Investigation of diagnostic significance of midregional-pro-adrenomedullin (Mr-Pro-Adm), soluble trigger receptor expressed from myeloid cells (sTREM-1) and hematological parameters in cows with pericarditis

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SUMMARY

In this study, it was determined how the levels of Mr-Pro-ADM and sTREM-1 and some biochemical and hematological parameters changed in cows diagnosed with traumatic pericarditis. A total of 60 cows, 40 diseased and 20 healthy, of Simmental breeds between the ages of 1-7 were used in the study. Clinical, radiological, hematological and biochemical examinations were performed on diseased animals brought to the Department of Internal Medicine, Faculty of Veterinary Medicine, Kafkas University, with complaints of loss of appetite, exercise intolerance, rumen atony and recurrent tympani, abdominal tension, constipation, moaning and fatigue. As a result of the examination, it was determined that lactate dehydrogenase (LDH) enzyme activity was statistically significantly higher ($p<0.001$) and creatine kinase (CK) enzyme activity was significantly higher ($p<0.05$) in cows diagnosed with pericarditis. In the hematological comparison; Total leukocyte (WBC) and granulocyte (GRA) counts, mean erythrocyte volume (MCV) and mean erythrocyte hemoglobin (MCH) were statistically significantly higher ($p<0.001$) in cows with pericarditis; Monocyte (Mon) count, mean erythrocyte hemoglobin concentration (MCHC) and platelet count (THR) were found to be significantly higher ($p<0.05$). However, the erythrocyte count (RBC) was found to be statistically significantly lower ($p<0.001$). In the comparison of glutaraldehyde coagulation test (GLA) time and vital signs between the diseased animals and the control group, rectal body temperature, pulsation and respiratory rate were statistically significantly higher in diseased animals ($p<0.001$); It was determined that the glutaraldehyde coagulation test (GLA) duration was significantly lower ($p<0.001$) in the diseased animals, depending on the severity of inflammation. When inflammatory biomarkers were compared, Mr-Pro-ADM level was significantly higher in the diseased animals ($p<0.001$); sTREM-1 level was found to be significantly higher ($p<0.05$). As a result, pericarditis is a disease frequently encountered in cattle farming enterprises and is life-threatening and ends in death. It is formed as a complication of RPT. It is the perforation of the diaphragm by foreign objects such as sharp wires and nails in the reticulum and their penetration into the heart. Clinical, hematological, biochemical tests as well as radiological examinations are very important for diagnosis.

KEY WORDS

Biomarker; cow; pericarditis; hematology.

INTRODUCTION

Reticuloperitonitis traumatica (RPT) is a disease seen in cattle that occurs when sharp, pointed, and penetrating foreign objects taken with feed sink into the reticulum and leave this organ by piercing, causing inflammation and damage to various organs. The fact that cattle are greedy and have a weak sense of taste, pica, barns and pastures being contaminated by foreign objects, and animals staying in the pasture for a long time are factors that make it easier to ingest objects. Pointed and sharp-edged objects cause peritonitis by piercing the reticulum wall or sink into the liver, kidney, spleen, lung and heart, causing damage to these organs (1). As a result of objects in the reticulum passing through the diaphragm and sinking into the heart, inflammation of the pericardial sac occurs, and this disease is called pericarditis traumatica (PT) (2). Symptoms include fever, loss of appetite, rumen atony and recurrent tympani, abdominal tension, moaning because of pain, cachexia, tachypnea, tachycardia, jugular vein fullness and positive venous pulse, friction in the heart and subsequent turbulence sound, swelling in the ventral part of the body due to circulatory failure, dull sound during cardiac percussion, and cardiac arrhythmia (3). Clinical findings, ferroscopic and radiographic examinations are used in the diagnosis of pericarditis traumatica (2).

