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THE USE OF SERUM BIOMARKERS IN MONITORING CARDIAC ONCOPATHIES IN COMPANION ANIMALS

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Abstract

Cardiac oncopathies in companion animals, particularly dogs, are often underdiagnosed due to nonspecific clinical signs and limitations of standard diagnostic tools. In our study involving 42 dogs, we evaluated the diagnostic potential of several serum cardiac biomarkers for detecting myocardial damage or dysfunction of neoplastic origin. The biomarkers tested included cardiac troponin (cTnI), creatine kinase (CK), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and NT-proBNP. Among these, cTnI and NT-proBNP proved to be the most specific and valuable markers for identifying cardiac involvement, whether from primary cardiac tumors or metastatic infiltration. NT-proBNP was particularly useful in differentiating cardiac causes from non-cardiac causes of clinical signs, while elevated cTnI levels reflected direct cardiomyocyte injury. Supporting enzymes such as CK, AST, and LDH indicated tissue damage but lacked specificity for cardiac lesions. The combined profiling of these biomarkers in our cohort of 42 dogs enhanced diagnostic accuracy and may serve as a useful tool for monitoring disease progression and therapeutic response in veterinary cardiac oncology. Further research is needed to establish reference ranges and to tailor applications for specific species.

Key words*: cardiac biomarkers, NT-proBNP, cTnI, creatine kinase, cardiac oncopathies.*

INTRODUCTION

Cardiac oncopathies in companion animals represent an insufficiently explored field in veterinary medicine, despite their significant impact on patient health status and unfavorable prognosis. In dogs, cardiac tumors, whether primary or metastatic, are frequently diagnosed in advanced stages, mainly due to the nonspecific nature of clinical signs and the limitations of current diagnostic methods. This highlights the need for more sensitive, accessible, and minimally invasive diagnostic tools capable of early detection of cardiac involvement and timely referral of the patient for cardiologic evaluation (Oyama et al., 2008; Boswood et al., 2008; Langhorn & Willesen, 2016a; Baisan et al., 2016).

In recent years, the use of serum cardiac biomarkers has gained increasing interest as a promising method for detecting cardiac injury and dysfunction. Biomarkers such as cardiac troponins and natriuretic peptides have already demonstrated their utility in human cardiology, and their applicability in veterinary medicine is becoming increasingly recognized (Langhorn & Willesen, 2016b; Langhorn & Willesen, 2016a; de Lima et al., 2017; Pelander et al., 2017; Baisan et al., 2016; Lobetti et al., 2012; Ljungvall, 2018; Peyron, 2020; Illinois College of Veterinary Medicine, 2019; Rebez et al., 2024). However, their specific role in the context of cardiac oncopathies in companion animals remains insufficiently clarified.

The aim of the present study was to evaluate the diagnostic relevance of a panel of serum cardiac biomarkers, including cardiac troponin I (cTnI), N-terminal pro-B-type natriuretic peptide (NT-proBNP), creatine kinase (CK), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH), in identifying myocardial lesions or dysfunctions of neoplastic origin in dogs. By analyzing their specificity and combined utility, this research aims to contribute to the improvement of early diagnosis, differential diagnosis, and disease progression monitoring in veterinary cardiac oncology (Oyama et al., 2008; Langhorn & Willesen, 2016a; Langhorn & Willesen, 2016b; Smith, 2023; Rebez et al., 2024; Lee et al., 2025; Chompoosan et al., 2025).

MATERIALS AND METHODS

The study was conducted within the "Prof. Univ. Dr. Alin Bîrțoiu" University Emergency Hospital, with the aim of evaluating the diagnostic utility of serum cardiac biomarkers in identifying myocardial damage associated with cardiac oncopathies in dogs. The research included 42 dogs diagnosed or suspected with neoplasms involving primary or secondary cardiac involvement, which were investigated through clinical, imaging, and paraclinical examinations.

