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Case Report

Traumatic Reticulopericarditis in a Holstein Dairy Cattle with Highlighting Sonographic and Electrocardiographic Findings: A Case Report

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ABSTRACT

Introduction: Traumatic reticulopericarditis (TRP) is a severe condition in cattle caused by foreign body penetration, leading to pericardial inflammation, resulting in significant economic and welfare concerns in dairy farms. The present study aimed to indicate a case of TRP in a Holstein dairy cow, highlighting sonographic and electrocardiographic findings.

Case report: A 7-year-old Holstein cow, 40 days postpartum, was referred to the large animal clinic at the School of Veterinary Medicine, Shiraz University, Iran. The cow exhibited several concerning signs, including anorexia, a significant decrease in milk yield (from 40 liters to 5 liters), tachycardia, hypothermia, reduced ruminal motility, loose feces, distended jugular veins, muffled heart sounds, and brisket edema. Sonography revealed pericardial effusion, fibrin strands, ventricular compression, and pleural effusion. Electrocardiography (ECG) indicated ST-segment elevation, PR-segment depression, and reduced QRS amplitude. Laboratory findings revealed leukocytosis (24.8 × 10^3/μL), elevated liver enzymes, including aspartate aminotransferase (AST, 93.5 U/L) and alkaline phosphatase (ALP, 205 U/L), as well as hypoalbuminemia (1.95 g/dL). Based on clinical examinations, sonography, electrocardiography (ECG), and laboratory results, the diagnosis was TRP. Given the poor prognosis, culling was advised. The diagnosis was confirmed after the culling process at the slaughterhouse.

Conclusion: Ultrasonography and ECG were crucial in diagnosing TRP, identifying pericardial effusion, and assessing cardiac dysfunction. Early detection of TRP in cattle with these modalities may facilitate the development of improved treatment options.

1. Introduction

In the past decade, the global demand for food production has rendered food animals a vital component of communities. As the population of dairy cattle continues to increase, effective management and control of diseases have become imperative. This heightened demand has exerted pressure on bovine populations, resulting in the creation of artificial living environments for dairy cattle, which in turn has led to the emergence of new diseases that require urgent attention.

Bovines are not selective eaters, which often results in the ingestion of foreign bodies that can penetrate the digestive tract and affect surrounding organs, including the pericardium, spleen, and liver[1]. Trauma to the pericardium triggers an inflammatory response. The accumulation of exudates due to this inflammation, along with the formation of adhesions, can lead to cardiac tamponade, ultimately resulting in right-sided heart failure, systemic congestion, and toxemia[2,3].

Traumatic reticulopericarditis (TRP) represents a serious condition affecting cattle and sheep, leading to significant economic losses and raising concerns regarding animal welfare[4]. Clinical signs include tachycardia, distended jugular veins, muffled heart sounds, and edema. Diagnosis can be challenging, but laboratory findings, ultrasonography, and cardiac biomarkers like troponin cTnI can aid in early detection[5]. In this study, the authors present a case of TRP with detailed sonographic and ECG findings to aid in diagnosis and management.

2. Case report

2.1. Patient information

The subject is a 7-year-old cow that calved 40 days prior, with a documented history of dystocia during parturition,

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and was referred to the large animal clinic at the School of Veterinary Medicine, Shiraz University, Iran. The cow has exhibited signs of anorexia for the past week, accompanied by a significant decrease in milk production, declining from 40 liters to 5 liters. The current diet consists of alfalfa, oats, and straw.

2.2. Clinical findings

The clinical findings include tachycardia, hypothermia, reduced milk yield, ruminal hypomotility, loose feces, distended jugular veins, muffled heart sounds, and brisket edema in this case (Figure 1).

Figure 1. Distended jugular vein (yellow arrow), in a 7-year-old Holstein dairy cow

2.3. Diagnostic assessment

2.3.1. Sonographic findings

The most sensitive diagnostic technique for examining heart-related conditions is echocardiography[14,16]. For diagnostic purposes, the region between the third and fifth ribs was meticulously shaved. Subsequent to this preparation, the authors employed the Hitachi model HITACHI EUB 405 sonography, utilizing a convex probe with a frequency of 5 MHz. The intercostal space was utilized to identify signs of fibrin and exudate. Observations included the presence of pericardial effusion accompanied by echogenic fibrin strands, ventricular compression, and pleural effusion (Figure 2).