Biomarkers are used to evaluate both the severity of inflammation, response to treatment and prognosis (4,5). Triggering receptor-1 (TREM-1) expressed from myeloid cells is a cell surface receptor from the immunoglobulin family (6). This biomarker was discovered in 2000 (7). It has a molecular size of 30 kilodaltons (kDa) and is located on and released from the surface of neutrophils, monocytes, macrophages and en-

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dothelial cells (8). sTREM 1, a soluble form of trigger receptor 1 (9), is a biomarker measured in biological fluids (Adly *et al.,* 2014) and used in the assessment of inflammation severity (10). Adrenomedullin (ADM) is another biomarker measured in blood (11). It is concentrated in the mesenteric artery and aorta. It is released both from monocytes and macrophages and by cardiac, vascular smooth muscle cells (12). Adrenomedullin has been reported to serve as a good biomarker in sepsis (13,14) and cardiovascular system diseases (15). Midregion-pro-adrenomedullin is a fragment of 48 amino acids with a higher half-life than ADM, indicating the activity and level of ADM (14).

The aim of this study was to determine the changes in the levels of biochemical and hematological parameters with Mr-Pro-ADM and sTREM-1 in cows diagnosed with traumatic pericarditis.

MATERIALS AND METHODS

Ethical approval and animal material

This study was initiated after obtaining approval from Kafkas University Animal Experiments Local Ethics Committee (KAÜ-HADYEK/2022-095). The animal material of this study consisted of 40 diseased cows of Simmental breed between the ages of 1-7 years, which were brought to Kafkas University, Faculty of Veterinary Medicine, Animal Health Education, Research and Application Hospital, Department of Internal Medicine with complaints of loss of appetite, exercise intolerance, constipation, rumen atony and recurrent tympani, abdominal tension, moaning and fatigue, and 20 healthy cows of the same age group and breed without any health problems (control group), totaling 60 animals.

Vital parameter evaluation

While performing clinical examinations of diseased animals rectal body temperature, respiration and pulse rate per minute were evaluated and noted. Pulse and respiratory rates were assessed by auscultation with a stethoscope. Rectal body temperature was taken from the rectal mucosa with a digital thermometer.

Pain tests

Pain tests such as back squeezing and stick tests were performed on diseased cattle. All animals in the diseased group were found to be in pain (16).

Blood sampling biochemical and hematologic measurements

Blood samples were collected from diseased cows after diagnosis and from healthy cows once in vacuum gel serum tubes and K3 EDTALI tubes. Blood samples collected in vacuum tubes were centrifuged at 3000 rpm for 10 minutes (Hettich Rotina 380R®, Hettich, Germany) to obtain serum samples. Biochemical measurements were made from the serum samples obtained. Alanine aminotransferase (ALT (IU/L), aspartate aminotransferase (AST (IU/L) enzyme activities and glucose (mg/dL), creatinine (Crea mg/dL), urea (Urea mg/dL), total protein (TP g/dL), albumin (ALB g/dL), creatine kinase (CK IU/L), lactate dehydrogenase (LDH (IU/L), iron (Fe, (mg/dl) levels are among the biochemical parameters evaluated. After whole blood samples were collected in K3 EDTALI tubes, total leukocyte count (WBC x10^3/ L), lymphocyte count (LYM x10^3/ L), monocyte count (Mon x10^3/ L), granulocyte count (Gra x10^3/ L), erythrocyte count (RBC x10^6/ L), mean erythrocyte volume (MCV fL), hematocrit percentage (HCT %), mean erythrocyte hemoglobin (MCH pg), mean erythrocyte hemoglobin concentration (MCHC g/dL), hemoglobin concentration

