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Original Study

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NT-PROBNP assay and MINE score in dogs with mitral valve disease

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Abstract

Myxomatous mitral valve disease (MMVD) is the most common acquired cardiac disease in dogs. This study aimed to evaluate the relationship between the Mitral INsufficiency Echocardiographic (MINE) score, an echocardiographic staging system, and plasma NT-proBNP levels. Twenty-one client-owned dogs with MMVD were prospectively enrolled and underwent clinical, radiographic, electrocardiographic, and echocardiographic examinations. Dogs were classified according to MINE score. Plasma NT-proBNP concentrations were measured using a validated immunoassay. Results showed significant differences in echocardiographic parameters among severity groups and demonstrated a correlation between disease severity and NT-proBNP levels. These findings suggest that combining the MINE score with NT-proBNP measurement may improve staging accuracy, the association with MMVD severity, and clinical management of dogs affected by MMVD.

Key words: Myxomatous mitral valve disease; MINE score; biomarker; NT-proBNP

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Introduction

Myxomatous mitral valve disease (MMVD) represents approximately 75% of acquired heart diseases in dogs and is characterized by progressive degeneration of the mitral valve apparatus (1-3). Structural alterations, including collagen disorganization and mucopolysaccharide accumulation, lead to leaflet thickening and mitral regurgitation, resulting in chronic volume overload and cardiac remodeling (4-6). Although compensatory mechanisms initially preserve cardiac function, disease progression can culminate in congestive heart failure (7).

Diagnosis and staging rely primarily on echocardiography, while biomarkers such as NT-proBNP provide additional information regarding myocardial stress (8). The MINE score, based on four reproducible echocardiographic parameters, has been proposed as a practical tool for disease stratification (9). This study aimed to investigate the correlation between the MINE score and NT-proBNP levels to enhance staging and prognostic assessment in dogs with MMVD.

Materials and Methods

Client-owned dogs with MMVD were included. Inclusion criteria required normal renal and hepatic function, while dogs younger than two years were excluded. All animals underwent physical examination, thoracic radiography, electrocardiography, and transthoracic echocardiography without sedation. Echocardiographic parameters included left atrium-to-aorta ratio (LA/Ao), left ventricular end-diastolic diameter normalized for body weight (LVIDDn), fractional shortening (FS), and transmitral E-wave velocity.

These variables were used to calculate the MINE score, classifying dogs as mild, moderate, severe, or end-stage disease (9). Blood samples were collected and processed for plasma NT-proBNP measurement using a validated immunoassay (Assay Genie Canine NT-proBNP ELISA Kit, Dublin, Ireland). Statistical analysis included descriptive statistics, Mann-Whitney for group comparisons, and Spearman correlation analysis, with significance set at $P < 0.05$.

Results

The study population included 21 dogs (62% males, 38% females) with a mean age of 9.8 ± 2.8 years and a mean body weight of 6.8 ± 4.0 kg. Multiple breeds were represented, with small breeds predominating

Based on the MINE score, 3 dogs were classified as mild, 8 as moderate, 8 as severe, and 2 as end-stage; in particular, 2 dogs included in a mild ACVIM stage (B1) were classified as moderate stage with MINE score, and similarly, 3 staged as moderate ACVIM stage (B±2) were classified as severe with MINE score.

Significant differences were observed among groups. The LA/Ao ratio was significantly higher in end-stage compared to mild cases ($P = 0.05$). Fractional shortening differed significantly, with lower values in mild cases compared to more advanced stages ($P \leq 0.003$) (Tab.1).

Tab. 1. Variables considered in the MINE score assessment expressed as mean and standard deviation in different groups.

Echocardiographic Variables	Mild	Moderate	Severe	End-Stage
LA/Ao	1.35±0.07[c]	1.68±0.27	2.1±0.60	2.35±0.28
LVIDDn	1.4±0.14	2.88±0.15	2.7±0.47	2.93±0.63
FS%	34.5±10.6[abc]	53.4±17.59	51.6±13	62±8.48
E-Vel (m/sec)	0.5±0.14[bc]	0.88±0.25	1.58±0.70[a]	2.65±0.28

[a]$P < 0.05$ compared to the mild group
[b]$P < 0.05$ compared to the moderate group
[c]$P < 0.05$ compared to the severe group

NT-proBNP concentrations were above the normal range in mild, moderate, and severe groups, which showed significantly higher values compared with the mild group (respectively, P=0.04, P=0.03, and P=0.02) (Tab.2)

Tab. 2. NT-pro-BNP concentrations in different MINE score groups.

MINE SCORE Groups	NT-pro-BNP (pmol/L)
Mild	139.66±50.21
Moderate	1016.12±804.98
Severe	1520.5±984.02[A]
End-stage	3000±1697[A]

NT-proBNP concentrations increased with disease severity, demonstrating a positive correlation with MINE score, supporting its role as a biomarker of cardiac dysfunction.

Discussion

The findings of this study confirm the clinical utility of the MINE score as a rapid and reproducible echocardiographic staging system, potentially more useful for detecting dogs in the mild-to-moderate stage at higher risk of cardiac death or progression to congestive heart failure (9-10). Its reliance on commonly measured parameters reduces inter-observer variability and enhances applicability in clinical practice. NT-proBNP, released in response to myocardial stretch, has proven to be a reliable biomarker of disease severity (8). Unlike natriuretic peptides with short half-lives, NT-proBNP offers greater stability and suitability for clinical use (12-14). The observed correlation between NT-proBNP levels and MINE score supports their combined use for improved diagnostic and prognostic evaluation. The results align with previous studies indicating that NT-proBNP concentrations increase with worsening cardiac disease and may aid in identifying dogs at higher risk of developing congestive heart failure (14). This study has some limitations, including a cross-sectional design, a relatively small number of dogs in some groups, and a lack of longitudinal follow-up and outcome data. Therefore, the results should be interpreted as preliminary associations rather than direct evidence of prognostic significance.

Conclusions

The correlation between NT-proBNP and the MINE score suggests that integrating biomarker analysis with echocardiographic assessment enhances disease staging dogs with MMVD. This combined approach may support earlier diagnosis, improved monitoring, and optimized management.

Conflicts of Interest. There is no potential conflict of interest, and the authors have nothing to disclose. This work was not supported by any grant. This prospective study was approved by the Ethics Committee of the Department of Veterinary Sciences, University of Messina (No. 12/2024).

Informed consent was obtained from all owners.

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