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Diagnosis and surgical management of colic in the foal

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Summary

Over a six year period, 83 foals that where referred to the clinic because of colic underwent explorative abdominal surgery.
Indication for an explorative laparotomy was based on the results of clinical examination, laboratory evaluation, abdominal radiography and peritoneal fluid analysation following abdominocentesis. Severe or persisting abdominal pain in combination with abdominal distension were predominant reasons for explorative surgery as well as radiographically visualized distension of small intestine or abnormal laboratory findings.
Intraoperative findings included small intestinal ileus (n=41), large intestinal lesions (n=25), uroperitoneum (n=8) and others (n=9) like perforated gastric ulcer, peritonitis or ovarian torsion.
Of the 83 foals subjected to abdominal surgery 49 (59%) could be released from the clinic in a good general condition without further signs of colic. 21 foals had to be euthanized during surgery because of a poor prognosis. Therefore there was a survival rate of 79% in those foals that were allowed to recover from surgery.
With one exception all foals in which uroperitoneum was diagnosed were discharged fom the clinic. In the contrast to this prognosis for foals with small intestinal strangulation was judged to be poor due to the common intraoperative finding of severe damage in large sections of the small intestine and a survival rate of 46%. In foals with large intestinal lesions, a survival rate of 80% was found.

Keywords: horse, foal, colic, abdominal surgery

Diagnose und chirurgische Behandlung bei der Kolik des Fohlens

In der Klinik für Pferde wurden innerhalb eines Untersuchungszeitraumes von sechs Jahren 83 aufgrund von Koliksymptomen eingewiesene Fohlen einer Laparotomie unterzogen.
Die Indikation zur Laparotomie wurde aufgrund der Ergebnisse einer klinischen und labordiagnostischen Untersuchung ergänzt durch Befunde einer röntgenologischen Untersuchung des Abdomens sowie der Untersuchung von durch Abdominozentese gewonnener Bauchhöhlenflüssigkeit gestellt. Dabei waren Präsentation abdominalen Schmerzes in Form von Koliksymptomen mit zunehmender abdominaler Distension vorherrschende Gründe zur Durchführung einer explorativen Laparotomie vor allem bei röntgenologischem Nachweis dilatierter Dünndarmschlingen oder abweichender Laborbefunde wie Hämokonzentration oder metabolische Azidose.
Intraoperativ ergab sich bei 41 Fohlen das Vorliegen eines Dünndarmileus, bei 25 Fohlen wurden Veränderungen im Bereich des Dickdarmes und bei acht Fohlen ein Uroperitoneum ermittelt. Andere Ursachen der Kolik wie perforierende Magenulzera, Peritonitis oder Ovartorsionen ergaben sich bei neun Fohlen. Von den 83 Fohlen, welche einer Laparotomie unterzogen wurden, konnten 49 (59%) nach Rekonvaleszenz mit ungestörtem Allgemeinbefinden aus der Klinik entlassen werden. Aufgrund einer infausten oder äußerst ungünstigen Prognose wurden während der Laparotomie 21 der Fohlen euthanasiert. Daraus ergibt sich für die Fohlen mit abgeschlossener Laparotomie eine Überlebensrate von 79%.
Mit einer Ausnahme konnten alle Fohlen mit Nachweis eines Uroperitoneums geheilt aus der Klinik entlassen werden. Dagegen gestaltete sich die Prognose für Fohlen mit nachgewiesener Dünndarmstrangulation mit einer Überlebensrate von 46% ungünstiger. Als Grund hierfür kann die während der Laparotomie häufig erkannte bereits eingetretene irreversible Schädigung ausgedehnter Dünndarmabschnitte gesehen werden. Eine Überlebensrate von 80% ergab sich bei Fohlen mit festgestellten Veränderungen im Bereich des Dickdarmes.

