

Research Article

Incidence and Risk Assessment of Cardiac Arrhythmias in Dogs with Respect to Age, Breed, Sex and Associated Biochemical Changes

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ARTICLE HISTORY

Received: 2014-03-22
Revised: 2014-05-01
Accepted: 2014-05-02

Key Words: Association, Cardiovascular, Electrocardiography, Incidence, Risk

ABSTRACT

The study was conducted on 374 client owned dogs in Bareilly (India) with objective to investigate cardiac arrhythmias (CA) in relation to breed, age and sex electrocardiographically (ECG). The overall incidence of CA was 21.92% with highest in Pomeranian (30.70%) and lowest in Pug (9.67%). The dog of 1-3years (29.68%) was most susceptible and incidence was higher in female (22.98%) than the males (21.13%). The risk factor for Pomeranian was 2.103 times more when compared with other breeds. The relative risk in Pomeranian (1.764), German shepherd (1.081) and Labrador (1.033) indicated positive association of these breeds with CA. On biochemical analysis of dogs with CA, plasma concentration of Na⁺, K⁺, Ca⁺, Mg⁺, P, BUN and creatinine did not show significant differences except chloride in comparison to healthy dogs. On ECG, the most common finding was low voltage ORS complex (20.73%) and hyperkalemia (14.63%). The breed, age and sex-specific association and risk factor obtained in present study could be helpful for early clinical diagnosis and decision making for early management of CA in dogs.

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ARTICLE CITATION: Kumar A, Dey S, Mahajan S (2014). Incidence and risk assessment of cardiac arrhythmias in dogs with respect to age, breed, sex and associated biochemical changes. Adv. Anim. Vet. Sci. 2 (5): 277 – 281.

INTRODUCTION

Heart suffers from variety of infectious, non-infectious, genetic, nutritional, environmental, and parasitic diseases leading to its compromised function and finally death. The canine cardiac diseases are common, complex, devastating and considered as silent killer (Parker et al., 2006). According to the American Veterinary Medical Association, 1 out of 10 dogs suffer from heart disease (Dove, 2001). The overall prevalence of cardiac diseases in dogs was recorded around 4.4% (Manczur et al., 2003). Heart diseases in dogs may be acquired or congenital former being more prevalent. Electrocardiography (ECG) is non-invasive and relatively inexpensive technique which not only records the disturbance in electrical potential i.e arrhythmia, rather it also serve as an indicator of electrolyte imbalance, drug toxicity and less precisely myocardial and pericardial affections of heart (Mattera et al., 2012). Therefore routine electrocardiography in conjunction with biochemical analysis in all the dogs remains the corner stone for possible early diagnosis of the most of cardio-vascular abnormalities.

Contrary to considerable research and progress made in developed countries, studies on the canine cardiology are still in infancy in India (Gaur and Varshney, 2002; Kumar et al., 2003; Gupta et al., 2007). Estimates of the association, risk or incidence of a particular disease in relation to various components of population as a whole or in specific subpopulations are used in diagnostic decision-making (Egenvall et al., 2000). Breed-specific rates and estimates of the proportion of deaths in a breed due to certain causes can describe the current or ongoing health problems in that

breed (Bonnett et al., 2005). However, in India, attempts to diagnose the cardiac diseases in dogs are rarely practiced which leads to non-availability of statistics related to cardiac diseases in dogs.

In ideal conditions, veterinary clinicians should have accurate statistics on the occurrence of specific dog disease with relation to its association and risk for various breeds, age and gender. Unfortunately, there are very few reports of such estimates in general and most of diseases specific data does not provide any population level estimates of the risk of disease especially in canines. Therefore veterinarians are forced to rely mainly on anecdotal information or on their own experience. Therefore, the present study was conducted with objective to record the incidence, risk association and biochemical alterations due to CA in various breeds in India.

