ABSTRACT

Dyspnea is one of the most common reasons for pet emergency veterinary visits. Respiratory suffering is the clinical expression of stress, pain or consequential impairment of respiratory, cardiac, nervous function, or even systemic pathologies. For some pathologies, management and therapy are not difficult, but there are many situations in which the veterinarian's options are limited.

For clinical practice veterinarians, it is important to recognize the types of breathing in order to locate the affected anatomical segment, as well as the ability to propose a differential diagnosis based on the patient's symptoms, medical history and clinical examination.

Carrying out special examinations highlights hemodynamic imbalances and helps to establish a definite diagnosis. Although there are numerous diagnostic techniques that can be used, the comfort of the patient and the need for rapid intervention must be taken into account.

The doctoral thesis entitled **„Hemodynamic changes in the dyspneic patient"** is structured in two main parts: the first part is entitled **„Current state of knowledge"** and contains 25 pages, and the second part entitled **„Personal contributions"** details the results obtained and contains 87 pages. In addition to these two parts, the thesis contains a table of contents, an introduction, a summary, list of bibliographic sources, list of abbreviations, list of figures and list of tables. The present work contains 72 figures and 21 tables, with 128 bibliographic sources consulted.

The first part, **„Current state of knowledge"**, is structured in two chapters and presents information on the comprehensive examination of the dyspneic patient, the general examination and special examinations useful in the management and diagnosis of the dyspneic syndrome, as well as the key points for the assessment of the patients' hemodynamic status .

The **first chapter**, entitled **„The clinical examination of the dyspneic patient"**, describes the normal and pathological respiratory types encountered in dogs and cats in association with the possible anatomical location of the condition, the hemodynamic implications of the ventilation/perfusion ratio depending on the restrictive or obstructive respiratory type, as well as the aspects that they must be followed during the general exam. This chapter presents general data taken from the literature regarding the etiology, pathogenesis and symptomatology of dyspneic syndrome.

The **second chapter**, entiteled **„Special examination methods applied to the dyspneic patient"**, briefly describes the biological, clinical and chemical methods applied to obtain the definitive diagnosis, weighing the advantages and disadvantages of using these techniques in an emergency setting.

The second part of the thesis, **„Personal Contributions"** consists of five chapters, each chapter presenting in detail the obtained results.

Chapter 3 presents the location of the experiments, the aim and objectives of the research. The **aim** of the PhD thesis **„Hemodynamic changes in the dyspneic patient"** is to evaluate the hemodynamic changes in patients with respiratory and non-respiratory dyspnea presented in the clinics of the Faculty of Veterinary Medicine in Iași. The assessment of the respiratory system, cardiovascular system and hemodynamics as a whole involves dynamic monitoring of patients, from the time of presentation to the end of the disease, with the aim of reaching a diagnosis of certainty, restoring the vital functions of the animal and improving his quality of life.

The dynamic, long-term monitoring of dyspneic patients and the high interest regarding the techniques for performing noncardiac thoracic ultrasound led to the realization of the thesis, representing elements of novelty in the veterinary literature.

The **first objective** of the paper is to evaluate the correlations between the clinical examination, imaging examination and hemodynamic changes in acute and chronic dyspnea, of respiratory or non-respiratory origin.

The **second objective** of the study aims at the use of non-cardiac thoracic ultrasound as a complementary method for diagnosing pulmonary pathologies.

The **third objective** of the thesis refers to the dynamic monitoring of patients with short-term and long-term dyspneic syndrome.

The originality of this thesis consisted in:

• The first reported data regarding the outcome of the pathologies that develop with dyspneic syndrome in dogs and cats, in correlation with the etiology of the conditions, with the monitoring of patients in hospital and ambulatory regime for a period of 2 years;

• The first report of dynamic monitoring of a feline diagnosed with idiopathic pleural cyst over a period of more than two years until the complete resolution of the condition;

• First proposal to introduce B-line count assessment at the pericardial point into chest ultrasound protocols for the diagnosis of congestive heart failure in the cat.

Chapter 4, entitled **„Results of the clinical examination"**, begins with an introduction, describing the materials and methods used to carry out the study. The study includes 132 patients (66 dogs and 66 cats), presented at the Clinics of the Faculty of Veterinary Medicine in Iasi with dyspneic syndrome between January 2019 and September 2021. The patients were retrospectively analyzed and classified according to the etiology of respiratory stress and the time of onset symptomatology. At the time of presentation of the patients to the clinic, the following parameters were evaluated: respiratory rate, heart rate, temperature, type of dyspnea, sounds obtained during lung and heart auscultation, mucous membrane color, presence of jetage, and the level of blood oxygenation (SpO2) were determined. Afterwards, we retrospectively analyzed the definitive diagnosis attributed to the patients and their survival rate, analyzing observation charts, radiological and ultrasonographic reports, blood tests and histopathological reports.