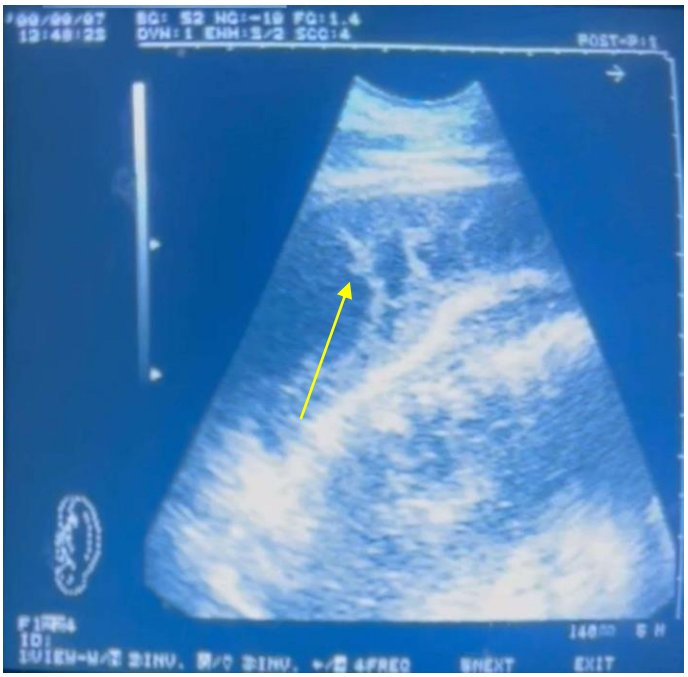

Figure 2. Sonographic examination with pericardial effusion accompanied by echogenic fibrin strands (yellow arrow) in a 7-year-old Holstein cow

2.3.2. ECG findings

The base apex approach was employed for taking the electrocardiogram (ECG). In this case, the authors used the Kenz ECG recorder model 110 (Suzuken Co., Japan). This lead was attached by placing the positive electrode on the left thorax located in the fifth intercostal space at the level of the point of the elbow or at the location where the apex beat was most readily palpated. The negative electrode was attached to the skin on the right jugular furrow two-thirds of the way from the ramus of the mandible to the thoracic inlet. The ground electrode was attached to a location remote from the heart[6]. A base–apex lead ECG was recorded at a paper speed of 25 mm/s and calibration of 10mm/mV (1cm= 1 mV). The authors observed an elevation in the amplitude of the ST segment, which is indicative of myocardial ischemia[7]. Additionally, the duration of the T segment was noted to increase to 160-200 ms, accompanied by a reduction in the amplitude of the QRS complex, suggesting a decrease in ventricular filling (Figure 3).

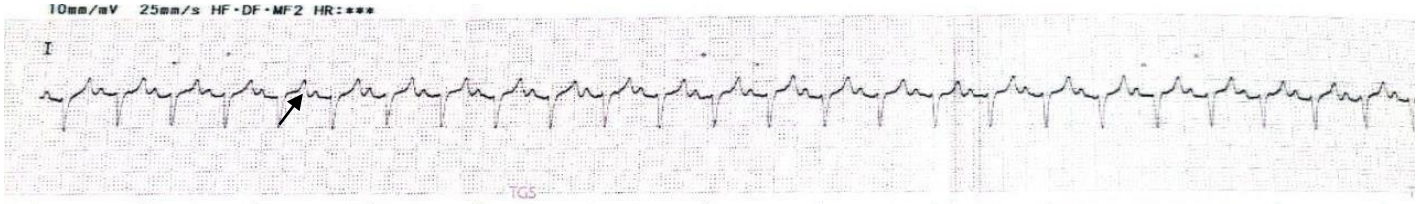

Figure 3. Electrocardiogram (ECG), reduced QRS complex amplitude, regularly changing the P, QRS, or T, and elevation in the ST segment (black arrow), in a 7-year-old Holstein dairy cow

Acute pericarditis is marked by specific electrocardiographic changes such as diffuse ST-segment elevations, PR-segment depressions, and T-wave inversions[8]. In stage 1, the ST-segment vector aligns with the QRS and T-wave vectors, while stage 3 features wide dispersion of T-wave inversions. PR-segment deviations

typically oppose the P-wave vector[9,10].

