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Analysis of Arrhythmia of the Heart in Dogs

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Abstract

The incidence of cardiac arrhythmias was studied in 435 dogs with a history of generalized diseases over a period of one year and two months from July 2022 to September 2023. The assessment was aimed to evaluate arrhythmias incidences and revealed 114 dogs (26.21%) exhibited various types, such as atrial fibrillation (30.70%), ST- coving and sinus arrest (9.65%, each), and ST-segment elevation (8.77%, each). Notably, atrial fibrillation had the highest incidence. Dogs over six years old accounted for most cases (59.64%), and Labradors showed the highest breed-specific occurrence (29.82%). Male dogs were more prone to arrhythmias (81.58%) than females (18.42%). This comprehensive analysis sheds light on the incidence and characteristics of arrhythmias in dogs.

Key words : Atrial Fibrillation, Heart Blocks, SVPC, VPC.

Cardiac arrhythmias are defined as deviations from normal cardiac impulse generation, conduction, rate, and regularity. Cardiac arrhythmias can have a variety of separate or combined causes, all of which are common. The causes of cardiac rhythm disruptions are multifaceted and include heart disease as well as conditions affecting the autonomic nervous system, endocrine system, electrolytes, and other body systems.

Cardiac diseases in the case of canines have a similar prevalence to humans. According to the AVMA in 2019, canine cardiac diseases affect 1 out of every 10 dogs (Dove 2001). For extended period, many dogs with heart disease may show no symptoms. Cardio-vascular diseases in dogs have spiked many folds in the recent past emanating predominantly from factors such as diet, genetics, and stress. The rising prevalence of cardiac failure, one of the leading causes of mortality in dogs, illustrates the significance of heart illnesses as a prevalent clinical issue.

Electrocardiography (ECG) emerges as a pivotal non-invasive diagnostic tool to assess the electrical activity of the heart, providing valuable information on heart rate, rhythm, and conduction. As the prevalence of cardiac diseases continues to rise, comprehensive understanding and effective diagnosis are imperative for addressing these significant clinical concerns in canine health. In addition to capturing disruptions in electric potential known as arrhythmias, electrocardiography is a reasonably cheap and non-invasive method that can detect electrolyte imbalance, drug toxicity, and less specifically myocardial and pericardial heart disease.

There is a paucity of information in the existing scientific literature regarding the occurrence of common cardiac arrhythmias and their etiopathogenesis in dogs of Himachal Pradesh. 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. Veterinarians should have up-to-date statistics on the prevalence of canine arrhythmias in connection to their association

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and risk for different breeds, ages, and genders. No such study on cardiac arrhythmias in dogs of Himachal Pradesh state has been reported to date. Therefore, the goal of the current study is to document the incidence, risk associations, and changes caused by cardiac arrhythmias and to implement the use of ECG based on the prevalence of the cardiac disorders found in the dogs of Palampur City of Himachal Pradesh.

Materials and Methods

435 canine subjects were enrolled in the study conducted at the Advanced Multispecialty Veterinary Clinic in Palampur throughout 14-months, commencing in July 2022 and concluding in September 2023. Specifically, dogs that were presented to the clinic with a clinical history indicative of generalized maladies encompassing exercise intolerance, respiratory distress, cyanosis, coughing, lethargy, weakness, anorexia, ascites, and gastroenteritis, among others, during preliminary screening assessments, were taken as subject for the study. These dogs underwent a comprehensive investigative protocol, which encompassed physical examinations, auscultatory evaluations, and subsequent Electrocardiography (ECG) recordings, employing the Vesta 301i apparatus, a 3-channel, 12-lead ECG machine.