The respiratory types identified were inspiratory dyspnea in 6.81% of patients, mixed dyspnea in 20.45% of them, abdominal breathing in 33.33% of animals, paradoxical breathing with an incidence of 5.3%, tachypnea in 28, 06% of patients and stridor in 6.06% of animals. The respiratory types were retrospectively correlated with the etiology of the pathology and the anatomical location of the affected segments. The data obtained in the case of pulmonary and cardiac auscultation showed changes in 65.15% of patients, respectively 28.78% of them, being a clinical triage method recommended for identifying cardiac pathologies or conditions that evolve with pleural space occupation .

In the study, patients with traumatic etiology predominated, followed by those with primary cardiac pathology, primary respiratory pathology, tumoral, infectious, obstructive, congenital, idiopathic, toxic, and unknown etiology.

The study concluded that stridor is a respiratory pattern pathognomonic for upper airway obstruction syndrome, and discordant breathing occurs frequently in patients with pleural space occupation. However, diseases of the pleural space and lung parenchyma cannot be diagnosed only on the basis of the clinical examination, as it is necessary to perform special examinations.

Chapter 5, with the title **„Results of the imaging examination"**, describes the radiological and ultrasound techniques, as well as the results obtained, in patients presented with dyspneic syndrome between March 2021 and May 2022 in the Faculty Clinics. The study includes 218 patients, 105 dogs and 113 cats, evaluated radiologically and 87 patients, 48 dogs and 39 cats, evaluated sonographically. The

ultrasound technique consisted of the application of T-fast and Vet-Blue protocols, as well as full chest ultrasound.

The radiological changes were classified according to the anatomical location, as follows: changes in the boundaries of the chest, changes in the pleural space, airways, lung parenchyma and mediastinum.

Later, patients examined both radiologically and sonographically were classified according to the etiology of dyspnea, and the results of the two methods were compared. Pulmonary ultrasound has high sensitivity and specificity for diagnosing cats with difficult breathing. The data obtained from this study have been published (Turcu et al. 2022a).

Chapter 6, entitled **„Study regarding the monitoring of the dyspneic patient"**, was carried out in two stages: a prospective pilot study, which included 132 patients, presented with dyspneic syndrome between January 2019 and September 2021 in the clinics of the Faculty of Veterinary Medicine in Iasi, and a retrospective study that included patients monitored in the same institution between January 2021 and January 2023. 170 patients were included, who were included in two groups - patients monitored in hospital and outpatient. For both groups, the clinical signs observed at the time of presentation, therapeutic stabilization maneuvers and diagnostic procedures, the number of re-evaluations, the total duration of monitoring and the outcome of the disease were stated.

The monitoring involved the dynamic evaluation of the pathology, from the time of presentation until the time of resolution of clinical signs or until the time of death. Each group was subclassified according to the etiologic agent, and the therapeutic protocol chosen was detailed.

High mortality was observed in the first days after the clinical expression of the dyspneic syndrome. This period is critical because animals present with decompensated pathologies. Therefore, it is recommended that patients be monitored permanently, in a hospital setting. In the case of hemodynamically stable patients with chronic or compensated pathologies, periodic ambulatory re-evaluation is recommended to help the therapeutic scheme and to be able to intervene promptly when the pathology advances, in which case the monitoring can be prolonged for months or years.

Chapter 7, **„General Discussions"**, is divided into two chapters. In subchapter 7.1, **„Diagnostic value of the methods and techniques used"**, the recommendation to use thoracic ultrasound as a triage method for dyspneic patients is reinforced. In addition, it is proposed to quantify the number of B lines at the pericardial point for the diagnosis of pulmonary edema in cats diagnosed with feline hypertrophic cardiomyopathy, the identification of more than three B lines being associated with radiologically confirmed pulmonary edema both in the case of short axis and long axis evaluation of the heart. Subchapter 7.2, **„Evaluation of hemodynamic changes in dyspneic patiens enroled in the study"**, aims to evaluate the pulmonary vein/pulmonary artery ratio in normal dogs and those with pulmonary hypertension. Statistically significant results were identified comparing left atrium/aorta and pulmonary vein/pulmonary artery ratios when comparing groups of normal dogs and those with postcapillary pulmonary hypertension, with a cutoff value of 1.17 for the VP/AP ratio in the study population.

The last chapter, **Chapter 9, „Final Conclusions"**, summarizes the conclusions of our research, creating an overview of the results of the PhD thesis. The results of this study provide new data on dynamic monitoring of dyspneic patients, additional data on noncardiac pulmonary ultrasound, and aspects of hemodynamic changes in dogs with pulmonary hypertension.

Turcu