There has been an increase in the overall interest in veterinary cardiology in Romania in the past few years. To date, there is no information regarding the prevalence of cardiac diseases in small animals from Romania. This study aims to describe the epidemiological data of acquired and congenital heart diseases in small animals from a single-centre retrospective database.

This retrospective study was generated from the Cardiology Unit between January 2016 and December 2020 including a total number of 635 animals of which 476 dogs and 159 cats. There was a slight increase in the yearly distribution of cases in the total population, with the highest number of referred cases in 2020. In dogs, the most common cardiac pathology was mitral valve disease (MMVD) followed by dilated cardiomyopathy (DCM) while in cats, hypertrophic cardiomyopathy (HCM) was overrepresented. In the total population diagnosed with cardiac pathologies in both dogs and cats, 94.05% of cases were represented by acquired cardiac diseases while 5.95% by congenital diseases. Associated pathologies were found in 91 patients (24.7%). The most common associated pathologies were represented by tricuspid valve disease (5.7%), pulmonary hypertension (5.1%), ascites (3.8%), pleural effusion (3.6%), and aortic thromboembolism (2.2%).

To the best of the author’s knowledge, this is the largest epidemiological retrospective study on cardiac diseases in Romania. This study describes the epidemiological data of the most common cardiac diseases in dogs and cats from a single veterinary cardiology centre large database, over 5 years.

Keywords: cardiac, cat, dog, single-centre

There has been an increase in the overall interest for veterinary cardiology in Romania in the past few years. Larger database studies have shown that approximately 10% of dogs presented to primary care veterinary practices have heart disease (1), while in older dogs, the prevalence reaches more than 60% (15). The most common acquired cardiac disease in dogs is represented by mitral valve disease (MMVD), accounting up to 75% (9). Another common morbidity in large breed dogs is dilated cardiomyopathy (DCM) with a prevalence as high as 58% in Doberman pinschers (23). In feline patients, hypertrophic cardiomyopathy (HCM) is overrepresented and has an estimated prevalence of approximately 15% (11). Congenital heart diseases are less frequent, with a prevalence of 0.13% (17).
To date, there is no information regarding the prevalence of cardiac diseases in small animals from Romania. This study aims to describe the epidemiological data of acquired and congenital heart diseases in small animals from a single-centre retrospective database.

MATERIALS AND METHODS

This retrospective study was conducted at the Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" of Iași. Data was generated from the Cardiology Unit between January 2016 and December 2020.

For the descriptive analysis, age, body-weight, sex, and reproductive status were recorded. Only patients with a complete cardiologic examination consisting of a physical exam, five-minute six-lead electrocardiography (21), thoracic radiography (19), and an echocardiographic exam (18) were selected. All files were selected only once, on the first examination and re-checks were excluded. Non-cardiac patients - represented by those in which clinical signs were not associated with a cardiac disease or normal animals that were examined for pre-anesthesia or breeding and patients without a final diagnosis after the complete cardiologic examination were included in the study.

Statistical analysis was performed with Office Excel 2016 and SPSS v.17 software (IBM, Armonk, NY, USA). Continuous variables were expressed as mean and standard deviation and categorical variables are expressed as numbers or percentages.

RESULTS AND DISCUSSIONS

A total number of 635 files of animals referred to the cardiology unit, of which 476 dogs and 159 cats met the inclusion criteria. These animals represented 62 breeds. Demographic data of the entire population and divided by species are presented in Table 1.

The most representative breeds for dogs were Mix breed (n=134), Maltese (n=94), mix CKCS (n=37), Poodle (n=25), Yorkshire Terrier (n=22), Shih-Tzu (n=12), Labrador Retriever and German Shepherd (n=11). Other breeds were less represented. In cats, the most frequent breeds were DSH (n=97), Persian (n=18), and Birman (n=15).

There was a slight increase in the yearly distribution of cases in the total population, with the highest number of referred cases in 2020. However, the number of cats referred to the cardiology centre did not differ between years. The total number of cases per year, divided by species, is represented in Fig. 1.

Of the total population of dogs, 44.75% were considered normal or had other pathologies unrelated to cardiac disease such as primary respiratory disease, while in the cat population, 33.96% were considered normal after the cardiologic examination. The cardiac pathology was classified as the primary diagnosis, considered the most important and associated with physical signs, and secondary diagnosis as associated changes due to the primary disease, or other pathology that can express similar clinical signs. In dogs, the most common cardiac pathology was mitral valve disease (MMVD) (n=166), followed by dilated cardiomyopathy (DCM) (n=26), other morphological changes such as the unknown origin of cavities dilatation or hypertrophy (n=13), pulmonary hypertension (n=8) and Dirofilaria immitis infection (n=7); in 9 dogs, a final diagnosis could not be reached. The prevalence of cardiac pathologies diagnosed in the population of dogs is represented in Fig. 2.