For the ECG acquisition, each dog was positioned in a right lateral recumbent posture, with its four limbs oriented perpendicular to the longitudinal axis of the body. Following adequate fur removal and the application of conductive gel to the epidermal surface, the right arm (RA) and left arm (LA) electrodes were affixed to the forelimbs proximal to the olecranon along the caudal aspect. Conversely, the right leg (RL) and left leg (LL) electrodes were affixed proximally to the patellar ligament on the cranial aspect of the hind limbs, all following the norms. Precise attention was given to prevent any electrode contact. In cases where the animal exhibited signs of distress under the specified positioning, the ECG acquisition was executed with the animal in a standing stance. All dogs underwent a thorough assessment of crucial cardiac parameters including heart rate, rhythm analysis, and scrutiny for anomalies in the morphology and duration of the cardiac complexes.

Results and Discussion

Out of these 435 dogs subjected to electrocardiography, 72 dogs exhibited sinus rhythm arrhythmias (38 sinus arrhythmias,22 wandering pacemakers,10 sinus tachycardias, and 2 sinus bradycardias), 105 that had abnormal wave morphology, and 114 that had pathological arrhythmias. The pathological arrhythmias were further sub-classified into supraventricular arrhythmias (43;37.72%) and ventricular arrhythmias (12; 10.53%). A total of 26.21% of dogs with various systemic disorders were found to have cardiacarrhythmias. There were cases with multiple arrhythmias, conduction disturbances, and waveform morphological abnormalities. The incidence of arrhythmia in dogs with generalized diseases reported in the current study is higher than the observations of Kumar *et al*., (2014). They reported the prevalence of cardiacarrhythmias in dogs to be 7.27% and 21.92% respectively and less than Noszczyk-Nowak *et al*., (2017) who reported pathological arrhythmias in 39.55% of the dogs suspected of cardiac diseases. The variations in the populations being screened in each study and the inclusion criteria for dogs could be the cause of the disparity in the prevalence rates.

The arrhythmias detected in dogs that screened are depicted in (Table I). Pathological arrhythmias recorded in the study were atrial fibrillation, SVPC/APC, VPC/VT, VF, and atrial flutter (35; 30.70 %), 7 (6.43%), 9 (7.89%), 3 (2.63%) and 1 (0.88%), respectively. The highest incidence was of atrial fibrillation.

In the current study, the most commonly observed arrhythmia was atrial fibrillation (n=35; 30.70 %). (Fig. 2) represents an electrocardiogram with atrial fibrillation. This is in accordance with Tejaswi *et al.,* (2023) and Noszczyk-Nowak *et al*., (*loc cit*.) who reported AF as the most common form of arrhythmia recorded with incidence of 32.1% and 33.68%, respectively. In dogs exhibiting symptoms of heart disorders, Saho *et al*.,(2021) found that the prevalence of AF was 22.58% among supraventricular abnormalities. Guglielmini *et al*.,(2000) in a study found out the incidence of AF to be 24.3%. This result is also consistent with statement made by Tejaswi *et al*., (2023) that AF

is the most typical arrhythmia in cardiac dog patients. The finding might be the result of the fact that the bulk of the population, including those studied, belongs to the cardiac group, as revealed by their echocardiographic examination.

Nine dogs (7.89%) had ventricular premature complex (VPC). (Fig. 1,6,7,8,9,10) and (Fig. 12) represent various morphologies of QRS-T associated with VPCs. This conclusion is smaller than Noszczyk-Nowak *et al*., (*loc cit*.) who reported VPCs as 23.37% in their study in cardiac afflicted dogs and is likeHellemans*et al*.,(2022) recording of VPCs among dogs with pathological arrhythmias. The results obtained are greater than Guglielmini *et al*., (*loc cit*.) who found in their study the incidence of VPC to be 2.40%.

The current study revealed that the incidence of atrial premature complex/atrial tachycardia is 7 (6.14%) which is slightly higher than the investigated findings of Kumar *et al*., (*loc cit*.) who found the incidence of atrial tachycardia to be 3.3% and 3.65% respectively. (Fig. 3) represents an ECG with supraventricular premature complexes or atrial premature complexes.