MATERIALS AND METHODS

Clinical Subjects

The study was conducted on client owned dogs reported during the year (2010-12) at the Referral Veterinary Polyclinic, Indian Veterinary Research Institute, Izatnagar, India. A total of 374 dogs were screened by ECG and were categorized for different CA in relation to breed, age (0-1, 1-3, 3-5, 5-7, 7-10 and above 10 years) and sex. Six dogs maintained at Division of Animal Nutrition, IVRI, Izatnagar, and found free of CA on ECG were selected as healthy control to compare biochemical alterations in dogs with CA. All the dogs included for study were maintaining by their owners with proper care at their places.

Electrocardiography

The ECG was recorded in standard body position (Tilley, 1985) using standard ECG recorder (6 leads), Cardiart-408-BPL (Service power supply Class I, 220-240 V ± 10%; 50-60 Hz) at paper speed of 50 mm seconds with sensitivity of (1cm=1 mV) without use of filter. A minimum of 10 complexes in bipolar limb leads (I, II, III) and augmented unipolar limb leads (aVR, aVL and aVF) were recorded.

Biochemical Study

Blood was collected from saphenous vein of the animal in a K₃ EDTA coated tubes and plasma was harvested by centrifugation at 3000 rpm for 15 minutes and then stored at -20° C till analyzed. The plasma concentration of sodium, potassium, magnesium calcium, inorganic phosphorus, chloride, urea and creatinine was measured using commercially available diagnostic kits (Span Diagnostic Ltd, Surat, Gujarat, India) and values were calculated as per manufacturers instruction and expressed in respective units.

Statistical Analysis

The data were analyzed statistically using standard methods (Snedecor and Cochran, 1994). The risk and association of CA with that of age, sex and breed was determined by estimating odd ratio and relative risk at 95% CI by using online program.

RESULTS

82 (21.92%) out of 374 suspected cases, were found positive for various types of CA. The most observable symptoms in presented dogs were exercise intolerance (39.02%), dyspnoea (12.19%), overweight 12.19%, and ascites 17.07%. The incidence of CA was highest in Pomeranian (30.70%) and lowest in Pug (9.67%). Whereas no CA was found in Dachschild, Mastiff, Cocker spaniel and Boxer breeds. On further analysis of risk factor and association at 95% confidence interval, the value of odd ratio and relative risk was highest in Pomeranian when compared with other breeds (Table 1).

Breed	Odd ratio	95% CI*	Relative risk	95% CI*	Incidence (%)
Pomeranian/Spitz	2.103	1.237-3.574	1.764	1.179-2.620	30.70
Labrador	1.043	0.565-1.912	1.033	0.631-1.912	22.47
German shepherd	1.106	0.440-2.696	1.081	0.505-2.011	23.53
Doberman	0.600	0.170-1.904	0.659	0.211-1.600	14.81
Great Dane	0.639	0.096-3.140	0.694	0.120-2.164	15.38
Pug	0.358	0.084-1.278	0.420	0.108-1.206	9.67
Rampur Hound	0.709	0.031-6.354	0.757	0.039-2.972	16.66
Bhutia	0.588	0.026-5.024	0.647	0.034-2.709	14.28
Dalmatian	0.443	0.021-3.493	0.499	0.026-2.367	10.00
Non-descript	0.815	0.180-3.165	0.499	0.026-2.367	18.75
Dachschild	0.000	0.000-14.641	0.000	0.000-3.708	00.00
Mastiff	0.000	0.000-8.036	0.000	0.000-3.194	00.00
Cocker Spaniel	0.000	0.000-5.500	0.000	0.000-2.795	00.00
Boxer	0.000	0.000-14.641	0.000	0.000-3.708	00.00
Terrier	0.000	0.000-8.036	0.000	0.000-3.194	00.00

*CI: Confidence interval

Table 1: Breed wise incidence, risk and association of Cardiac arrhythmias in dogs