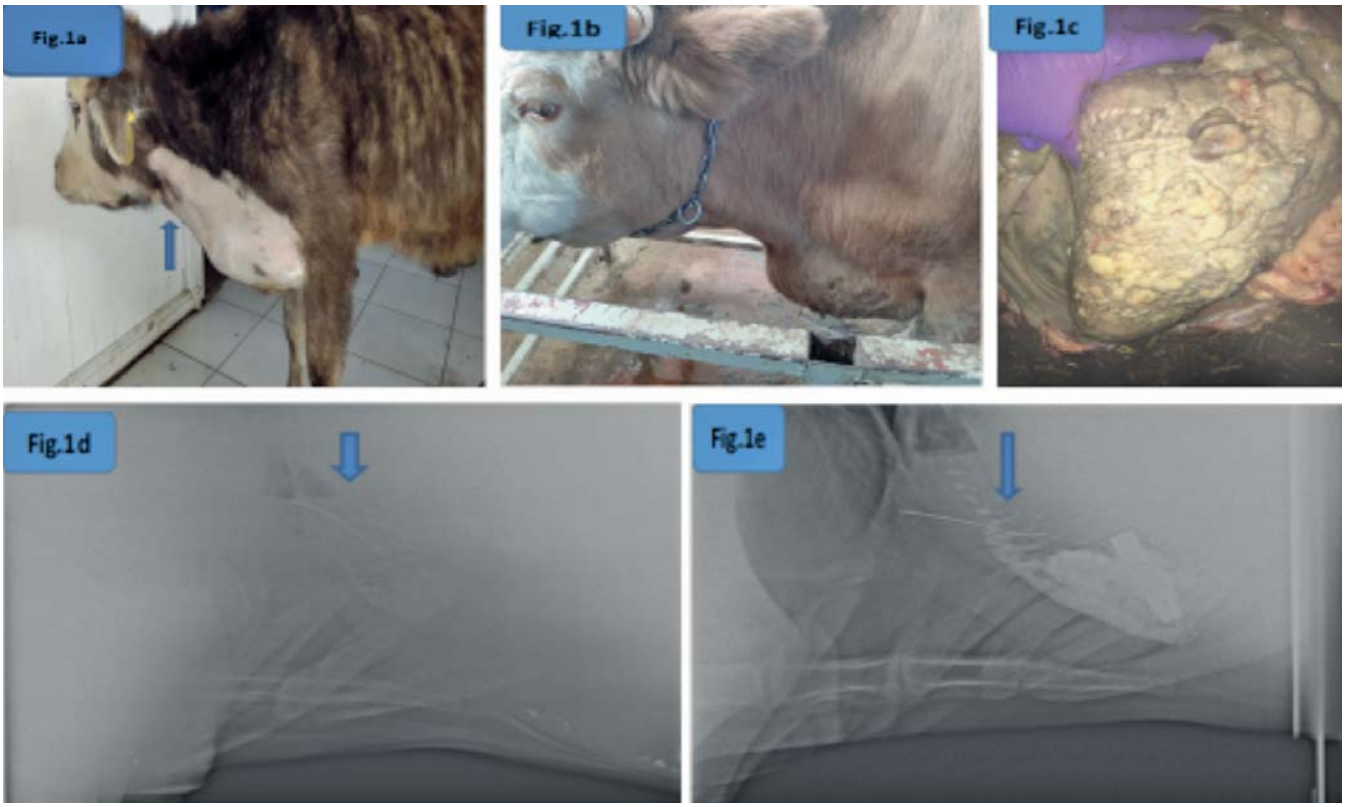

Figure 1 - **a:** Jugular venous distension, **b:** Sternal edema, **c:** Pericarditis heart image, **d and e:** Foreign body passing through the reticulum and heading towards the chest cavity.

Table 1 - Comparison of clinical findings between diseased animals and control group.

Clinical Findings	Diseased Animals (n=40)	Control (n=20)
Jugular Venous Distention	Positive	Negative
Sternal Edema	Positive	Negative
Pain	Positive	Negative
Anorexia	Positive	Negative
Loss of Productivity	Positive	Negative
Swishing Sound on Cardiac Auscultation	Positive	Negative
Edema under the Jaw	Positive	Negative

(HGB g/dL), platelet count (THR x10^3/ L) parameters were analyzed with a complete blood count device (VG-MS4e®, Melet Schloesing, France). Serum samples to be used for measurements of Midregional-Pro-Adrenomedullin (Mr-Pro-ADM) and soluble trigger receptor expressed from myeloid cells (sTREM-1) levels were stored at-20 °C until analysis.

Glutaraldehyde coagulation test (GLA) procedure

The GLA test was used to evaluate both the severity of inflammation and the prognosis of cows diagnosed with pericarditis traumatica. The aim is to calculate the conversion time of fibrinogen to fibrin. As mentioned in the literature, whole blood samples taken in sterile empty tubes and 0.25% GLA solution prepared in advance were mixed in a ratio of 1/1 and the clotting time was interpreted by looking at the duration of clotting by turning upside down every 30 seconds. If the clotting time is between 1-3 minutes, the inflammation is severely positive, if between 3-6 minutes, the inflammation is moderately positive, if between 6-15 minutes, the inflammation is mildly positive, and if no clotting occurs within 15 minutes, the test is negative (16).