Schlüsselwörter: Pferd, Fohlen, Kolik, Abdominalchirurgie

Introduction

Limited attention has been focussed on the diagnosis and surgical management of acute abdomen in the foal *(Adams and Koterba 1988; Adams et al. 1988; Bostedt 1987; Orsini 1997; Vatistas 1996)*.
It can be difficult to differentiate medical from surgical cases of colic due to the size of foals, because rectal palpation, which often yields definitive diagnostic information in the adult horse, is not feasible. Radiography and ultrasonography can replace data from rectal palpation and have proved helpful in diagnosing colic in foals *(Gerhards et al. 1990)* with a high sensivity but a relative low specifity.
A so called ‚watch and wait' approach has been described by *Orsini (1997) as* carrying as much risk as explorative surgery. Decision making for a diagnostic or therapeutic laparotomy should take place as early as possible because the clinical state of colic with acute sign of pain in foals is often followed by an indolent condition. Once an indolent state is reached, mortality rate is raising fastly *(Adams et al. 1988)*.
Short term survival rate for foals aged < 150 days in a study was 65% after colic surgery *(Vatistas et al. 1996)* This is comparable with a 61% short-term survival rate and a 45% survival rate for those over six months as found by *Cable et al. (1996)*. Colic surgery survival rates differ markedly by diagnosis *(Orsini 1997)*. Mortality in foals undergoing abdominal surgery with intestinal strangulation has been reported to be much higher than in those with nonstrangulating obstructions *(Vatistas et al. 1996)*.

Material and methods

Over a six year period, 83 foals with a maximum age of six months were referred to the clinic with a case history and clinical signs of an acute abdomen and underwent surgical therapy. Indication for laparotomy was based on the results of case history, physical examination, laboratory findings and radiography or ultrasonography of the abdomen.

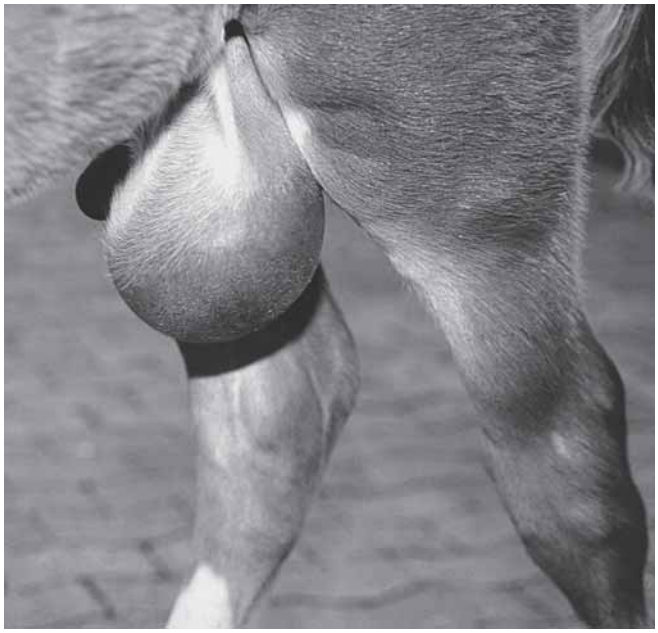

Fig. 1: Hernia scrotalis in a foal.

Hernia scrotalis bei einem Fohlen.

Physical examination included evaluation of heart rate, borborygmi, mucosal surfaces, degree of abdominal distension, palpation of the abdominal wall and digital rectal examination. A nasogastric tube was passed and in 40 foals abdominocentesis was performed (Fig. 3) with a 16 G epidural needle (Tuohy, Fa. Vygon), for collection and analyzation of peritoneal fluid.

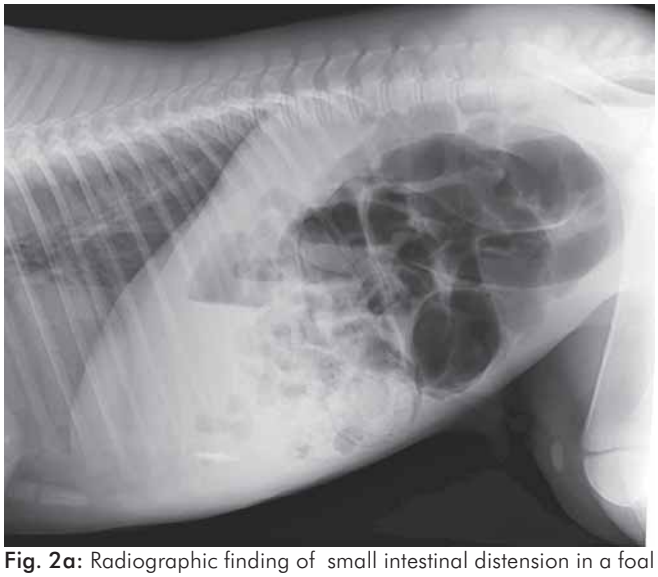

Fig. 2a: Radiographic finding of small intestinal distension in a foal with volvolus mesenterialis.