In conduction disturbances ST coving, sinus arrest or block, ST elevation, 1st degree heart block, electrical alternans, atrial standstill, Bundle Branch blocks, 2nd degree heart block and 3rd degree heart block were studied and their incidence recorded were 11 (9.65%), 11 (9.65%), 10 (8.77%), 10 (8.77%), 8 (7.02%), 3 (2.63%), 4 (3.51%), 1 (0.91%) and 1 (0.91%) respectively as represented in (Table II). The highest incidence observed among conduction disturbances was ~~of~~ sinus arrest and ST-coving.

The current investigation revealed, the incidence of sinus arrest was found in 11 (9.65%) canines. This documented rate is higher than the findings of Saho *et al*., (2021), who found that supraventricular anomalies in dogs exhibiting symptoms of cardiac disorders were more likely to cause sinus arrest than other abnormalities (4.84%). Dogs with pathological arrhythmias had a higher incidence of sinus arrest, according to Noszczyk- Nowak *et al*., (*loc cit*.), which was 27.58%. (Fig. 11) represents an electrocardiogram with sinus arrest.

The study undertaken revealed 10 canines (8.77%) to have first-degree HB. According to Noszczyk-Nowak *et al*., (2017) 12.63% of dogs with pathological arrhythmias had 1st degree HB. 2nd and 3rd degree HB is found in 1 (0.88%) dog each. (Fig. 1) represents third degree/complete heart block also known as ventricular standstill. This is in accordance with Guglielmini (*loc cit)* who recorded the prevalence of 2nd and 3rd degree HB as 0.5% in canines with cardiac abnormalities. This result is less than that of Noszczyk- Nowak *et al*., (*loc cit*.), who found that it was 6.74% in canines with pathological arrhythmias. One (0.88%) dog is found to have atrial flutter which is in accordance with the study of Kumar (*loc cit*.) who found 1 case of atrial flutter (1.21%), in a study conducted on 374 patients in Bareilly.

Table I: Table representing pathological arrhythmias

S.No.	Arrhythmia	Animals Affected	% Incidence (n=114)
1	Atrial fibrillation	35	30.70
2	Atrial Premature Complex/AT	7	6.14
3	Atrial Flutter	1	0.88
4	Ventricular Premature Complex/VT	9	7.89
5	Ventricular Fibrillation	3	2.63

Table II: Table representing conduction disturbances

S.No.	Arrhythmia	Animals Affected	% Incidence (n=114)
1	Sinus Arrest	11	9.65
2	Atrial Standstill	3	2.63
3	1st degree Heart Block	10	8.77
4	2nd degree Heart Block	1	0.88
5	3rd degree Heart Block	1	0.88
6	Bundle Branch Blocks	4	3.51
7	ST elevation	10	8.77
8	ST coving	11	9.65
9	Electrical alternans	8	7.02

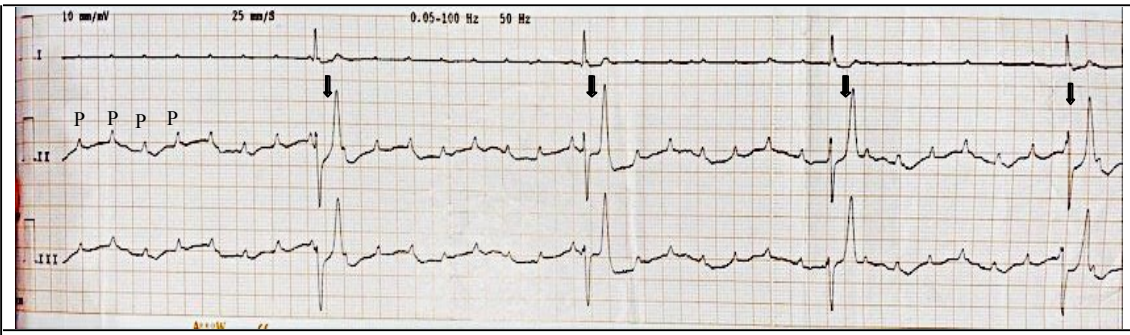

Fig 1: Third degree AV block (complete heart block) along with Ventricular Ectopic Complexes indicated by arrows in a 10-year old Mongrel suffering from MMVD and DCM (paper speed @25mm/sec, 10mm/mv standardization). Complete heart block is suggestive as there are P-waves (as marked) with no associated QRS complexes.