Radiologic assessment

Incoming diseased animals were evaluated at the Radiology Unit of the Department of Surgery, Faculty of Veterinary Medicine, Kafkas University. Radiologic evaluation was performed using 35 × 43 cm cassettes at doses of 85-90 kV and 20-25 mAs in the right or left L/L position and radiographic images were obtained with a CR device (Fujifilm FCR Prima T2 Veterinary Set®, Tıbbi Teknoloji, Turkey). According to the results of radiologic evaluation, penetrating foreign bodies were detected in the cases examined. In each case, foreign bodies were observed to move cranially and lodge at the border of the diaphragm.

ELISA measurements

Serum sTREM-1 and Mr-Pro-ADM concentrations were determined using commercial bovine specific ELISA kits (Bovine sTREM-1 ELISA kit®, Bovine Mr-Pro-ADM ELISA kit®, BT Lab, China). ELISA tests were performed as recommended by the manufacturer and optical density was determined on an ELISA reader at 450 nm wavelength (Thermo Scientific®, USA). Regression analysis was performed and sTREM-1 and Mr-Pro-ADM values were read.

Statistical analysis

The normal distribution test of the data belonging to the groups was evaluated with the Shapiro-Wilk test. Pairwise comparisons of the groups were evaluated with the Independent Sample T test. The data obtained in the study were given as mean ± standard error (SE). Statistical analyses were performed in SPSS® (Version 26.0, Chicago, IL, USA) package program. In statistical analyses, the difference obtained in the comparison of the data in the groups was accepted as significant at the $P<0.05$ level.

RESULTS

Clinical and necropsy findings

Clinical examination of the patients revealed fullness in the vena jugularis, edema under the jaw and in the sternal region.

Diseased cows diagnosed with pericarditis traumatica were sent to slaughter. A necropsy was performed after the cut. As a result of the necropsy, a foreign body penetrating the heart was detected and the diagnosis of pericarditis exudativa was confirmed.

Radiological findings

According to the results of radiologic evaluation, penetrating foreign bodies were detected in the cases examined. In each case, foreign bodies were observed to move cranially and lodge at the border of the diaphragm.

In lateral radiographs taken from cases with clinical findings of pericarditis traumatica, it was seen that the metallic foreign body pierced the cranial reticulum wall and diaphragm and was associated with the chest cavity. While the inflammatory changes localized in the reticulum wall were observed, the presence of radiolucent areas with clear borders, especially in the

Table 2 - Comparison of vital findings between diseased animals and control group.

Parameter	Pericarditis (n=40)	Control (n=20)	P value	Reference (16)
Body temperature (°C)	39.41±0.10	38.60±0.10	P<0.001	38.5
Pulsation (number/min)	97.20±2.24	71.30±2.23	P<0.001	55-80
Respiration (number/min)	36±0.93	29±1.22	P<0.001	10-30

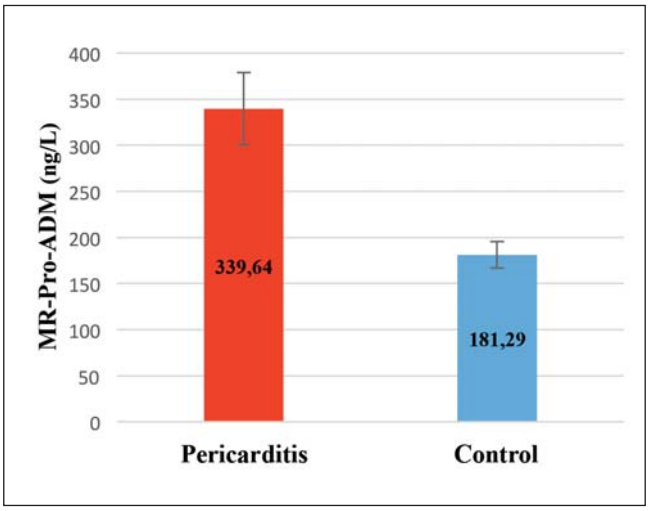

Figure 2 Comparison of Mr-Pro-ADM finding between diseased animals and control group (P<0.001).