Radiologischer Nachweis zahlreicher dilatierter Dünndarmschlingen bei einem Fohlen mit Volvolus mesenterialis.

Fig. 2b: Radiographic finding of large colon distension in a foal with nephrosplenic entrapment.

Radiologischer Nachweis von aufgegastem Dickdarm bei einem Fohlen mit Milz-Nieren-Band Verlagerung.

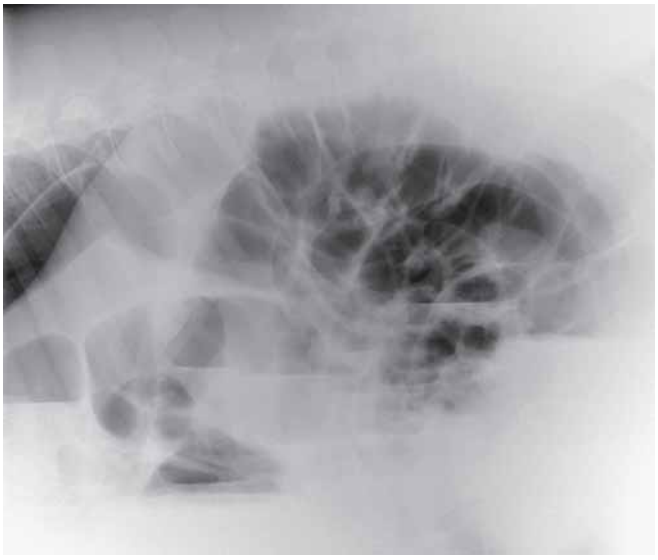

Fig. 2c: Radiographic finding of small colon distension in a foal with retained meconium.

Röntgenologischer Nachweis von aufgegastem Colon descendens bei einem Fohlen mit Mekoniumverhaltung.

Lateral radiographic views of the abdomen (96 kV, 8 mAs) using the technique described by *Gerhards et al. (1990)* were obtained from 41 foals with digitalized radiography (Philips Computed Radiography).

Laboratory evaluation included packed cell volume, total plasma protein, white cell count and serum concentrations of glucose, sodium, chloride, potassium, creatinine and urea. Furthermore, blood gas analysis was performed. Cytology, total leucocyte count and total protein determination were evaluated from peritoneal fluid. In foals with suspected uroperitoneum, peritoneal fluid creatinine concentration was measured and compared to the serum creatinine concentration.

Pre- and perioperative therapy included antimicrobial medication with amoxicillin (Amoxicillin pro inj., Fa. Serum-Werk Bernburg) 10 mg/kg bw intravenously, subcutaneous low dose heparinization and anti-endotoxemic and single antiinflammatory medication with flunixin meglumine 1 mg/kg bw iv (Finadyne®

Fig. 3: Abdominocentesis in the standing and fixed foal.

Abdominozentese am stehenden und fixierten Fohlen.

Fa. Essex). Tetanus prophylaxis was achieved with intramuscular administration of 7500 IU tetanus serum (Equilis› Tetanus-Serum, Fa. Intervet). Hydration and electrolyte balance was maintained with intravenous infusion of Ringer's solution or saline solution in cases of uroperitoneum and serum hyperkalaemia. Preoperative treatment of uroperitoneum with severe abdominal distension and serum hyperkalemia also included evacuation of excessive free abdominal fluid through a surgically inserted Foley catheter (Fig. 4).

Fig. 4: Drainage of excessive abdominal fluid through a foley catheter in a foal with uroperitoneum prior to abdominal surgery.

Präoperative Drainage freier Bauchhöhlenflüssigkeit durch einen Foley Katheter bei einem Fohlen mit Uroperitoneum.

Anaesthesia varied depending on the age of the foal according to *Otto (1992)*.

Sedation before anaesthesia was obtained in neonatal foals with an intravenous administration of 0,05–0,1 mg/kg bodyweight Diazepam (Diazepam›ratiopharm, Fa. Ratiopharm). General anaesthesia was induced and maintained with oxygenized isoflurane (Forene› Fa. Abbott or Isoflo›, Fa. Essex).

