



Review on Traumatic reticulopericarditis in Cattle

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Abstract

Traumatic reticulopericarditis occurs due to the ingestion of foreign bodies that penetrate the reticulum towards the diaphragm and then the pericardium, resulting in traumatic pericarditis. Indiscriminate eating habits and the mechanization of food are predisposing factors. The most common clinical signs are tachycardia, distention of the jugular veins, mufed heart sounds and submandibular, brisket and ventral edema. However, they are present in several pathologies. To address this problem, there are different diagnostic techniques devised such as rumenotomy, radiography and laparotomy are considered useful methods for making an early diagnosis. The prognosis is unfavorable and treatment is generally unsatisfactory, and proper management of this disorder is essential to prevent major losses.

Keywords: traumatic, pericarditis, foreign body, cattle, treatment

1. Introduction

Traumatic reticulopericarditis is one of the major problems encountered in cattle resulting in greater economic loss to the community and causes mortality. Traumatic pericarditis is most commonly reported in cattle and bufaloes (Attia, 2016), but it has description in goats (Akkoc, 2007), sheep (Torki et al., 2011). Cattle and buffalo have unique mouth anatomy and due to their long prehensile tongue, they grasp feed without any selection of the feed items. Due to their unselective feeding habit, foreign bodies, metallic or non-metallic, mixed with the feed often make entry into their stomach(Misk et al. 2001).

The small distance between the reticulum and the pericardium facilitates the perforation of these by a contaminated foreign body resulting in traumatic pericarditis (Athar et al., 2012). Pericarditis is usually caused by long, thin sharp foreign bodies like binding wire, needle and nails that penetrate the reticulum, diaphragm and pericardial sac resulting in traumatic reticulopericarditis (Braun, 2009).

Greater than 99% of foreign bodies injure the reticulum, and although rare, injury to the abomasum (Nuss et al., 2004), duodenum and jejunum (Egle et al., 2007) has been reported and it also cause pericardial disorder in cattle (Bexiga

et al., 2008) and is associated with progressive disturbances in heart function and almost always results in death. Pericarditis attributable to haematogenous spread of infectious diseases (such as colibacillosis, pasteurellosis, salmonellosis and anaerobic infections) is much less common and is usually masked by signs of septicaemia (Grunder, 2002). The presence of a mixed bacterial infection of the reticulum causes severe local inflammation, with accumulation of serous or fibrinous inflammatory products, which can subsequently trigger toxemia and heart failure, being lethal in most cases (Constable et al., 2017).

The disorder results a great economic losses due to the marked decrease in production, cost of treatment, fetal losses and potential fatalities, usually associated with progressive disturbances in cardiac function (Attia, 2016). Due to its importance in health and animal production, traumatic reticulopericarditis is still a matter of worldwide concern. So that the objective of the present review was to highlight the recent advances in relation to the disease in cattle.

2. Literature Review

2.1. Etiopathogenesis

Traumatic reticulopericarditis is one of the main complications of ingesting long, thin and sharp foreign bodies, such as needles, pieces of wire, wood splinters and nails that can penetrate the reticulum, diaphragm, peritoneum, pericardial sac, resulting in pericarditis traumatic (Mohamed, 2010). Cattle do not have proper oral discernment, are not very selective and cannot distinguish metallic objects in food mixes. These materials can stick to the reticulum mucosa due to their anatomical conformation in a honeycomb shape without causing damage, however reticular physiological contractions, pressure of the fetus in advanced gestation and uterine contractions at the time of delivery, promote penetration of the wall reticular (Ghanem, 2010; Anteneh and Ramswamy, 2015).

The targeting of the foreign body when perforating the reticulum causes injuries in several adjacent organs and allows the content to leak into the thoracic or peritoneal cavity (Abdelaal, et al., 2009; Khalphallah et al., 2017). Pericarditis is an inflammation of the pericardium that occurs after trauma, causing an accumulation of serous and fibrinous inflammatory products in the pericardial sac (Kumar et al., 2012; Yildiz et al., 2019). This is divided into three general forms, effusive, fibrinous and constrictive, and their combinations can occur (Athar et al., 2012). The effusive consists of the accumulation of liquid with proteins inside the pericardial sac, the fibrinous is triggered by the posterior deposition of fibrin, while the presence of fibrinous tissue in the pericardium or epicardium, result in constrictive due to the progressive loss of ventricular elasticity (Pekins et al., 2004; Athar et al., 2012). As the effusion develops, the accumulated fluid compresses the atria and the right ventricle, thus, there is no complete filling of the organ, causing congestive heart failure (Sasikala et al., 2018). In addition, the absorption of toxins leads to toxemia, resulting in death in most cases (Braun, 2009; Constable et al., 2017)