The study protocol included the evaluation of the following serum biomarkers: cardiac troponin I (cTnI), N-terminal pro-B-type natriuretic peptide (NT-proBNP), creatine kinase (CK), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH), selected due to their relevance in detecting myocardial injury and cardiac dysfunction.



Figure 1. Automated biochemical analyzer Seamaty SMT-120V used in the study for the determination of serum biochemical parameters and enzymes associated with tissue and myocardial damage (CK, AST, LDH) in the dogs included in the research

Biological samples were collected through peripheral venipuncture using whole blood and serum samples obtained according to standardized laboratory protocols. Biochemical analyses were performed using the automated Seamaty SMT-120V analyzer, employed for the determination of serum enzymatic and metabolic parameters, while the assessment of specific cardiac biomarkers was carried out using immunological methods with the Vcheck V200 (Bionote) system.



Figure 2. Immunological system Vcheck V200 (Bionote) used for the quantification of specific cardiac biomarkers, namely cardiac troponin I (cTnI) and NT-proBNP

The obtained results were centralized and subjected to comparative statistical analysis in order to determine the sensitivity and specificity of each biomarker in detecting cardiac involvement of neoplastic origin. Furthermore, the diagnostic value of the association between cTnI and NT-proBNP was analyzed, together with the relationship between serum biomarker variations and the severity of cardiac changes identified clinically and through imaging investigations. The integrated interpretation of clinical, imaging, and biochemical data allowed the evaluation of the potential of cardiac biomarkers as minimally invasive tools for early diagnosis, differential diagnosis, and monitoring of disease progression in veterinary cardiac oncology.

RESULTS AND DISCUSSIONS

In the present study, 42 dogs diagnosed or suspected with cardiac oncopathies were evaluated, investigating the serum alterations of cardiac biomarkers and their correlation with the degree of myocardial involvement. The obtained results highlighted significant variations in biomarker values depending on the type and severity of cardiac lesions identified clinically and through imaging examinations.

Increased values of cardiac troponin I (cTnI) were consistently associated with the presence of active myocardial lesions, suggesting direct cardiomyocyte injury caused by tumor infiltration, local ischemia, or tissue

compression. Elevated cTnI concentrations were predominantly observed in patients with primary cardiac tumors and in cases with extensive cardiac metastases, confirming the sensitivity of this biomarker for detecting myocardial injury. The obtained results are consistent with the scientific literature, where cTnI is considered one of the most relevant markers of myocardial damage in veterinary medicine.

NT-proBNP showed significantly increased values in patients presenting with cardiac chamber dilation, pericardial effusion, and clinical signs suggestive of heart failure secondary to neoplastic involvement. This biomarker proved useful in differentiating cardiac from non-cardiac respiratory and circulatory manifestations, an important aspect in oncologic patients presenting nonspecific clinical signs. The results support previously reported data regarding the usefulness of NT-proBNP in identifying occult cardiomyopathies and evaluating patients with respiratory signs of cardiac origin. An important finding of the present study was that NT-proBNP did not show markedly elevated values (>200 pmol/L above the maximum reference value) in cases of non-infiltrative chemodectomas.

Serum enzymes CK, AST, and LDH showed moderate to severe increases in most investigated cases, reflecting processes of cellular necrosis, tissue hypoxia, and muscular destruction. However, the reduced specificity of these parameters limits their individual diagnostic value in cardiac oncopathies, requiring interpretation in correlation with specific cardiac biomarkers and complementary imaging investigations. Another important aspect is the limited applicability of these serum enzymes in patients with concomitant hepatic or muscular dysfunctions.

Comparative analysis of the results demonstrated that the combined use of cTnI and NT-proBNP provides the highest diagnostic accuracy in identifying cardiac involvement of neoplastic origin. The combined biomarker profile allowed a more precise assessment of myocardial injury severity and may represent a useful tool for both early diagnosis and monitoring disease progression and therapeutic response in veterinary cardiac oncology.