Foals aged more than four weeks were sedated with 1,1 mg / kg bw Xylazin (Rompun›, Fa. Bayer Vital) intravenously, anaesthesia was achieved with 2,2 mg/kg bw Ketamin (Narketan›, Fa. Chassot) iv and was maintained with isofluran in oxygen following intubation.

Depending on the results of the presurgical examination, laparotomy was performed by median, paramedian or inguinal incision with the foal positioned in dorsal recumbency.

In neonatal foals, the umbilicus or the umbilical remnants were completely resected following ligation of the umbilical vessels. Intraabdominal exploration, manipulations and surgical procedures were performed as dictated by the case and included correcting the position of the intestine, decompression, enterotomy or resection of nonviable sections of small intestine. Enterotomies of the large colon were performed in the pelvic flexure and those of the small colon in cases of retained meconium through the anti-mesenteric tenial band. Cystorrhapy had to be done in case of uroperitoneum due to bladder rupture (Fig. 6). During the surgical procedures exposed viscera were handled gently and were rinsed with warm saline solution. Peritoneal lavage was performed after completion of the procedures with heparinized saline solution.

Fig. 5: Intraoperative finding of an atresia coli in a foal.

Intraoperativer Befund einer Atresia coli bei einem Fohlen.

Fig. 6: Intraoperative finding of a dorsally ruptured bladder in a foal with uroperitoneum.

Intraoperativer Befund einer dorsal rupturierten Harnblase bei einem Fohlen mit Uroperitoneum.

The linea alba was closed with 5 metric Dexon› (Fa. Braun-Dexon) in a continous or interrupted pattern. The skin was apposed with 3 metric Supramid (Fa. Braun-Dexon).

Depending on the results of laparotomy, some foals had to be euthanized intraoperatively due to poor prognosis.

Postoperative management included close monitoring, and continuation of the antimicrobial and anticoagulative treatment. Cimetidin (H2-Blocker ratiopharm›, Fa. Ratiopharm, 5mg/kg

bw qid per os) was administered depending on clinical signs of gastric disease.
In case of fatal postoperative complications such as recurrent colic, paralytic ileus, sepsis or endotoxic shock the foals had to be euthanized.
Following complete recovery foals were discharged from the clinic.
Survival rates were calculated for all foals undergoing surgery and for those which recovered from anaesthesia. Survival was defined as released from the clinic.

Results

Pre-surgical evaluation
Of the 83 foals in this study, 39 were females and 44 were males. Breeds included warmblooded horses, thoroughbreds, trotters, arabians and ponies with the warmblooded horses the predominant breed.
Preoperatively, persistent pain of varying degree and abdominal discomfort and distension were noticed in all the foals. Physical examination, in particular palpation of the scrotum or abdominal wall, allowed the diagnosis of incarcerated umbilical hernia or scrotal hernia (Fig. 1) in one respectively five cases.
Abdominocentesis was performed in 40 foals (Fig. 3). Of the 18 foals with a total protein in the abdominal fluid greater than 25g/l, 14 had to be euthanized intra- or postoperatively. In contrast to tht, only three of the 22 foals with a total protein lower than 25 g/l had to be euthanized.
Abdominal radiographic views were obtained in 41 foals and were found to be helpful in determining the location but not the cause of a strangulation or an obstruction. Small intestinal distension could be clearly distinguished from large intestinal meteorism. In 33 foals a diagnosis of small intestinal distension (Fig. 2a), large intestine meteorism (Fig. 2b) or retained meconium (Fig. 2c) could be made according to the parameters that have been described by *Gerhards et al. (1990)*. Three foals had radiographic evidence of uroperitoneum because excessive abdominal fluid was visualized.
The peritoneal fluid:serum creatinine ratio was more than 2:1 in all the foals with surgically confirmed uroperitoneum (n=8). In 22 foals the cause of the acute abdomen or location of the intraabdominal lesion could not be determined preoperatively.

Surgical findings
Surgical findings of 83 foals included small intestinal ileus in 41 foals, lesions of the large intestine in 25 foals, uroperitoneum as a result of bladder rupture (Fig. 6) in seven foals and as a result of congenital bladder defect in one foal as well as other findings (peritonitis, perforated gastric ulcers, ovaric torsion). Detailed findings are listed in table 1.

