunum, ileum or caecum; the type of ileus and the affected intestinal segment can often be determined from rectal findings. As a rule, duodenal ileus cannot be detected on rectal examination. In 11 of the patients in this report, the only sign of impairment of ruminal emptying was an over-filled rumen. Based on the general condition of the animals, the markedly reduced gastrointestinal motility, no faeces in the rectum and the increased concentration of chloride in samples of rumen fluid, the problem can usually be localised to the abomasum and duodenum. Right-side displacement of the abomasum can usually be ruled-out based on clinical findings. Acute pyloric stenosis and duodenal ileus cannot be differentiated clinically, even by determining the bile acid concentration in rumen fluid. The concentration of bile acids in rumen fluid is sometimes increased in animals with acute pyloric obstruction (Braun et al., 1990), and occasionally duodenal reflux of bile acids does not occur in cows with duodenal ileus when the ileus is cranial to the opening of the bile duct (Braun et al., 1989a). Until recently, information concerning duodenal ileus described in this report could only be determined by exploratory laparotomy. Ultrasonographic examination of the abdomen of cow 21 revealed marked dilatation of the duodenum. It is therefore conceivable that ultrasonography can be used to differentiate duodenal ileus from pyloric stenosis. Ultrasonographic examination of three cows with acute pyloric stenosis, admitted to our clinic, revealed that the abomasum was large and filled with feed while the intestine, especially the duodenum, was not dilated. It would be advantageous to ultrasonographically differentiate cows with duodenal ileus attributable to compression of the duodenum by a liver abscess from those with duodenal ileus caused by duodenal obstruction by a phytobezoar because the prognosis for the former is poor. Differentiation would mean that the former group would be slaughtered without exploratory laparotomy, and

**Sintomi, diagnosi e terapia dell'ileo duodenale nel manzo**

In 23 mucche, affette da una ostruzione o compressione duodenale, vengono descritti i sintomi clinici, i cambiamenti nel sangue e nel fluido ruminale, i referti delle laparatomie, la terapia ed il prosieguo della malattia. In 14 casi fu riscontrata un'ostruzione del duodeno dovuta a phytobezoar, in 8 casi la compressione del duodeno era dovuta all'adesione del duodeno ad un ascesso del fegato ed in una mucca fu riscontrata un'ostruzione duodenale dovuta ad un coagulo. I sintomi clinici più importanti erano uno stato generale da mediamente a molto disturbato, una drastica riduzione delle funzionalità gastro-intestinali, assenza parziale o totale della defecazione e la sindrome da riflusso abomasale. 10 mucche furono macellate dopo la visita o dopo la laparatomia. In 13 casi il phytobezoar fu frantumato manualmente e trasportato più in avanti nell' intestino, oppure se questo non era possibile veniva asportato mediante un'enterotomia. La terapia postoperatoria consisteva nell'infusione di una soluzione di NaCl glucosio, cloruro die potassio, metoclopramid, procaina-penicillina e flunixin-meglumin per una durata di 3–5 giorni. 2 delle mucche in terapia vennero macellate entro pochi giorni. Le restanti 11 mucche mostrarono entro poco tempo chiari segni di miglioramento e normalizzazione dello stato generale ricominciando a mangiare e a defecare.

**Symptômes, diagnostique et traitement de l'iléus du duodénum chez la vache**

La présentation clinique, les altérations du sang et du jus de panse, les observations lors de la laparatomie, la thérapie et la progression de la maladie après le traitement sont décrits chez 23 vaches qui étaient atteintes d'une obstruction ou d'une compression du duodénum. Chez 14 vaches, l'obstruction du duodénum a été causée par un phytobézard. Chez 8 vaches, la compression du duodénum était due à une adhésion du duodénum à un abcès du foie et chez une vache un caillot de sang était à l'origine de l'obstruction. Les observations importantes étaient un état général moyennement à hautement perturbés, un dérangement important de la fonction gastrointestinale, une défécation fortement diminuée ou supprimée et un syndrome de reflux de la caillette. Dix vaches ont été abattues après la laparatomie. Chez 13 vaches, le phytobézard a été pressé manuellement pendant la laparatomie et dirigé distalement dans l'intestin ou, si cela n'était pas possible, éloigné après enterotomie. La thérapie postopératoire consistait en l'administration d'une solution di glucose NaCl, di potassium de chloride, de metoclopramide, de procaïne-penicilline et de flunixine meglumine pendant 3 à 5 jours. Deux des vaches traitées ont du être abattues en l'espace de quelques jours. Chez les autres 11 vaches, une amélioration une normalisation de l'état de santé général, de la préhension des aliments et de la défécation se sont manifestées rapidement.

removal of the phytobezoar could be performed by enterotomy in the latter group. Our goal in the future will be to diagnose a duodenal ileus noninvasively and to differentiate the various causes of duodenal ileus via ultrasonography so that only cows with a good prognosis will undergo laparotomy.

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## Acknowledgements

The authors wish to thank the students and veterinary surgeons who took care of the cows at night and on weekends.

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Manuskripteingang: 16. Dezember 1992