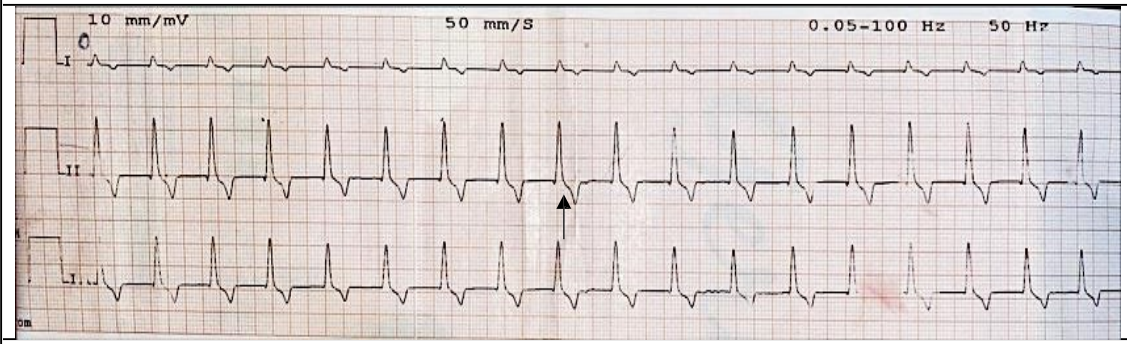

Fig 2: Atrial fibrillation (no discernible P-wave) and ST-coving (arrows) in a 5 year Labrador which later got diagnosed with tricuspid regurgitation and right atrial enlargement (paper speed @50mm/sec, 10mm/mv standardization).

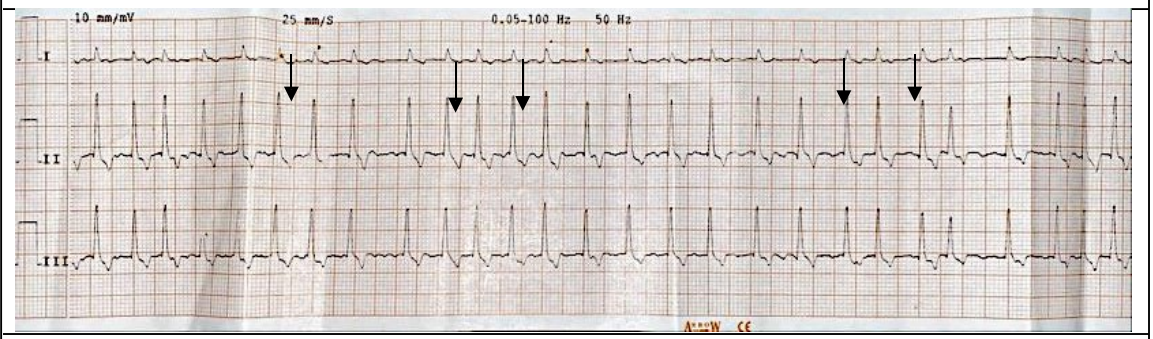

Fig 3: Supraventricular tachycardia (arrows represent Atrial Premature Complexes) in a 8 year old Pomeranian diagnosed with Left atrial enlargement (paper speed @25mm/sec, 10mm/mv standardization). APCs are suggestive with the merging/coinciding P-wave with preceding T-wave.