region where the foreign body caused trauma, was evaluated as an indicator of local abscess foci formed by gas-liquid combination. In addition, while tissue opacity increased in the cranial reticulum wall, it was noted that the reticulum and diaphragm borders lost their sharp lines. While lesions including the diaphragm border were detected in all cases, it was not possible to evaluate these areas due to the increased opacity in the heart field and caudal ventral lung lobes. In lateral radiographs, it was detected that all or most of the metallic foreign body had left the boundaries of the reticulum, and in one case, the presence of magnets that the patient owner had made the animal swallow was detected at the base of the reticulum. However, after the clinical findings intensified, it was clearly seen in the radiographic images that these swallowed magnets did not come into contact with the foreign body that had penetrated the reticulum wall. In cases of reticulo-pericarditis traumatica, determining the exact location of the foreign body is only possible by evaluating several extraction positions together. Since all the cases included in the study were adult and large-bodied cattle, it was not possible to obtain dorso-ventral radiographic images, so it was not possible to evaluate the exact localization of foreign bodies and pathological lesions.
While the presence of a magnet was detected, more than one third of the foreign body was found to have left the reticulum. t was observed that most of the foreign body remained within the reticulum borders, but a certain part of the foreign body continued to penetrate. ncreased opacity at the base of the reticulum and radiolucent foci in the area (blue arrow) were interpreted as a strong sign of local inflammatory response.

Clinical findings
Vital findings

Rectal body temperature, number of pulsations and respirations per minute were statistically significantly higher (P<0.001) in the diseased animals

Hematologic and biochemical findings

Glutaraldehyde coagulation test (GLA) time was statistically significantly lower (P<0.001) in the diseased animals. In all diseased animals, the GLA test time was less than 3 minutes. This shows that the inflammation in the diseased animal group was very severe. In the control group, the GLA test time was over 15 minutes in all animals. This shows that there was no inflammation in the control group. A hematologic comparison was made between the diseased animals and control groups. Total leukocyte (WBC) and granulocyte (GRA) counts, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) were higher in the group diagnosed with pericarditis traumatica (P<0.001). Similarly, monocyte (Mon) count, mean erythrocyte hemoglobin concentration (MCHC) and platelet count (THR) were also high (P<0.05). However, erythrocyte count (RBC) was statistically significantly lower (P<0.001) in the diseased animals. Although there was a difference in other biochemical parameters measured, there was no statistical difference between the diseased animals and control groups. In the comparison of biochemical findings between the diseased animals diagnosed with pericarditis traumatica and the control group, it was found that lactate dehydrogenase (LDH) enzyme activity was significantly higher in the diseased animals (P<0.001) and creatine kinase (CK) enzyme activity was significantly higher in the diseased animals (P<0.05). Although there was a difference in other biochemical parameters measured, there was no statistical difference between the diseased animals and control groups. In the comparison of Mr-Pro-ADM and sTREM-1 findings between the diseased animals diagnosed with pericarditis traumatica and the control group; Mr-Pro-ADM level was statistically significantly higher (P<0.001) and sTREM-1 level was significantly higher (P<0.05) in the diseased animals.

DISCUSSION

Braun (2) was mentioned that the clinical signs seen in animals diagnosed with pericarditis traumatica included fullness in the vena jugularis, edema in the submandibular and sternal regions, positive results to pain tests, and associated friction/churning sound in the heart. Braun (2) and Attia (17) were that the main cause of these clinical findings is pericardial effusion. Intracardiac pressure increases due to effusion resulting from pericarditis. With this increase, cardiac output decreases and venous return to the heart is blocked. Because venous hydrostatic pressure increases, right heart failure develops, resulting in both stagnant edema and accumulation of blood in the venous ves-