2.2. Clinical signs

Clinical signs vary, depended to the severity of the disease and the extent of the lesions (Mohamed, 2010). The primary clinical sign observed is tachycardia, however it is not specific, as it is present in several physiological or pathological conditions (Attia, 2016). Muffling of cardiac sounds, asynchronous cardiac sounds, oedema in the submandibular, brisket and ventral region, positive venous pulse and distention of the jugular vein may be characteristic (Braun, 2009;). Anorexia, depression, weight loss, increased body temperature, pale or congested mucous membranes, with increased capillary filling time, tachypnea, bruxism, abdominal pain, abduction of thoracic members and reluctance to move have also been reported (Singh et al., 2019).

The most important complications of TRP are traumatic pericarditis (Braun et al., 2009), hepatic inflammation or abscesses, splenic inflammation or abscesses (Nuss et al., 2009), pleuropneumonia, vagal indigestion ((Dirksen, 2002). There also have been reports of cardiac tamponade following foreign body-induced perforation of a coronary artery, fatal reticular haemorrhage after puncture of the reticular vein by a foreign body (Constable et al., 2017), thrombosis of the cranial vena cava and aortic thromboembolism(Gerspach et al., 2011).

Braun (2009) describes that tachycardia can be mild or severe above 130 beats per minute (bpm) depending on the degree of heart compression by pericardial effusion. The increase in body temperature and tachypnea are suggestive of a systemic reaction, possibly related to a toxemia due to foreign body injury (Ghanem, 2010). Associated with brisket oedema and positive venous pulse, the suppurative stage of pericarditis occurs, in which there is a reduction in myocardial contractility (Khalphallah et al., 2017) Clinical pathology Laboratory tests are useful tools to auxiliary in diagnosis. In hematological evaluation, anemia occurs because to different degrees of dehydration, blood loss during penetration of the object or as result of the chronic inflammatory process (Braun et al., 2018). The serum increase in total plasma protein and fibrinogen is observed as a hepatic response due to severe, but not exclusive inflammation of this disease (Ghanem, 2010; Habasha and Yassein, 2014; Attia, 2016; Braun et al., 2018). The glutaraldehyde test is a non-specific inflammation indicator due to the increase in fibrinogen and globulin, being a useful method used to differentiate inflammatory from noninflammatory heart failure (Braun, 2009).

Leukocytosis with neutrophilia are commonly described and attributed to the inflammatory or infectious response caused by foreign body penetration (Braun, 2009). According to Habasha and Yassein (2014), these changes associated with monocytosis are present in cattle with chronic peritonitis. In serum biochemistry, hyperproteinemia, hyperglobulinemia and

hypoalbuminemia are described due to the characteristic inflammatory response (Hussein and Staufenbiel, 2014). Albumin reduction occurs by prioritizing the synthesis of acute phase proteins by the liver, in order to prevent inflammation and contribute to healing (Cray et al., 2009).

The increase in the glutamyl transferase (GGT), aspartate aminotransferase (AST), serum bilirubin, dehydrogenase enzyme (LDH) e creatine kinase (CK) were also reported (Ghanem, 2010; Abu-seida and Al-abbadi, 2016; Sasikala et al., 2018). Braun (2009) suggests that elevations in serum concentrations of liver enzymes generally indicate chronic lesions associated with right heart failure with secondary hepatic congestion. The reduction of protozoa in the analysis of ruminal content is notable (Sasikala et al., 2018). Abdominocentesis can be valuable when the lesion is not located and reveal the presence of inflammatory cells with a predominance of neutrophils in the cytological analysis (Wittek et al., 2010). In pericardiocentesis, a protein concentration >3.5 g / dL, leukocyte count >2500 / μ L, straw yellow to reddish, foamy and foul odor pericardial fluid are characteristics of the disease (Elhanafy and French, 2012).

