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**A RETROSPECTIVE STUDY OF PERITONEAL FLUIDS IN
COWS WITH ABDOMINAL DISORDERS*****RETROSPEKTIVNA STUDIJA PERITONEALNIH TEČNOSTI KOD
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At the Clinic for Ruminants in Ljubljana, an investigation of peritoneal fluid in cows that stretched over 30 years was conducted. A total of 779 cows were studied; 444 had hardware disease, 212 had left abomasal displacement, 98 cows had right abomasal displacement with or without abomasal torsion, and 25 cows had problems with the uterus. Abdominocentesis, macroscopic and microscopic examination of peritoneal fluid (physical appearance, differentiation to transudate/exudate, cytological characteristics) offered valuable diagnostic information. On the basis of the results of 779 laboratory examinations, we have come to the conclusion that abdominal fluid is of significant diagnostic, therapeutic and prognostic value for several acute and chronic abdominal diseases.

Key words: abdominocentesis, abdominal disorders, cow, peritoneal fluid

Introduction / Uvod

Abdominal problems are one of the most important diseases in cattle around the world and also in Slovenia (Radostits *et al.*, 2007; Zadnik and Jazbec, 1996). Clinicians pay them special attention. At our Clinic, we have always supported surgical treatment (clinical-laparorumenotomy) of abdominal disorders (Zadnik and Jazbec, 1996). Most diagnoses are made after a clinical examination and history taking. Coupled with a conscientious history, the physical examination will permit a relatively accurate diagnosis in most abdominal problems. Laboratory tests and other ancillary examinations are best viewed as adjuncts to traditional, low technology diagnostic approaches (Radostits *et al.*, 2000; 2007). Ab-

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dominocentesis (abdominal paracentesis) is a surgical puncture into the abdominal cavity for the aspiration of fluid. Abdominocentesis of the abdomen includes obtaining a sample of peritoneal fluid when peritonitis or inflammation of serosae of the intestines or other viscera of the abdomen is suspected (Oehme and Moorsdy, 1970; Radostits *et al.*, 2000; 2007). Peritoneal fluid reflects the pathophysiological state of the parietal and visceral mesothelial surfaces of the peritoneum (Hosgood and Salisbury, 1989; Radostits *et al.*, 2007; Zadnik, 2000). Furthermore, it is of vital importance in the diagnosis of abdominal disorders in cows (Frame and Cert, 1997; Zadnik, 2000; Wilson *et al.*, 1985). Today, abnormal peritoneal fluid in cows is a highly sensitive indicator of peritoneal diseases, but not a good indicator of the nature of the diseases (Anderson *et al.*, 1995; Kopcha and Schultze, 1991; Radostits *et al.*, 2000; Wilson *et al.*, 1985).

The use of abdominal fluid as an aid to diagnose abdominal diseases has been well documented (Hanson *et al.*, 1992; Hosgood and Salisbury, 1989; Oehme and Moorsdy, 1970; Radostits *et al.*, 2000; 2007). A normal small quantity of peritoneal fluid in the abdomen of an adult cow does not mean that the carrying out of abdominocentesis has no diagnostic value. Peritoneal fluid changes quantitatively as well as qualitatively, especially in more serious diseases of abdominal organs (Hirsch and Townsend, 1982; Hosgood and Salisbury, 1989; Oehme and Moorsdy, 1970). There is also extensive description of normal bovine peritoneal fluid (Anderson *et al.*, 1995; Radostits *et al.*, 2007). Healthy and not pregnant cows have about 15–20 ml of peritoneal fluid (Anderson *et al.*, 1995; Oehme and Moorsdy, 1970). Normal peritoneal fluid is amber and crystal clear – transudate (Hirsch and Townsend, 1982; Radostits *et al.*, 2000; 2007). Peritoneal fluid analysis was a very useful aid in clinical examinations and the correct diagnosis of abdominal disorders, especially if it was not possible to carry out blood tests (Oehme, 1969; Radostits *et al.*, 2000).

In cows, the choice of sites for abdominocentesis is a problem because the rumen covers such a large portion of the ventral abdominal wall and avoiding its penetration is difficult. The most profitable sites are those that, on an anatomical basis, consist of recesses between the fore stomachs, abomasum, diaphragm and liver. These are usually caudal to the xyphoid sternum and 4 – 10 cm lateral to the midline (Radostits *et al.*, 2000; 2007; Wilson *et al.*, 1985).