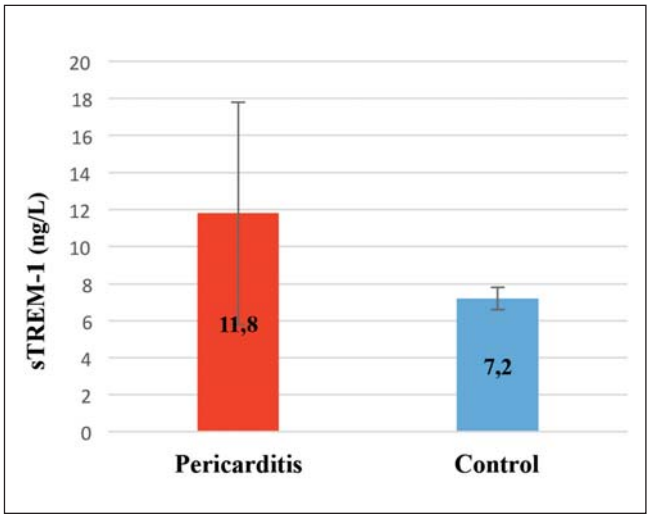

Figure 3 Comparison of sTREM-1 finding between diseased animals and control group (P<0.05).

Table 3 - Comparison of hematologic and biochemical findings between diseased animals and control group.

Parameter	Pericarditis (n=40)	Control (n=20)	P value
WBC (10^3/µl)	18.24±1.37	11.10±0.42	P<0.001
Lym (10^3/µl)	6.42±0.68	6.04±0.33	0.705
Mon (10^3/µl)	0.83±0.09	0.50±0.02	P<0.05
Gra (10^3/µl)	10.97±1.15	4.81±0.37	P<0.001
RBC (10 /µl)	7.20±0.20	9.82±0.33	P<0.001
MCV (fl)	50.56±1.07	39.21±0.59	P<0.001
HCT (%)	36.08±1.04	38.41±1.33	0.191
MCH (pg)	14.82±0.39	10.77±0.28	P<0.001
MCHC (g/dL)	29.41±0.48	27.56±0.49	P<0.05
Hb (g/dL)	10.64±0.34	10.59±0.39	0.923
THR (10^3/µl)	771.85±79.34	499±33.53	P<0.05
Glucose (mg/dL)	66.23±4.65	68.45±3.85	0.714
Crea (mg/dL)	0.93±0.05	0.81±0.05	0.144
TP (g/L)	59.53±1.71	60.29±2.78	0.809
ALB (g/L)	19.61±0.64	20.82±0.98	0.296
AST (IU/L)	135.20±20.25	129.45±29.29	0.871
ALT (IU/L)	19.13±1.28	20.20±2.46	0.670
LDH (IU/L)	1142.90±77.4	346.15±71.94	P<0.001
CK (IU/L)	434.03±119.9	125.65±17.75	P<0.05
Fe (mg/dL)	72.85±10.99	65.15±9.58	0.600
Urea (mg/dL)	37.93±3.33	28.65±3.11	0.080
GLA (seconds)	123.75±12.30	900±84.26	P<0.001
Mr-Pro-ADM (ng/L)	339.64±39.18	181.29±14.47	P<0.001
sTREM-1 (ng/L)	11.8±6	7.2±0.6	P<0.05

WBC: total leukocyte count, **Lym:** lymphocyte count, **Mon:** monocyte count, **Gra:** granulocyte count, **RBC:** erythrocyte count, **MCV:** mean erythrocyte volume, **HCT:** hematocrit percentage, **MCH:** mean erythrocyte hemoglobin, **MCHC:** mean erythrocyte hemoglobin concentration, **Hb:** hemoglobin concentration, **THR:** platelet count, **Crea:** creatinine, **TP:** total protein, **ALB:** albumin, **AST:** aspartate aminotransferase, **ALT:** alanine aminotransferase, **LDH:** lactate dehydrogenase, **CK:** creatine kinase, **Fe:** iron, **GLA:** glutaraldehyde coagulation test, **Mr-Pro-ADM:** Midregional-Pro-Adrenomedullin, **sTREM-1:** soluble trigger receptor expressed from myeloid cells-1.

sels throughout the body. In this study, similar results were obtained in accordance with the given literature.