2.3. Diagnosis

Traumatic reticulo-peritonitis is diagnosed mainly on the basis of physical examination and diagnostic imaging, and is aided by laboratory work in less obvious cases. In absence of an accurate history and when the condition has been present for several days, diagnosis becomes more difficult. Peritonitis arising with other causes particularly perforated abomasal ulcers becomes difficult to distinguish from TRP (Constable 2015). As mentioned above, TRP can also result from foreign penetrating abomasum, duodenum and jejunum. Abdominocentesis: Abdominocentesis, performed blindly or under ultrasound guidance, offers a valuable diagnostic aid in evaluation of peritoneal fluid (Solcan et al. 2018). Peritoneal fluid amount, colour, transparency, odour, consistency and presence or absence of other materials is assessed (Braun

2016). Elevated total solids and white blood cell numbers supports peritonitis.

Clinical findings provide also a preliminary diagnosis, but may be present in several pathologies, requiring additional tests to confirm the disease. Foreign body tests such as withers clamping, painful percussion on the reticulum with a rubber hammer and pole test are important when foreign bodies are suspected of being ingested, being more common in cattle when compared to buffaloes (Braun et al., 2007). Eventually, characteristic lesions of traumatic reticulopericarditis observed in on postmortem examination supply the diagnosis (Braun, 2009).

2.3.1. Electrocardiography

The electrocardiography (ECG) is an important parameter for an animal with cardiovascular disorders (Reddy et al., 2015). Decreased amplitude of the QRS complex, electrical alternation (configuration of the P, QRS or T complexes regularly) and distortion or elevation in the ST segment are common ECG changes in cases of traumatic pericarditis (Tharwat, 2011).

2.3.2. Radiography

Radiography is the best test for confirming metallic foreign body, the current location or its penetration of the reticulum or rarely rumen, the presence and size of perireticular abscesses (Fubini and Divers 2008). The sensitivity and specificity of radiography in detecting TRP was 83% and 90%, respectively (Partington and Biller 1991). A linear foreign body that is at least 1 cm long is considered clinically relevant (Partington and Biller 1991). Bovine abdominal radiographs with a high probability of TRP is usually presented with readily recognized lesions, including large unattached metallic foreign bodies outside the reticular contour (Partington and Biller 1991). A perireticular gas shadow or gas fluid interface strongly suggests a perforating foreign body and infection with gas producing and pyogenic bacteria (Braun et al. 2020).

These foreign objects may or may not be adjacent to focal perireticular gas collections which represent a partially gas filled abscess (Partington and Biller 1991). These gas collections may be present ventrally in the cranial reticular area adjacent to the diaphragmatic line or superimposed over the reticulum (Athar et al. 2010). However, radiography isn't considered as a reliable tool for the diagnosis of reticular abscess in bovines (Saini et al. 2005, Kumar et al. 2008, Athar et al. 2010). Ancillary aids therefore help determine the need or approach for surgery, and prognosticate more specifically than possible without this ancillary aid (Fubini and Divers 2008).

Laterolateral radiographic images are obtained from the thorax and the caudoventral reticulum with the animal standing, but for accurate localization of a foreign body, a dorsoventral view is necessary, which cannot be performed in adult cattle due to the great depth of the thorax (Braun, 2009). Furthermore, right or left lateral radiographs of the cardiac and reticular area of the decubitus animals are also reported (Athar et al., 2012). In the left lateral decubitus, it is possible to notice the cardiac silhouette and the diaphragm outline and obscured, showing opaque areas (Misk and Semieka, 2001). Despite, to avoid complications such as the spread of infections in the affected animals, it is advisable to perform the examination standing (Abu-seida and Al-abbadi, 2016).

Radiographic changes may not be detected in early pericarditis and if there is a concomitant large amount of pleural fluid, it is not possible to differentiate it from pleuritis (Imran et al., 2011). Radiography shows loss of thorax details, changes in heart shape and opacity, and radiopaque foreign bodies, such as needles and other metallic objects, can be observed, perforating the reticle, diaphragm or heart (Khalphallah et al., 2017). However, the non-visualization of the object may occur due to inflammatory reactions and the presence of fibrinous exudates in the pericardial sac, not excluding the suspicion of the disease (Makhdoomi et al., 2018; Sasikala et al., 2018).