2.4. Other diagnostic tests

The complete blood count (CBC) revealed marked leukocytosis (WBC: 24.8 × 10^3/µL; reference: 4–12 × 10^3/µL), indicating systemic inflammation, most likely associated with neutrophilia caused by pericardial infection or a foreign body reaction. Biochemical analysis demonstrated urea (31.0 mg/dL; reference: 15–40 mg/dL) and creatinine (0.97 mg/dL; reference: 0.8–2.0 mg/dL) within normal ranges, confirming preserved renal function[11]. Cholesterol levels were low-normal (95.5 mg/dL; reference: 80–150 mg/dL), suggesting reduced feed intake. Aspartate aminotransferase (AST) was elevated (93.5 U/L; reference: 30–80 U/L), pointing to possible liver or myocardial injury, while alanine aminotransferase (ALT) remained normal (16.5 U/L; reference: 11–40 U/L), excluding primary hepatic damage[11]. Alkaline phosphatase (ALP) was elevated (205 U/L; reference: 20–150 U/L), consistent with cholestasis or inflammatory changes. Serum calcium was decreased (6.8 mg/dL; reference: 8–10 mg/dL), while phosphorus was at the low-normal range (3.98 mg/dL; reference: 4–7 mg/dL), also suggestive of reduced intake[11]. Total protein (4.5 g/dL; reference: 6–8 g/dL) and albumin (1.95 g/dL; reference: 3–4 g/dL) were markedly reduced, supporting chronic inflammation or effusion as possible causes. Gamma-glutamyl transferase (GGT) remained within normal limits (24.0 U/L; reference: 15–40 U/L), excluding significant hepatobiliary disease[11].

These findings suggest systemic inflammation, possible liver hypoxia, and protein loss due to pericardial effusion, consistent with advanced TRP[11,12].

Because of a poor prognosis, culling was suggested. The diagnosis was confirmed after culling at the slaughterhouse.

3. Discussion

Bovines are not selective eaters, which often results in the ingestion of foreign bodies that can penetrate the digestive tract and affect surrounding organs, including the pericardium, spleen, and liver. Trauma to the pericardium triggers an inflammatory response[1].

3.1. Diagnostic role of ultrasonography

Cattle diseases caused by foreign bodies can be diagnosed with the help of radiographic and ultrasonographic examination[13-16]. In the reticulum, radiography can identify magnets and ferromagnetic foreign bodies in a variety of locations and penetrations. Ultrasonography, a non-invasive and readily accessible imaging modality, plays a crucial role in the detection of various abdominal pathologies. Among these, alterations in reticulum motility and the presence of peritoneal inflammation are two distinct conditions that can be effectively visualized and assessed using this technique[3]. Reticulum motility, characterized by rhythmic contractions essential for proper digestion in ruminants, can be evaluated via ultrasonography[3,12]. Changes in the frequency, amplitude, or pattern of these contractions may indicate underlying gastrointestinal dysfunction or disease. Furthermore, ultrasonography is valuable in identifying peritoneal inflammation, often manifested as increased peritoneal fluid, thickening of the peritoneal lining, and altered echogenicity of surrounding tissues. These findings can be indicative of peritonitis, abscess formation, or other inflammatory processes within the abdominal cavity. Therefore, ultrasonography serves as a valuable diagnostic tool for assessing reticulum motility and detecting peritoneal inflammation, aiding in the timely diagnosis and management of associated conditions[13]. Ultrasonography can be considered a novel approach for diagnosing TRP and its complications, including pericardial effusion and peritonitis[5]. The ultrasonographic examination of the normal bovine heart has been well-documented in prior study[14] and is typically conducted on standing cows using a 5.0 MHz sector or convex transducer. This procedure is carried out from the third to the fifth intercostal spaces within the cardiac region on both sides of the thorax in traumatic pericarditis. Most of the time, the thorax contains a significant amount of hypoechogenic fluid, which occasionally contains fibrin strands or free clots[3]. It was observed that within the fluid interposed between the epicardium and pericardium, fibrin strands are suspended, and the lungs exhibit compression and are displaced medially and dorsally. Similar findings were reported by Braun[3], and Ghanem[11].

3.2. Diagnostic role of ECG

Reduced QRS complex amplitude (<1.5 mV), electric alternans (regularly changing the P, QRS, or T complex configuration), and slurring or elevation in the ST segment were all observed in this case.

Electrocardiography can be used to identify irregularities in the heart's rhythm, rate, and conduction system. Although the ECG can be used to detect cardiac hypertrophy and dilatation in humans and small animals, it is not very useful for detecting the enlargement of cardiac chambers in large animals due to the deep penetration of Purkinje fibers in the myocardium[15].

TRP must be differentiated from conditions with overlapping clinical signs, including TRP, septic pericarditis, lymphosarcoma, cor pulmonale, endocarditis, and abomasal displacement. Traumatic reticuloperitonitis, caused by foreign body penetration without pericardial involvement, presents with ruminal hypomotility and fever but lacks pericardial effusion and ECG changes[11]. Septic pericarditis, often secondary to hematogenous bacterial spread (*Pasteurella* spp.), may mimic TRP but typically shows systemic sepsis signs and no foreign body on imaging[12]. Lymphosarcoma, a neoplastic condition in cattle, can cause pericardial effusion but is characterized by lymphadenopathy and absence of fibrin strands on ultrasound[16]. Cor pulmonale, resulting from chronic lung disease, presents with right-sided heart failure but normal pericardial findings on ultrasound. Endocarditis, caused by bacterial vegetations on heart valves, shows echocardiographic lesions absent in this case[3]. Abomasal displacement may cause ruminal hypomotility and reduced milk yield but lacks cardiac signs and effusion.