Survival rates
Depending on the location and the quality of intraabdominal lesions, survival rates differed markedly (table 2).

Of the 83 foals that underwent abdominal surgery, 49 (59 %) could be discharged from the clinic. 21 foals had to be euthanized intraoperatively due to poor prognosis which results in a survival rate of 79% in foals that were allowed to recover from surgery.

Tab. 1: Surgical findings and survival rate in 83 foals undergoing abdominal surgery because of an acute abdomen aged less than six months

Intraoperative Befunde und Überlebensrate von 83 Fohlen mit einem Alter unter sechs Monaten und Durchführung einer Laparotomie aufgrund eines akuten Abdomen

findings	n	released
small intestine		
volvolus mesenterialis	16	5
volvolus nodosus	11	6
intussusception	4	2
hernia mesenterialis	3	0
hernia scrotalis incarcerata	5	5
hernia umbilicalis incarcerata	1	1
hernia foraminis epiploici	1	0
large intestine		
retained meconium	15	13
torsio coli	3	2
hernia spatii renolienalis	1	1
invaginatio caecocolica	1	0
large colon impaction	2	2
small colon impaction	2	2
atresia coli	1	0
urogenital tract		
uroperitoneum male	5	4
uroperitoneum female	3	3
ovarian torsion	1	1
others	8	2

Discussion

In this study, severe abdominal pain and abdominal distension in foals were the primary indications for a surgical intervention. Another indication was persisting pain following a single spasmoanalgetic treatment with metamizol (Novalgin®, Fa. Intervet) or butylscopolamin (Buscopan®, Fa. Boehringer) without a definite diagnosis of non strangulating disease.

Abdominal radiography was found to be useful in locating the site of lesion but differentiation of mechanical from functional ileus was judged to be difficult as has been pointed out by *Adams et al. (1988)*. For that reason, radiographic findings of small intestinal distension (Fig. 2a) combined with abdominal pain were taken as a clear indication for surgical exploration.
In all foals with radiographic findings of small intestinal distension described in this study, a mechanical ileus of the small intestine was present during abdominal surgery.

Tab. 2: Outcome in foals with acute abdomen following surgery depending on location of lesion.

Klinischer Ausgang bei Fohlen mit akutem Abdomen nach Laparotomie in Abhängigkeit vom Ort der Erkrankung.

findings	n	euthanasia		released
		intra op.	post op.	
small intest. ileus	41	15	7	19 (46%)
large intest. lesion	25	1	4	20 (80%)
uroperitoneum	8	1	-	7 (87%)
others	9	4	2	3 (33%)
total	83	21	13	49 (59%)

Following severe clinical signs of acute abdomen due to an ileus, foals may rapidly develop a state of indolence, which can be mistaken as a recovery from colic or a result of a successful medical treatment. According to *Orsini (1997)* a reserved approach can carry as much risk as explorative surgery.
The high percentage of foals which had to be euthanized during surgery may indicate the problem of distinguishing medical from surgical cases of colic and missing the point for a successful surgical intervention.
Consequently, a shorter duration of clinical signs may contribute to an improved survival rate.
Once foals recovered from anaesthesia, survival rate was found to be high with 79%.
In the foals described here, the effects of anatomic location of the surgical lesion on recovery from anaesthesia and survival rate were similar to those recorded from prior studies. In addition, a high mortality rate in foals with strangulating small intestinal lesion and vascular compromise has been reported previously *(Adams et al. 1988; Singer and Livesey 1997; Vatistas et al. 1996)*.
Apart from common findings like small intestinal volvolus or retained meconium some rare surgical lesions such as atresia coli (Fig. 5) or ovarian torsion could be discovered in foals presented with acute abdominal pain.
Despite previous studies stating that uroperitoneum is usually seen in male foals *(Adams and Koterba 1988)*, foals of both sexes were compromised in this study with a homologous distribution. Foals with uroperitoneum presented as surgical emergencies had a good prognosis following adequate medical treatment and suc-cessful repair of the bladder defect.
In general, the prognosis for foals with genitourinary tract problems was found to be more favorable than for foals with gastrointestinal lesions.
With advances in anaesthesia, surgery and medical care, operative management of acute colic in the foal has become increasingly common with a fair prognosis.

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