The aim of this paper was to present the results of a retrospective study of peritoneal fluid. Examinations of cows with abdominal disorders were carried out in our Clinic according to our routine procedure of left or right exploratory laparotomy (Zadnik *et al.*, 1992). Our collection technique, physical evaluation and fast laboratory analysis of abdominal fluids in cows with most frequently abdominal disorders have been described.

Material and methods / *Materijal i metode rada*

All abdominal fluid samples (n = 779) collected from the clinical cases admitted to the Clinic for Ruminants of the Veterinary Faculty (Slovenia) during the years 1976 to 2009 were retrospectively analyzed. All samples collected have been subsequently subjected to the routine clinical method according to left or right side exploratory laparotomy (Zadnik *et al.*, 1992).

Techniques for collection of abdominal fluid /

Tehnike za sakupljanje abdominalne tečnosti

The choice of region for abdominocentesis and the technique for collection of fluid we used were described by Kopcha and Shcultze (1991), Zadnik (2000) and Radostits *et al.* (2000; 2007). Fluid was collected from the cows in a standing position, restrained with nose tongs and a lift-grip of the tail. According to the history of the disease and the clinical signs, we carried out abdominocentesis in two regions.

1. The right cranio-ventral region is located 4–8 cm caudal from the xyphoid sternum and 5 to 8 cm lateral and right from the midline.

2. The left cranio-ventral region is located 4–8 cm caudal from the xyphoid sternum and 5 to 8 cm lateral and left from the midline.

Preparation of the abdominocentesis region was clipped; the skin is prepared aseptically and surgically prepared. For abdominocentesis we used with care and caution a 16 gauge and 5 cm hypodermic needle. The needle is pushed carefully and slowly through the abdominal wall, which will twitch when the peritoneum is punctured. Fluid may drip from the cannula or it may be necessary to connect a syringe to apply a vacuum. It may be necessary to move the cannula back and front in a few different directions before fluid is obtained. The fluid obtained was collected in a small tube containing ethylene diamine tetra acetic acid (EDTA), to avoid clotting and analyzed about 10 minutes after collation.

Laboratory evaluation of abdominal fluid /

Laboratorijska evaluacija abdominalne tečnosti

Three parameters of the abdominal fluid were examined: (a) physical appearance (b) differentiation to transudate or exudate and (c) cytological characteristics.

a. With physical appearance of abdominal fluid, its color, transparency, density and smell were evaluated. The fluid density was determined with a hand refractometer.

b. The differentiation of peritoneal fluid on transudate or exudate was made by Rivalta test (Marek and Mocsy, 1956; Žemva and Žemva Mimica, 1960).

c. Peritoneal fluid cytology was evaluated with a microscopic examination. The droplet of the original fluid sample was covered with micro cover glass and examined by microscopy (10x40) to present mesothelial cells, red blood cells, leukocytes and bacteria.

Classification of peritoneal fluids / Klasifikacija peritonealnih tečnosti

The results of these three analyses were classified in six categories (Table 1):

1. Negative or normal findings (-): fluid is transudate, crystal clear to pale yellow in color, without odor, specific gravity 1.005 do 1.015; in the course of the microscopic examination of droplet native peritoneal fluid we did not find mesothelial cells, red blood cells, lymphocytes, neutrophils and bacteria; the Rivalta test for differentiation of peritoneal fluid to transudate or exudate was negative.

2. Suspected findings – weak inflammation (\pm): fluid is transudate, pale yellow in color, without odor; during the microscopic examination of droplet of native fluid we found single mesothelial cells, red blood cells, lymphocytes, neutrophils and bacteria; the Rivalta test was negative.

3. Positive findings – moderate inflammation (+); is exudate, amber to turbid yellow color fluid, specific gravity > 1.025 , during the microscopic examination of droplet of native fluid we found from 2 to 4 lymphocytes or leukocytes, single blood cells and bacteria; the Rivalta test showed suspected findings.

4. Positive findings – inflammation ($++$); fluid is exudate: turbid amber to pink in color, specific gravity from 1.025 to 1.055, during the microscopic examination of droplet of native fluid we found from 4 to 10 lymphocytes or neutrophils, 5 to 8 red blood cells, some mesothelial cells and bacteria. The Rivalta test was positive.