Table 2: Age wise incidence, risk and association of Cardiac arrhythmias in dogs

Age groups	Odd ratio	95% CI*	Relative risk	95% CI*	Incidence (%)
0-1 yrs	1.269	0.467-3.324	1.200	0.532-2.266	25.92
1-3 yrs	1.655	0.866-3.148	1.461	0.892-2.270	29.68
3-5 yrs	0.705	0.375-1.322	0.757	0.44-1.240	17.70
5-7 yrs	0.909	0.483-1.697	0.928	0.533-1.492	20.68
7-10 yrs	1.008	0.486-1.697	1.006	0.554-1.702	22.03
>10 yrs	0.848	0.345-2.021	0.878	0.407-1.672	19.51

*CI: Confidence interval

Sex	Odd ratio	95% CI*	Relative risk	95% CI*	Incidence(%)
Male	0.898	0.533-1.514	0.919	0.613-1.386	21.13
Female	1.114	0.722-1.631	1.088	0.722-1.631	22.98

*CI: Confidence interval

Table 3: Sex wise incidence, risk and association of Cardiac arrhythmias in dogs

The highest incidence (29.68%) of CA was recorded in dogs of 1-3 year age group followed by 0-1years (25.92%), 7-10 years (22.03 %), 5-7 years (20.68 %), >10 years (19.51%) and 3-5 years (17.70 %) age groups. The sex wise analysis of data revealed higher incidence and risk with positive association of CA in female (22.98%) than males (21.13%). The detailed

age wise and sex wise values of relative risk and odd ratio at 95% CI has been presented in Table 2 and 3.

Cardiac Abnormalities Detected by ECG

A total of 20 types of CA have been detected by ECG with most common finding of low voltage QRS complexes in 20.73% dogs (Table 4).

Table 4: Types of cardio-vascular abnormalities recorded in dogs by electrocardiography

Sr. No.	Parameters	Percent positive
1	Sinus tachycardia	6 (7.30%)
2	Sinus Bradycardia	5 (6.09%)
3	Atrial fibrillation	6 (7.30%)
4	Atrial flutter	1 (1.21%)
5	Atrial tachycardia (APCs)	3 (3.65%)
6	Sinus arrest (Sino atrial Block)	5 (6.09%)
7	Sick sinus syndrome with AV block	1 (1.21)
8	Hyperkalemia (Atrial Standstill)	12 (14.63%)
9	Wandering pacemaker	1 (1.21%)
10	Low voltage QRS	17 (20.73%)
11	P- pulmonale (Right atrial enlargement)	2 (2.43%)
12	P- mitrale (left atrial enlargement)	4 (4.87%)
13	2 nd degree AV block (Mobitz type II)	4 (4.87%)
14	Ventricular escape rhythm (Idioventricular rhythm)	1 (1.21%)
15	Right Ventricular enlargement	7 (8.53)
16	Left anterior fascicular block	1 (1.21%)
17	Biventricular enlargement	3 (3.65%)
18	Left ventricular enlargement	1 (1.21%)
19	Electrical alternance	1 (1.21%)
20	Ventricular tachycardia (VPCs)	1 (1.21%)

Biochemical Analysis

The plasma concentration of chloride (Cl⁻) was found significantly (P<0.05) elevated in animals with CA as compared to the healthy dogs. However, the plasma concentration of sodium (Na⁺), potassium (K⁺), calcium (Ca⁺⁺), phosphorus (P), magnesium (Mg⁺⁺), blood urea nitrogen (BUN) and creatinine in diseased animals were found statistically non-significant when compared with healthy dogs (Table-5).