Hyperthermia, tachypnea and tachycardia were the vital signs detected in the diseased animals. These findings are consistent with similar systemic reaction findings reported for the disease. The main reason for hyperthermia and tachypnea observed in the diseased animals is both the release of inflammatory cytokines due to endotoxemia and the foreign body sinking into the heart causing circulatory and respiratory failure. Pericardial effusion and fibrin deposition are responsible for tachycardia and pathologic heart sounds (17). The cause of fullness in the jugular vein and edema seen in the submandibular and sternal region is cardiac tamponade and right heart failure (2). In the present study, hematologic examination in a group with pericarditis traumatica revealed leukocytosis, granulocytosis, thrombocytosis, monocytosis, erythropenia and increased MCV-MCH-MCHC. The main cause of leukocytosis and granulocytosis is penetration of the reticulum and diaphragm by a foreign body and severe infection and sepsis due to abscessation. Monocytosis is inevitable when the infection becomes chronic (18). Possible reasons for the decrease in erythrocyte count in the group with pericarditis include malnutrition due to anorexia due to the disease, atony in the anterior stomachs and bleeding that occurs when the foreign body pierces the reticulum and passes to the diaphragmatic membrane (19). Anemias are morphologically classified by assessing mean red blood cell volume (MCV) and mean red blood cell Hb concentration (MCHC). Increased MCV and MCH indicate macrocytic anemia, while increased MCHC indicates hyperchromic anemia. Macrocytic-hyperchromic anemias are found in nutritional deficiencies and chronic blood loss. Thrombocytosis is seen in conditions of cytokine release, stress, chronic blood loss, inflammation (20). The information provided in the literature supports the hematologic findings encountered in this study.

In the present study LDH and CK enzyme activities were significantly higher in the diseased animals compared to the control group. Attia (17) was mentioned that the main reason for this was due to damage to the heart muscle and soft tissue due to the foreign body and the resulting infection. The results obtained are consistent with the information given in the literature.

The glutaraldehyde coagulation test is an economical, rapid and practical method used in the diagnosis of inflammatory diseases in cattle in recent years. This test shows an increase in serum globulin and fibrinogen concentrations. Glutaraldehyde reacts chemically with free amino groups in fibrinogen and immunoglobulin to form a clot. The duration of coagulation provides information about the degree of inflammation (21). Stud-

ies have shown that a clotting time of less than 3 minutes indicates that the inflammation is severe, between 3-6 minutes indicates that the inflammation is moderate, and between 6-15 minutes indicates that the inflammation is mildly severe (22). In the present study, the mean glutaraldehyde coagulation test time in the group with pericarditis traumatica was 123 seconds, indicating that the inflammation was severe in the diseased animals.

In this study, serum sTREM 1 levels were found to be higher in the group diagnosed with pericarditis traumatica compared to the control group. Trigger receptor-1 (TREM)-1 expressed on myeloid cells is a cell surface receptor belonging to the immunoglobulin family (6). It is located on the surface of neutrophils, monocytes, macrophages and endothelial cells. Molecularly, it has a size of 30 kDa and a glycoprotein structure. Levels increase in endotoxemia and acute inflammatory conditions (8). When we look at the basic mechanism of this increase; TREM 1 plays a very important role in monocytic activation triggered by toll-like receptors (TLR 2 and TLR 4). The response to inflammation is mediated by the DAP12 protein on the cell surface (23). With the binding of bacterial endotoxins to Toll-like receptors, TREM 1 is released and as a result, the production of cytokines and chemokines such as interleukin 1 beta (IL 1), interleukin 8 (IL 8), tumor necrosis factor alpha (TNF) begins (7). The soluble form of this trigger receptor 1 is called soluble myeloid cell-expressed trigger receptor-1 (sTREM 1) (9). This form is very advantageous in detecting inflammatory conditions as it is suitable for measurement in biological fluids such as blood (10). It has been reported that serum sTREM-1 levels are high in patients with severe infections such as sepsis and high morbidity rates (24). Proteolytic enzymes released by pathogenic agents cause necrosis in cells and thus severe damage to tissues. In such cases, sTREM -1 levels increase (25). In a study, it was reported that the sensitivity and specificity level of sTREM-1 in the follow-up of infection in infections caused by bacterial causes was 95% (23). Based on all this literature information, we attribute the reasons for the high serum sTREM-1 levels in pericarditis traumatica cases, which have a high mortality rate and in which pus-forming secondary bacteria are frequently involved, to the following factors. The first is that the foreign body penetrates the reticulum wall and diaphragm, causing both reticulitis and peritonitis. The second is that it penetrates the pericardial sac and causes myocarditis, pericarditis and severe pericardial effusion with this perforation in the heart. As the body crosses the reticulum, it also carries pus-forming anaerobic bacteria into the heart. Proteolytic enzymes released by pathogenic agents cause inflammation and necrosis of myocardial and pericardial cells, leading to sepsis. In response to this situation, serum sTREM-1 level increases, stimulating cytokine and chemokine stimulation and initiating phagocytic activation.