2.3.3. Ultrasonography

Abdominal ultrasonography is an excellent diagnostic and prognostic tool. It aids in deciding whether the animal should undergo surgical or medical treatment or be slaughtered. It is an ideal diagnostic tool for investigating gastrointestinal disorders in cattle. In animals with traumatic reticuloperitonitis, inflammatory fibrinous changes and abscesses can be imaged (Braun and Jacquat, 2011). So, ultrasonography provided exact information concerning the various sequelae of TRP in animals. Moreover, ultrasonography made it possible to determine the location and extent of the lesions accurately, and the site best suited for abdominal and thoracocentesis.

Reduced or absent biphasic reticular contractions and deposition of inflammatory materials on its serosal surface were the classical ultrasonographic identifies in TRP, according to (43-Mohamed and Oikawa, 2007) described reticular and thoracic abscesses as circumscribed masses with an choicetochogenic content. Healthy bovine reticulum appeared half-moon shaped with a smooth contour which plays a crucial role in the ruminant digestive tract because the primary cycle of rumen motility always starts with a reticular contraction. Ultrasonography is helpful for the diagnosis of traumatic reticuloperitonitis and differentiation of localised peritonitis from diffuse peritonitis (45,46). Intraoperative echocardiography can be applied to evaluate the entire bovine pericardial sac and heart (Ghanem, 2010).

2.3.4. Echocardiography

The echocardiographic examination is a simple and well-established tool for cardiac evaluation, being performed from the third to fifth intercostal space of both antimers (Buczinski, 2009; Hassan and Torad, 2015). In suppurative pericarditis, a large amount of hypoechogenic to echogenic fluid is usually observed in the pericardial sac, while in fibrinous is possible to evidence echogenic fibrin deposits and cords in the epicardium (Abu-seida and Alabbadi, 2016). Other findings include cardiomegaly, thickening of the walls and

increased cardiac contractions, in addition to vegetation of the tricuspid, mitral and pulmonary valves (Ghanem, 2010; Khalphallah et al., 2017) and the obscured heart due to the effusion (Schweizer et al., 2003).

2.3.5. Ferroscopy

Performing a metal detector scan on the ventral and lateral thoracic and abdominal wall can provide information on the presence of ferromagnetic foreign bodies (Sawandkar et al., 2009), although it is not possible to differentiate between perforating and non-perforating objects (Reddy and Sasikala, 2012). In a study of 38 animals diagnosed with traumatic reticulopericarditis, 21 of them had foreign body detection through ferroscopy (Hussain et al., 2018), despite not being a tool widely used in suspected cases.

2.3.6. Pericardiocentesis

Pericardial fluid can be collected by structures that penetrate the centesis in the location with the greatest audibility of cardiac sound, usually in the fourth or fifth intercostal space on the left side (Athar et al., 2012). However, the procedure can cause deleterious effects, spreading the infection to the pleural cavity (Braun, 2009). In the chronicity of the disease, few amounts of liquid can be found, making it difficult to obtain a sample.

2.3.7. Cardiac biomarkers

Cardiac biomarkers are considered useful indexes for the early diagnosis of traumatic pericarditis. Cardiac Troponin I (cTnI), cardiac Troponin T (cTnT), creatine kinase myocardial band (CK-MB) and nitric oxide are considered important biomarkers of cardiac diseases because they elevate their serum concentration even without the characteristic signs of the disease (Mellanby et al., 2007; Neamat-allah, 2015; Attia, 2016). Venkatesan et al. (2020) found that the evaluation of cTnI at the place of care proved to be a simple diagnostic measure, which facilitated the assessment of myocardial involvement and cell

damage in cattle affected by traumatic reticulopericarditis.

2.3.8. Laparoscopy

Right flank laparoscopy using a flexible fiberopticlaparoscope, 14 mm diameter and 1120 mm working length, is a reliable diagnostic aid for the presence of traumatic reticuloperitonitis(Bakos and Voros, 2011). Laparoscopy in cattle is a promising tool for clinical diagnosis and treatment. The lower cost of the materials available in addition to the possibility of an intervention on an animal that is sedated does not entail more costs than an exploratory laparotomy. The application of this tool during abdominal explorations and biopsies allows the avoidance of invasive and often useless surgical interventions and even with the diagnosis and prognosis of certain conditions(37)

2.3.9. Necropsy and histopathological

In acute cases, distension of the pericardial sac is found foul-smelling liquid with fibrin and the appearance of scrambled eggs (Abu-seida and Al-abbadi, 2016). In chronic cases, the pericardial sac is adhered to the pericardium by fibrinous junctions and thickened (Athar et al., 2012). Findings may also include presence of fluid peritoneal fluid with the presence of fibrin, fibrinous adhesions between the reticulum and / or diaphragm, spleen, abomasum, rumen, liver, abdominal wall and between the intestinal loops and omentum, as well as splenic, pulmonary abscesses, reticular, abdominal and hepatic, depending on the direction of the object when penetrating the reticulum (Ghanem, 2010; Chanie and Tesfaye, 2012; Abu-seida and Al-abbadi, 2016).