5. Strong positive findings - severe inflammation ($+++$); serous sanguineous, turbid, pus, viscous fluid with fibrin, specific gravity > 1.055 , during the microscopic examination of droplet of native fluid we found from 8 to 15 lymphocytes or leukocytes, few mesothelial cells, red blood cells and bacteria; the Rivalta test was strongly positive.

6. Useless; full blood, rumen fluid, amnion or allantoids fluid.

Results / Rezultati

Table 1 shows the results of the retrospective study of abdominal fluids in cows with abdominal disorders. The examination of the cows was carried out at our Clinic from 1979 to 2009. Definitive diagnosis was determined after routine exploratory laparotomy.

Table 1. Results of peritoneal fluid examination associated with the diagnosis of the diseases of cows (n = 779) admitted to the Clinic for Ruminants in 1979 – 2009 /
 Tabela 1. Rezultati ispitivanja peritonealne tečnosti u vezi sa dijagnozom bolesti krava (n = 779) primljenih na Kliniku za preživare tokom 1979 – 2009.

Diagnosis / Dijagnoza (n = 759)	Number and % of cows / Broj i % krava	% of negative fluid / % negativne tečnosti (-)	% of suspect fluid (±) Weak inflammation / % sumnjive tečnosti (±) Blaga upala	% of positive fluid (+) Moderate inflammation / % pozitivne tečnosti (+) Umerena upala	% of positive fluid (++) Inflammation / % pozitivne tečnosti (++) Upala	% of strong positive fluid (+++) Severe inflammation / % snažno pozitivne tečnosti (+++) Jaka upala	% of useless / % neupotrebljivih
Foreign body ¹ / Strano telo ¹	444 (55.9%)	1.7	3.1	13.3	29.0	47.7	5.2
LDA ²	212 (27.9%)	12.2	20.1	43.1	5.3	6.0	13.3
RDA/AV ³	98 (12.9%)	0.0	6.1	14.2	27.2	40.6	11.9
Uterus ⁴	25 (3.3%)	0.0	1.5	9.8	32.2	52.5	4.0

¹foreign body and related diseases / strano telo i povezane bolesti;

²Left-side displacement of the abomasum / dislokacija sirišta na levo;

³Right-side displacement of the abomasum with or without abomasal volvulus / dislokacija sirišta na desno sa ili bez torzije sirišta;

⁴Rupture and uterine torsion / pucanje i torzija uterusu

Discussion / Diskusija

The results in Table 1 show that a foreign body was the commonest disease of the alimentary tract in cows treated at our Clinic.

Peritoneal fluids can be analyzed to aid in diagnosis. The surface of parietal and visceral peritoneum is 1.5 larger than the surface of the skin (Hosgood and Salisbury, 1989; Radostits *et al.*, 2007). Fluid that is normally found in abdominal cavities is characteristically low in protein and contains few cells. It is thought to be an ultra filtrate of plasma, and the mesothelial lining cells may regulate the fluid flow (Hosgood and Salisbury, 1989). Complete fluid analysis includes protein measurement, cell count, and the types of cells present (Hirsch and Townsend, 1982; Hosgood and Salisbury, 1989; Radostits *et al.*, 2000; 2007). According to findings in literature, peritoneal fluid is of lesser diagnostic value in cattle (Radostits *et al.*, 2000, 2007; Rosenberger, 1979). The cause of this is a low amount of fluid, the site and type of inflammatory reaction, an inadequate technique for collection, and an inexperienced clinician. In cows, abdominal disorders are predominantly without distinct signs for a longer period of time. Therefore it is recommended to carry out abdominocentesis repeatedly in accordance with the course of the disease and the clinical picture (Frame and Cert, 1997; House *et al.*, 1992; Samad *et al.*, 1994a; 1994b).