Adrenomedullin (ADM) is one of the biomarkers whose level can be measured in the bloodstream (11). Studies have mentioned that it is synthesized and released during sepsis (26). It is abundant in mesenteric arteries and aorta. Adrenomedullin is also synthesized by monocytes and macrophages (12). It is also released by cardiac and vascular smooth muscle cells. It has many properties such as vasodilator (27), natriuretic (11), positive inotropic, antioxidant, angiogenesis antihypertrophic, antiapoptotic, antifibrotic and aldosterone inhibitor (28). In addition, it has many effects such as antimicrobial (13), anti-inflammatory, apoptosis stimulator, immunomodulator (27). In studies, it was emphasized that ADM served as a good biomarker in sepsis, respiratory and cardiovascular system diseases (28). Serum ADM levels increase in heart failure with impaired systolic function. Thus, diastolic function is impaired and pressure in the pulmonary arteries increases. In this regard, it has been stated that it is more advantageous than natriuretic peptides in determining the mortality rate in patients with heart failure (29). ADM is bound to ADM binding protein 1 (AMBP-1) in the blood. Angiotensin-II (A-II), noradrenaline, endothelin-1 (ET-1), adrenaline vascular smooth muscle cells, glucocorticoids, lipopolysaccharides, proinflammatory cytokines such as TNF- and IL-1 and hypoxia, oxidative stress and inflammatory factors stimulate ADM synthesis (13). It has been reported that ADM plays important roles in the regulation of perfusion in tissues by regulating vascular tone, especially in sepsis-induced circulatory disorders. ADM has been implicated in vasodilatation and hypotension that occur in inflammation and endotoxic shock states. It has been stated that ADM provides regeneration in damaged vascular endothelium with its angiogenetic activity. It has been reported that ADM reduces ischemia in myocardial infarction with both antioxidant and vasodilative effects in coronary vessels (30). It has been reported that ADM levels increase in severe diseases with high mortality rates (12,14) and inhibit cytokine release, reduce vascular permeability and reduce inflammatory exudate formation (3). To determine the level of ADM, levels of the more stable midregion fragment Midregion-Pro-adrenomedullin (Mr-Pro-ADM), called Pro-ADM, are measured (30). The sensitivity and specificity of Midregion-Pro-adrenomedullin was 91.6% and 87.4%, respectively (14). With this information, it was determined that Mr-Pro-ADM levels were high in the diseased animals diagnosed with pericarditis traumatica in accordance with the information in the literature. We think that this increase is due to myocardial damage and oxidative stress in pericarditis traumatica, hypoxia due to circulatory failure, increased vascular permeability, sepsis, inflammation, and glucocorticoid release due to stress associated with the disease.

Limitations of the study

In this presented manuscript, ultrasonographic examination could not be performed according to the available possibilities. The biomarkers used have not been studied in cattle with pericarditis before. Therefore, these tests need to be validated for cattle and reference values need to be determined. For this purpose, ultrasonographic examination will need to be included under the guidance of the results obtained in the present manuscript and other studies on the subject will need to be conducted. The present manuscript is a preliminary study on the subject.

Ethical approval

This study was initiated after obtaining approval from Kafkas University Animal Experiments Local Ethics Committee (KAÜ-HADYEK/2022-095).

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Authors contribution

The authors declared that they contributed equally to the article.

Conflict of interest

The authors declare no conflicts of interest associated with this study or its results.

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