Table 5: Biochemical parameters (Mean ± SE) in healthy and dogs with cardio-vascular abnormalities

Parameters	Diseased (n=82)	Healthy (n=6)
Na+ (mEq/L)	134.88 ± 6.40	138.46 ± 2.51
K+ (mEq/L)	4.12 ± 0.23	3.10 ± 0.31
Calcium (mg/dl)	8.24 ± 0.35	8.12 ± 0.36
Mg ⁺⁺ (mg/dl)	3.05 ± 0.11	3.48 ± 0.33
P (mg/dl)	3.04 ± 0.35	4.00 ± 0.33
Chloride (mEq/L)	89.06 ± 2.11*	90.37 ± 4.12
BUN (mg/dl)	18.94 ± 2.34	16.13 ± 1.92
Creatinine (mg/dl)	1.04 ± 0.11	0.96 ± 0.34

*Denotes significance (P ≤ 0.05) between row

DISCUSSION

The overall incidence of various types of CA in the present study was 21.92% (82/374) however much less incidence (7.67%) was reported in dogs (Sarita, 2008). Similarly, in another study 11% of dogs showed reliable signs of heart diseases and 9% had possible heart disease (Detweiler and Patterson, 1965). In the present study, the highest incidence of CA was found in Pomeranian when compared with other

breeds. Our findings are in agreement with earlier studies in which the prevalence of cardiac arrhythmia and conduction disturbances in different breeds in India was found highest in Pomeranian (Changkija, 2007; Sarita, 2008). The possible reason for higher risk and incidence of CA in Pomeranian breed in present and other studies in India could also be due to more number of dogs of this particular breed presented due to preference of Indian dog lovers for Pomeranian than other breed of dogs.

On further analysis of breed wise risk factor, odd ratio values in case of Pomeranian indicate that they were 2.103 times more prone to CA when compared with other breeds of study. Similarly the value of relative risk in Pomeranian (1.764), German shepherd (1.081) and Labrador (1.033) indicated positive association of these breeds with CA. The risk of developing a particular type of heart diseases varies with breeds (Gulanber et al., 2005).

The age wise analysis of data revealed highest incidence of CA in 1-3 years of age group, followed by 0-1 years, 7-10 years, >10 years with lowest in 3-5 year age group for CA. Similarly the risk of development of cardiac diseases is more in 1-3 years of age group followed by 0-1 and 7-10 years of age group with relative risk value of more than 1 indicating positive association of these age groups with the CA. In another study, the highest age wise prevalence was in the 0-3 years (46.4%) followed by 31.1% in above 9 years of age (Sarita, 2008). However, the prevalence of arrhythmia as 80% in pups (up to 2month), 65.34% (2-6months), 58.75% (6 months to 1 year), 51.29% (1-3 years), 57.15% (3-5 years), 52.94% (5-10 years) and 57.69% in dogs of above 10 years of age (Changkija, 2007). In the present study the incidence as well as risk of development of CA was observed to be higher in females than the males. In contrast to our findings, the CA was higher in males (69.0%) than females (31.0%) in earlier study (Sarita, 2008).

The most common CA observed on ECG in present study was low voltage QRS complex followed by hyperkalemia, sinus arrhythmia and right ventricular enlargement. In another study of cardiac arrhythmia and conduction disturbances in normal canine population in India, 56.67% dogs showed various types of arrhythmias with sinus arrhythmia as most prevalent 45.97%, followed by supraventricular arrhythmia (6.10%), conduction disturbances (3.35%), multiple changes (0.83%) and ventricular arrhythmias in 0.42% dogs (Changkija, 2007).

The low voltage complex is suggestive of pericardial effusion and could also be found in cases of ascites (Tilley, 1985). The higher percentage of low voltage in present study correlate well with clinical signs as all dogs showing low voltage were found to be affected with ascites (Pandian, 2005). The hyperkalemia atrial standstill was recorded in 14.63% dogs in the present study. Contrary to our findings, atrial standstill is reported to be rare (Ettinger et al., 2000). In the present study, average potassium concentrations in dogs with CA were found to be higher than healthy dogs (4.12±0.23 and 3.10±0.31 mEq/L) which could be the possible reason for higher number of atrial standstill cases.