The group of dogs diagnosed with mitral valve disease had a mean age of 11.8 years and a mean BW of 8.9 kg. The most common breed affected by MMVD was mix-breed (31.3%), followed by Maltese dogs (28.9%). Males (54.2%) were more commonly diagnosed compared to females (45.8%). In DCM group, the mean age was 8.57 years and the mean BW was 40.9 kg. The most common breeds affected were represented by Central Asia Shepherd (19.2%), Bucovina Shepherd, and mix-breed dog (11.5%). Males were overrepresented (80%) compared to females (20%).

In cats, hypertrophic cardiomyopathy (HCM) was overrepresented (n=80), followed by unclassified cardiomyopathy (n=5) and dilated cardiomyopathy (n=3). Restrictive cardiomyopathy was only diagnosed in 2 cats. In six cats a final diagnosis could not be reached. The prevalence of cardiac pathologies diagnosed in the population of cats is represented in Fig. 3.

Table 1

Demographic data of the entire study population and divided by species; continuous data are presented as mean ± SD and frequencies are presented as percentages

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Total</th>
<th>Dogs</th>
<th>Cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>9.05±4.6</td>
<td>9.36±4.32</td>
<td>8±5.3</td>
</tr>
<tr>
<td>Body-weight (kg)</td>
<td>12.39±12.87</td>
<td>15.1±13.9</td>
<td>4.5±1.3</td>
</tr>
<tr>
<td>Sex (M/F) %</td>
<td>57.5±42.4</td>
<td>56.5±43.3</td>
<td>60.4±39.6</td>
</tr>
<tr>
<td>Reproductive status (E/S) %</td>
<td>61/39</td>
<td>66.5±43.4</td>
<td>27.4±72.6</td>
</tr>
</tbody>
</table>

M – male; F – female; E – entire; S – spayed
The mean age in the group of cats diagnosed with HCM was 7.54 years and the mean BW was 4.53 kg. The most frequent breeds were domestic shorthair (DSH) (57.5%), followed by Persian (13.8%) and British Shorthair (8.8%). Males had a higher prevalence (66.3%) compared to females (33.8%).

In the total population diagnosed with cardiac pathologies in both dogs and cats, 94.05% of cases were represented by acquired cardiac diseases while 5.95% (n=21) by congenital diseases. Congenital diseases...
diagnosed were aortic (AS) and pulmonic (PS) stenosis, patent ductus arteriosus (PDA), tricuspid (TVD) and mitral (MVD) valve dysplasia, and peritoneal-pericardial diaphragmatic hernia (PPDH). The mean body-weight for patients with congenital diseases was 6.8 kg while the mean age for these patients was 5.7 years. Twenty-five percent of the congenital pathology diagnosed cases were above 11.5 years. The percentage of congenital diseases diagnosed is represented in Fig. 4. Associated pathologies were found in 91 patients (24.7%). The most common associated pathologies were represented by tricuspid valve disease (5.7%), pulmonary hypertension (5.1%), ascites (3.8%), pleural fluid (3.6%), and aortic thromboembolism (2.2%). Other associated pathologies with lower representation were pericardial fluid and intracardiac thrombus. Arterial hypertension was considered a secondary diagnosis. Arterial hypertension was found in

Fig. 3. Pie chart with bar representing the percent distribution of acquired and congenital cardiac diseases from the total population of cats diagnosed with a primary cardiovascular pathology; N/A – non-available; HCM – hypertrophic cardiomyopathy; DCM – dilated cardiomyopathy; RCM – restrictive cardiomyopathy

Fig. 4. Bar-chart representing the distribution of congenital cardiac diseases in both dogs and cats; AS – aortic stenosis, PDA – patent ductus arteriosus, TVD – tricuspid valve dysplasia, PS – pulmonic stenosis, PPDH – peritoneal-pericardial diaphragmatic hernia, MVD – mitral valve dysplasia
2.4% of the entire population of patients.

To the best of the author's knowledge, this is the first study addressing the prevalence of cardiac diseases in a large cohort of small animals referred to a single veterinary cardiology unit from Romania. The results from this study offer descriptive information regarding the characteristics of the animals presented for cardiologic evaluation as well as the prevalence of both acquired and congenital cardiac diseases. This study included a large number of animals evaluated over five years. Analyses of the yearly caseload showed an increasing number of visits from 2017 to 2020. This increase may be explained by the necessity in the general practice for both diagnosis and therapy approach as well as for pre-anesthesia or breeding management. Interestingly even if the overall case-load increased in the past few years, the number of feline patients referred to our center did not change significantly. This result may be explained by the peculiarity in which cats do not reveal clinical signs associated with cardiac diseases as frequently as dogs. One study showed that 55.1% of the cats without clinical signs that died suddenly revealed changes associated with the cardiac disease during necropsy (25). Another factor that may influence the number of feline patients in our center is the lack of screening for geriatric patients or predisposed breeds as recommended by the ACVIM consensus statement guidelines for the classification, diagnosis, and management of cardiomyopathies in cats (11). A large percentage of dogs and cats were normal or had other primary pathologies. These patients were referred to the cardiology unit mainly for a pre-anesthetic examination of breeding purposes as requested by the owner or referring veterinarian. Also, in some patients, the clinical signs were common for both cardiovascular and respiratory diseases, therefore, a cardiologic examination was required.