The foreign body is usually found in the exam, although its recovery may not be possible even with its visualization in complementary exams, due to adhesions and extension of the inflammatory process (Braun et al., 2007). Histopathology shows the presence of nodular hyperplasia of the stratified squamous epithelium in the reticulum (Sasikala et al., 2018), high

infiltration of inflammatory cells in the pericardium and myocardium, mainly of neutrophils and mononuclear cells, in addition to myocardial hyalinosis (Ghanem, 2010; Abu-seida and Al-abbadi, 2016).

2.4. Treatment

Initial treatment of cattle suspected of having traumatic reticuloperitonitis consists of oral administration of a rumen magnet (if the animal does not already have one; give only one magnet per animal) and antimicrobial therapy (most commonly penicillin or broad-spectrum antimicrobials such as ampicillin, ceftiofur, and tetracyclines). Anti-inflammatory drugs, including flunixin meglumine, ketoprofen, and meloxicam, are administered to manage pain. By capturing ferromagnetic foreign bodies in the reticulum and rumen, magnets prevent trauma. How well the rumen magnet works depends mainly on where the foreign body is situated in the reticulum; a magnet can pick up foreign bodies that on the ventral aspect of the reticulum or that are upright more easily than those that either are not in contact with the ventral aspect of the reticulum or are penetrating the reticulum(Bakos and Voros, 2011)

Treatment is considered successful when the rectal temperature normalizes and eating and rumination improve within 3-5 days. Radiographic evidence that a foreign body is completely attached to a magnet also confirms the success of treatment. If conservative treatment fails, the animal may need to be treated surgically or euthanized. The decision of which course to follow should be made only after radiographic evaluation confirms that the foreign body is not attached to the magnet.

Two main surgical techniques are used for rumenotomy. In laparorumenotomy, the rumen is permanently sutured to the peritoneum and transverse fascia so that the entire procedure including access to the rumen and healing of the incision can take place outside of the peritoneum. In temporary extra-abdominal fixation, the surgeon repositions the sutured

rumen to its normal position in the abdomen. Laparotomy is carried out in the left flank, the rumen is partially emptied so that the reticular lumen can be palpated, and foreign bodies are removed. Abscesses that are firmly and broadly attached to the reticulum can be incised and the content drained into the reticulum. For abscesses attached to the thoracic or abdominal wall, transcutaneous drainage guided by ultrasonography is the treatment of choice (Braun, 2022).

2.5. Prognosis

The prognosis depends on the early diagnosis, the value of the animal, the stage of the disease and the therapeutic attempts, being considered unfavorable in most cases (Buczinski et al., 2009; Mohamed, 2010; Premkumar, et al., 2019).

2.6. Prevention

Prevention Preventive measures include avoiding the use of baling wire, passing feed over magnets to remove metallic objects, keeping cattle away from sites of new construction, and completely removing old buildings and fences. Additionally, bar magnets may be administered PO, preferably after fasting for 18-24 hr. Usually, the magnet remains in the reticulum and holds any ferromagnetic objects on its surface. There is good evidence that giving magnets to all herd replacement heifers and bulls at ~1 yr of age minimizes the incidence of traumatic reticuloperitonitis.

3. Conclusion

Traumatic reticulopericarditis is now a days a challenge in veterinary medicine, especially in developing countries with low standard facilities. Clinical and epidemiological findings help in the presumptive diagnosis of the disease but, complementary exams are necessary for a definitive diagnosis. Although the condition has no specific clinical signs, it has several regular hematological, biochemical and radiographic characteristics. In addition, the use of ultrasonography and echocardiography for cardiac

evaluation, detection and characterization of effusions associated with the analysis of cardiac biomarkers as the most useful laboratory indicators, has provided recent advances in diagnosis and prognosis, which is generally considered poor. Treatment is usually not rewarding, so it is essential to use preventive measures to prevent the disease.

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