Adominocentesis which is performed to the most ventral part of the abdomen close to the linea alba is usually ineffective, because abdominal fluid is obtained instead of rumen fluid (Kopcha and Schultze, 1991; Zadnik, 2000; Wilson *et al.*, 1985). Wilson *et al.* (1985) report that abdominocentesis within this area in 85 cows with traumatic reticuloperitonitis was successful only in one case. With regard to our extensive experiences and the results of the study by Kopcha and Schultze (1991), we recommend that abominocentesis in cows with hardware and the diagnosis of anterior abdominal pain is performed 5-8 cm caudally from regio xyphoidea, approximately 5 cm to the left or right from the linea alba.

The sample of peritoneal fluid is an indicator of the pathophysiological status of the parietal and the visceral surface of mesotelial layers of the peritoneum. On the basis of analyses of the obtained results, extensive clinical and laboratory experiences, we are of the opinion that the diagnosis of abdominal disorders is incomplete without physical and microscopic analyses of peritoneal fluid. The collection and analysis of peritoneal fluid is simple, as it does not require special knowledge or equipment. It is merely an everyday clinical routine. The technique for collection is quick and therefore not invasive. The sedation of the cow is not necessary because penetration of the canulla is similar to s/c, i/m or i/v application of medicine. Nevertheless, the clinician should be aware that it is a surgical procedure and that septic and antiseptic principles must be observed. We recommend that the indication of the location and reversibility of abdominocentesis are determined by the clinicians themselves with regard to the current clinical status of the animal.

Cranio-ventral location of puncture on the left hand site was mostly performed in cows with symptoms of anterior abdominal pain (hardware). Caudo-ventral location of puncture on the right hand site of the abdominal wall was mostly performed in cows with symptoms of diseases of the abomasum and other abdominal disorders.

Conclusion / Zaključak

On the basis of extensive experiences and the data in our study of 779 clinical cases, abdominocentesis and abdominal fluid analyses proved as an effective tool in everyday buiatric practice. Abdominocentesis and abdominal fluid analyses are quick, simple and reliable. Because abdominocentesis and peritoneal fluid analyses are not only a reliable diagnostic but also a valuable surgical method of treatment of all abdominal diseases in cattle, we highly recommend it.

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SRPSKI

RETROSPEKTIVNA STUDIJA PERITONEALNIH TEČNOSTI KOD KRAVA SA POREMEĆAJIMA ABDOMENA

T. Zadnik

Na Klinici za preživare u Ljubljani, vršena su ispitivanja peritonealne tečnosti kod krava tokom 30 godina. Ispitano je ukupno 779 krava: 444 krave su imale traumatski retikuloperitonitis, 212 je imalo levu dislokaciju sirišta, 98 krava je imalo desnu dislokaciju sirišta, sa ili bez torzije sirišta, i 25 krava je imalo probleme sa matericom. Abdominocenteza, makroskopska i mikroskopska istraživanja peritonealne tečnosti (fizički izgled, diferencijacija na transudat/eksudat, citološke karakteristike) pružili su dragocenu dijagnostičku informaciju. Na osnovu rezultata 779 laboratorijskih ispitivanja zaključili smo da abdominalna tečnost ima značajnu vrednost kod postavljanja dijagnoze, određivanja terapije i prognoze kod nekoliko akutnih i hroničnih bolesti abdomena.

Ključne reči: abdominocenteza, poremećaji abdomena, krava, peritonealna tečnost

РЕТРОСПЕКТИВНОЕ ИЗУЧЕНИЕ ПЕРИТОНЕАЛЬНЫХ ЖИДКОСТЕЙ У КОРОВ С РАССТРОЙСТВАМИ АБДОМЕНА

Т. Задник

На Клинике для жвачных животных в Любляне, совершены испытания перитонеальной жидкости у коров в течение 30 лет. Испытано совокупно 779 коров: 444 коровы имели травматический ретикулперитонит, 212 имели левую дислокацию сычуга, 98 коров имели правую дислокацию сычуга с или без торсии сычуга, и 25 коров имели проблемы с маткой. Абдомиоцентез, макроскопические и микроскопические исследования перитонеальной жидкости (физический вид, дифференциация на трансудат) экссудат, цитологические характеристики) подали ценную диагностическую информацию. На основе результатов 779 лабораторных испытаний мы сделали вывод, что абдоминальная жидкость имеет значительную стоимость у поставления диагноза, определения терапии и прогноза у несколько острых и хронических болезней абдомена.

Ключевые слова: абдомиоцентез, расстройства абдомена, корова, перитонеальная жидкость