The use of these parameters should be complemented by echocardiographic examination in order to establish the diagnosis of cardiac oncopathy.

Table 1. Correlation of cardiac biomarkers with the type and severity of neoplastic cardiac involvement in dogs, according to the analyzer reference values

Parameter	Analyzer reference values	Active cardiac tumors	Inactive / stable cardiac tumors	Cardiac tamponade	Arrhythmias associated with neoplastic involvement	Pericardial effusion
cTnI	<0.1 ng/ml = normal 0.1-0.2 ng/ml = suspect >0.2 ng/ml = abnormal	Marked increase (>0.2 ng/ml), indicating active myocardial injury	Normal or slightly increased values	Severe increase due to myocardial compression and ischemia	Moderate increase in conduction system lesions	Moderate increase due to compression and local hypoxia
NT-proBNP	<900 pmol/L = normal 900-1800 pmol/L = suspect >1800 pmol/L = abnormal	Significant increases due to ventricular stress and cardiac remodeling	Values close to normal or slightly increased	Marked increase caused by acute hemodynamic overload	Variable increase depending on the degree of cardiac dysfunction	Moderate to severe increase due to atrial and ventricular distension
CK	0-559 U/L	Moderate increase associated with tissue necrosis	Generally within physiological limits	Increase due to hypoperfusion and secondary muscular injury	May increase during severe arrhythmic episodes	Mild to moderate increase
AST	0-48 U/L	Moderate increase in active tumoral infiltration	Stable values	Increase due to hypoxia and systemic congestion	Variable	Mild to moderate increase
LDH	0-798 U/L	Significant increase in extensive neoplastic processes and necrosis	Slightly increased or normal	Severe increase in tissue hypoxia and circulatory collapse	Moderately increased	Moderate increase due to secondary tissue damage

The use of these parameters does not establish or confirm the diagnosis of cardiac oncopathies; however, they allow the assessment of disease severity, therapeutic evolution under treatment, and the degree of myocardial involvement.

CONCLUSIONS

The results obtained in the present study highlight the usefulness of serum cardiac biomarkers in the evaluation of myocardial damage associated with cardiac oncopathies in dogs. Among the investigated parameters, cardiac troponin I (cTnI) and NT-proBNP demonstrated the highest diagnostic relevance, showing significant correlations with the severity of cardiac lesions identified clinically and through imaging examinations.

Increased cTnI values were mainly associated with active myocardial injury, tumor infiltration, and cardiac ischemia, while NT-proBNP reflected the degree of hemodynamic stress and cardiac remodeling secondary to neoplastic involvement.

The study demonstrated that cardiac biomarker values vary depending on the type and severity of cardiovascular complications associated with the neoplastic process. The most significant increases in cTnI and NT-proBNP were observed in cases complicated by cardiac tamponade, pericardial effusion, and heart failure, suggesting severe myocardial involvement and a guarded prognosis. In contrast, inactive or stable tumor lesions showed values close to physiological limits, indicating reduced pathological activity. An important finding observed during the study was the absence of significant NT-proBNP increases in chemodectomas, suggesting a possible variability in biomarker response depending on tumor type.

Serum enzymes CK, AST, and LDH showed alterations compatible with cellular necrosis and tissue hypoxia; however, their reduced specificity limits their individual diagnostic value in cardiac oncopathies. Furthermore, interpretation of these parameters should be performed cautiously in patients presenting concomitant hepatic or muscular disorders, as these conditions may significantly influence the obtained serum values.

The combination of specific cardiac biomarkers with echocardiographic examination represents the most effective approach for evaluating patients suspected of cardiac oncopathies. The use of these parameters does not establish or directly confirm the diagnosis of cardiac neoplasia; however, they provide important information regarding the severity of myocardial involvement, disease progression, and therapeutic response monitoring. In conclusion, serum cardiac biomarkers may represent valuable complementary tools in the diagnosis and management of veterinary cardiac oncology, although further studies are necessary to standardize their use and interpretation in clinical practice.

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