In dogs, the most representative cardiac disease was MMVD. These results are in accordance with the literature in which MMVD was reported with a prevalence of up to 75% of the total cardiac diseases (9). This pathology is most prevalent in small breed dogs, and these breeds are predominant in our population, which may impact the results. Also, the mean age of MMVD dogs group (11.8 years) is in accordance with the literature (9). The disease is age-related and the prevalence, especially in old, small breed dogs, approaches 100% thus the incidence of MMVD (rate of occurrence over a period of time) over canine lifetimes in most breeds is close to 100% (3). Interestingly, apart from mix-breed dogs, the most common breed affected by MMVD in our population was Maltese (51.1%). One study found significant single nucleotide polymorphism in several genes associated with cardiac function suggesting that MMVD could be a result of genetic cause in this breed (10). Therefore, additional attention should be addressed to this breed regarding cardiovascular pathology in general practice. Dilated cardiomyopathy was the second most common disease in dogs, accounting for 10% of the total cardiac diseases. In some breeds, such as Doberman Pinscher, DCM can reach a prevalence of 58% (23). One study showed a high cumulative prevalence (58.8%) of cardiomyopathy in Dobermans in Europe (24), comparable to that reported in the United States and Canada (45 and 63%) (5, 8).

In cats, HCM phenotype showed a prevalence of 76% of the feline population diagnosed with cardiac diseases and 50% of the total population of cats referred to the cardiology unit. Studies have shown that HCM has an estimated prevalence of approximately 15% in the general cat population (7, 14), while in older cats, the prevalence is much higher, with up to 29% reported affected, even when cats with hypertension and hyperthyroidism are excluded (14). Compared to normal cats, cats with HCM are more likely to be older, male, and have a loud systolic murmur, although HCM still can be seen in young cats, females, and in cats without a murmur (14, 16, 22). Our results showed similar demographic characteristics, in which HCM was most represented in adult-to-geriatric patients with a mean age of 7.54 years and males had a higher prevalence compared to females with a ratio of 1.9 to 1.

Congenital diseases in this study population revealed a prevalence of 5.95%. The main studies report a different prevalence of CHDs in the affected breeds, depending on the popularity of the breed in a country in a given period. In almost all studies, the most common CHDs observed were PDA, PS and SAS (6, 12, 13, 20). In a large retrospective study performed on 76,301 dogs and 57,025 cats, the overall prevalence of CHD was 0.13% in dogs and 0.14% in cats (17), however, this population was represented by animals from a shelter and is expected to be smaller compared to a referral unit. In a single referral center specialized in small animal cardiology and cardiovascular surgery, the reported prevalence of CHD in dogs was 21.7% of the overall cardiac population (13). One recent study reported a total number of 1779 CHD cases. Out of these, the most common CHD were PS, followed by PDA, SAS, VSD, aortic stenosis and TVD (4), findings in accordance with our results. Interestingly, the mean age at the time of diagnosis in animals with CHD was 5.7 years, compared to other reports in which the mean age was comprised between five months for tetralogy of Fallot and 25 months for aortic stenosis (4) or 6 months for PDA in feline patients (2) especially when prognosis and life expectancy significantly decreases above 2.5 years for mitral valve dysplasia, 12 months for PDA and 6 months for VSD with left-to-right shunting (12). The increased age for diagnosis of CHD in our population may be a result of under-diagnosis of the clinical signs by the referring veterinarians, low interest for diagnosis exhibited by the owner, or a combination of both.

The study limitations are represented by the reduced geographical area of the studied population. Other regions from Romania may reveal slightly different prevalence in some diseases, such as pulmonary hypertension secondary to Dirofilaria immitis infections or pathologies associated with certain Romanian breeds with different geographical distribution.
CONCLUSIONS

To the best of the author’s knowledge, this is the largest epidemiological retrospective study on cardiac diseases in Romania. This study describes the epidemiological data of the most common cardiac diseases in dogs and cats from a single veterinary cardiology centre large database, over 5 years. The highest prevalence of cardiac pathology in dogs was represented by mitral valve disease followed by dilated cardiomyopathy while in cats, hypertrophic cardiomyopathy was overrepresented. Of the total population of dogs with mitral valve disease, the most commonly affected breed was the Maltese dog, a finding that should be taken into account when examining these dogs. Congenital cardiac diseases revealed a moderate prevalence among cardiac patients; however, the age of presentation was very high rising suspicion of under-diagnosis in the primary care centres.

REFERENCES