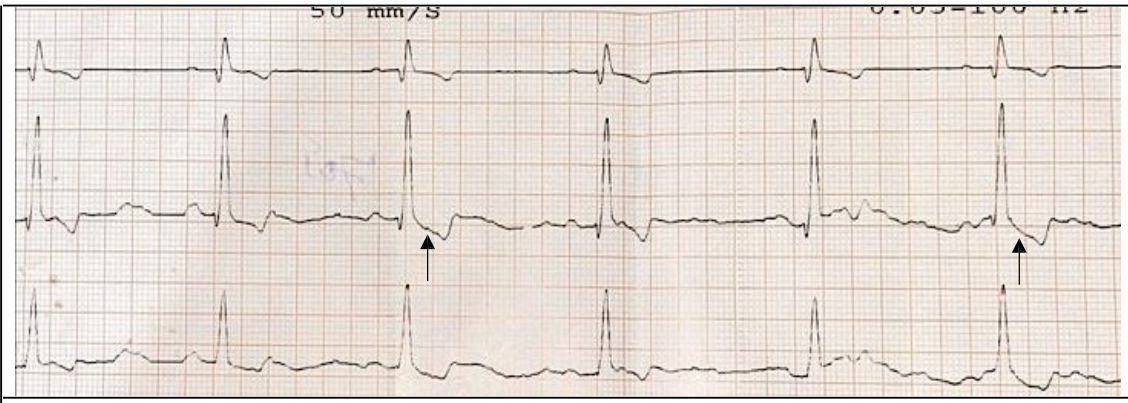

Fig 4: ST- coving in a 8 week old Labrador puppy with Canine Parvoviral Enteritis (paper speed @50mm/sec, 10mm/mv standardization).

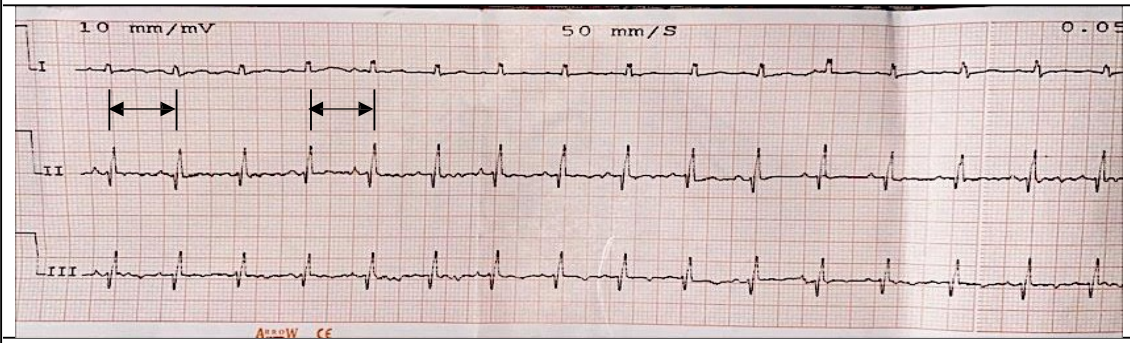

Fig 5: Atrial flutter (equal RR interval) regular rhythm unlike AF; 12 year old Rottweiler presented with syncope and exercise intolerance. Later diagnosed with HCM (paper speed @50mm/sec, 10mm/mv standardization). Heart Rate- 230 bpm

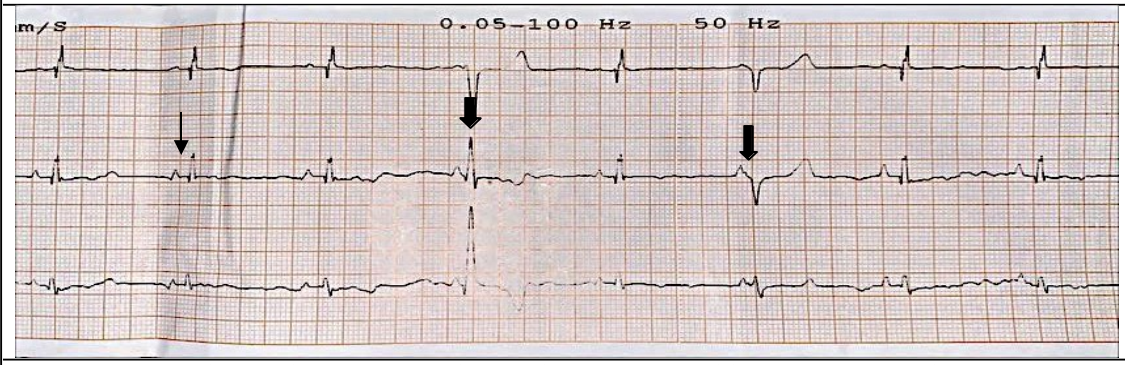

Fig 6: Polymorphic multiform VPC observed in a 13-year old pomeranian with MMVD. Broad arrows represent VPCs and thin arrow represents sinus rhythm (paper speed @25mm/sec, 10mm/mV standardization). Polymorphic VPC indicates multiple morphologies of VPC in a single electrocardiogram.