The sinus arrhythmia (6.09% sinus bradycardia and 7.30% tachycardia) recorded in this study has also been recorded by various other workers as one of the most common form of arrhythmia in young animals (Varshney and Tiwari, 2002; Changkija et al., 2006). The Deep Q-wave (greater than 0.5 mV in lead II) found in the present study

could be result of right ventricular enlargement (Tilley, 1985).

The other types of CA with lower percentage has been reported previously and include atrial fibrillation (Meurs et al., 2001), atrial tachycardia (Varshney and Chaudhary, 2007), sinus arrest (Kumar et al., 2011), wandering pacemaker (Saelinger et al., 2008), p-pulmonale (Eckeenfels and Tribes, 1979), second degree AV block –Mobitz type II (Mertin, 2007), left anterior fascicular block (Gordon et al., 1995), and biventricular enlargement (Tilley, 1985).

In the present study, the biochemical parameters of dogs with various CA were compared with healthy dogs. The serum concentrations of diseased and healthy for Na⁺, K⁺, Ca⁺⁺, Mg⁺⁺, Phosphorus, BUN and creatinine did not show any significant difference than the apparently healthy dogs except serum Cl⁻ concentration. The previous studies on clinico-pathological changes in tachyarrhythmias showed increase in serum concentration of Na⁺, Ca⁺⁺ and decrease in K⁺ and Mg⁺⁺ while dogs with bradyarrhythmias showed increased serum concentration of Na⁺, K⁺ and Mg⁺⁺ (Gupta et al., 2007). In another study, a non-significant decrease in serum K⁺ and Mg⁺⁺ was found in dogs with ventricular fibrillation than the healthy control whereas the serum Ca⁺⁺ was found significantly decreased than the healthy dogs (Salerno et al., 1987). The plasma K⁺ concentration in dogs with CA of present study was found higher than healthy dogs. In dogs, a mild increase in plasma K⁺ may lead to a variety of atrio-ventricular conduction abnormalities and changes in QRS which may simulate right bundle branch block or left bundle branch block in ECG recording if K⁺ is in range of 8.4mEq/L (Fisch et al., 1963). Only extreme increase in Ca⁺⁺ concentration produces arrhythmia under natural conditions, however mild increase plays minor role in production of arrhythmia (Surawicz and Gettes, 1971). Similarly the arrhythmias due to hypo or hypernatremia are rare in clinical conditions (Garcia-Palmieri, 1962). The role of Mg⁺⁺ in production of arrhythmia is not clear though; the studies suggest that hypomagnesaemia may enhance the susceptibility for arrhythmia (Tomiyasu et al., 1998). However, magnesium proved to play a vital role in the management of atrial, junctional and ventricular arrhythmia (Ho, 2008).

CONCLUSION

In nut shell it can be concluded that CA affects the significant proportion of dog population morbidity. The Pomeranian breed being the most favored pet among Indian animal lovers, the incidence and risk related to CA was also found higher than the other breeds of dog. The various types of arrhythmia and conduction disturbances were higher in young population than in the older ones which in future may lead to higher incidence of cardiomyopathy (dilated or hypertrophic) even in small breeds of dogs in India. Contrary to the earlier reports of male being at increased risk of CA, it was observed in the present study that females can also be at higher risk of developing CA. There was no significant difference in the biochemical parameters between dogs with CA and healthy control dogs however dogs were found to suffer with different type of CA therefore it is concluded that presence of normal level of biochemical parameters does not rule out CA.

ACKNOWLEDGEMENT

The financial assistance given to the first author in the form of INSPIRE FELLOWSHIP for Ph.D research work by DST, GOI to conduct the study is thankfully acknowledged. We also acknowledge the support of Joint Director (Academic) and Director, Indian Veterinary Research Institute, Izatnagar, Bareilly for providing necessary facilities to carry out research work.

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