ECG findings help differentiate TRP from myocardial infarction (seen in humans), as TRP lacks reciprocal ST-segment changes[7]. Ultrasonography is critical for

distinguishing TRP from these conditions by confirming pericardial effusion and fibrin strands. Laboratory findings, such as leukocytosis and hypoalbuminemia, support the diagnosis of TRP but are non-specific, necessitating a multimodal diagnostic approach[12].

3.3. Management and prognosis

The management of TRP in cattle is challenging due to the advanced stage at presentation and limited treatment options. In this case, euthanasia was recommended due to severe pericardial effusion, ventricular compression, and poor prognosis, aligning with welfare and economic considerations[3]. Supportive care with non-steroidal anti-inflammatory drugs (flunixin meglumine, 1.1 mg/kg IV) and broad-spectrum antibiotics (oxytetracycline, 10 mg/kg IM) was considered to reduce inflammation and combat secondary infections. Still, these are rarely effective in advanced cases due to irreversible cardiac damage[11]. Surgical interventions, such as rumenotomy to remove the foreign body or pericardiotomy to drain effusion, are theoretically viable but impractical in field settings due to high costs and lack of specialized facilities[17].

Experimental therapies, such as intrapericardial administration of corticosteroids or fibrinolytic agents, have been explored in human pericarditis[18]; however, they remain untested in cattle due to logistical and ethical constraints. In humans, early pericardiocentesis or pericardial window surgery significantly improves outcomes in pericarditis, with survival rates > 90% when performed promptly[19]. In contrast, bovine TRP has a grave prognosis, with euthanasia rates approaching 80% in advanced cases[3]. The economic value of dairy cattle often influences treatment decisions, as prolonged therapy may not be cost-effective compared to replacement. Preventive measures, such as magnetic devices in feed to capture metallic objects, could reduce TRP incidence[17].

3.4. Limitations

The diagnosis and management of TRP face several limitations. Diagnostic delays are common due to non-specific early signs, such as reduced milk yield and anorexia, which farmers may attribute to other conditions, as seen in this case with a one-week history of symptoms. The lack of advanced diagnostics, such as cardiac troponin I (cTnI) testing, which is highly sensitive for myocardial damage in humans, limits the assessment of cardiac injury in cattle[16]. Imaging modalities like CT or MRI, which provide superior resolution for foreign body localization and myocardial assessment, are rarely available in veterinary practice due to cost and infrastructure barriers[20]. Ultrasonography, while effective, is operator-dependent, and subtle findings may be missed in early-stage TRP, necessitating serial examinations.

Therapeutic limitations include the impracticality of surgical interventions in field settings, where access to specialized equipment and expertise is limited. Economic constraints often lead farmers to opt for euthanasia over costly treatments with uncertain outcomes, particularly in low-value animals[17]. Regional variations in veterinary care, such as limited access to ultrasonography or ECG in rural areas, further complicate diagnosis and management. The absence of standardized diagnostic algorithms for TRP in cattle hinders early detection, and the lack of validated biomarkers, such as cTnI, limits prognostic accuracy. Future studies should focus on developing portable diagnostic tools and cost-effective preventive strategies to address these challenges.

4. Conclusion

The history, clinical findings, laboratory findings, and sonography examination results, including pericardial effusion, fibrin strands, ventricular compression, and pleural effusion, as well as abnormalities in the ECG, revealed TRP in the present case. Ultrasonography and ECG were beneficial for diagnosing TRP, detecting pericardial effusion, and cardiac dysfunction. Laboratory findings confirmed systemic inflammation. Early detection using the mentioned methods can facilitate management in cattle and improve human outcomes. Future studies should explore novel biomarkers and diagnostic algorithms to enhance early intervention.

Declarations

Competing interests

The authors declare no competing interests.

Ethical considerations

This case involved the clinical management of a naturally occurring condition with the owner's consent, in accordance with the ethical standards of Shiraz University.

Authors' contributions

Abdoreza Amrollahi performed clinical examination and drafting; Seyed Ali Behnami conducted sonographic and ECG assessments; Alborz Yadollahi assisted in case management and literature review; Ali Hajimohammadi supervised the study, revised the manuscript, and is the corresponding author. All authors read and approved the final version of the manuscript.

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Availability of data and materials

All data are included in this article; further details are available from the corresponding author on request.

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