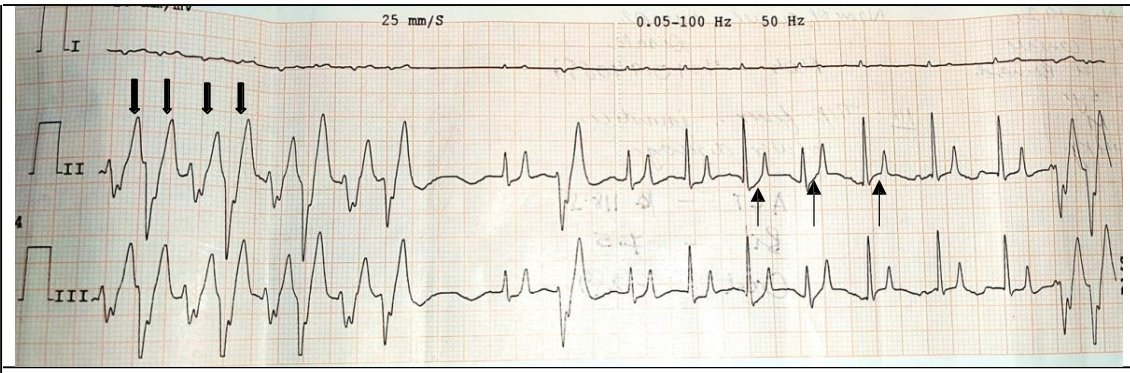

Fig 7: Paroxysmal ventricular tachycardia (more than 4 consequent VPCs-as shown by broad arrows), along with electrical alternans and ST-elevation (thin arrow) in a 7-year St. Bernard with MMVD and CHF leading to pericardial effusion and ascites (paper speed @25mm/sec, 10mm/mv standardization).

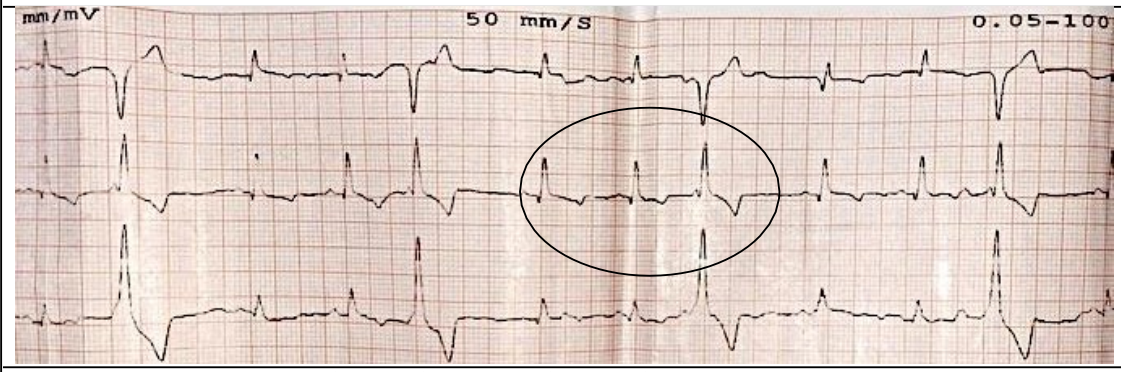

Fig 8: ECG from a spitz dog with CHF and UTI, showing two sinus complexes alternating with ventricular premature complexes; this is termed ventricular trigeminy (paper speed @50mm/sec, 10mm/mv standardization).

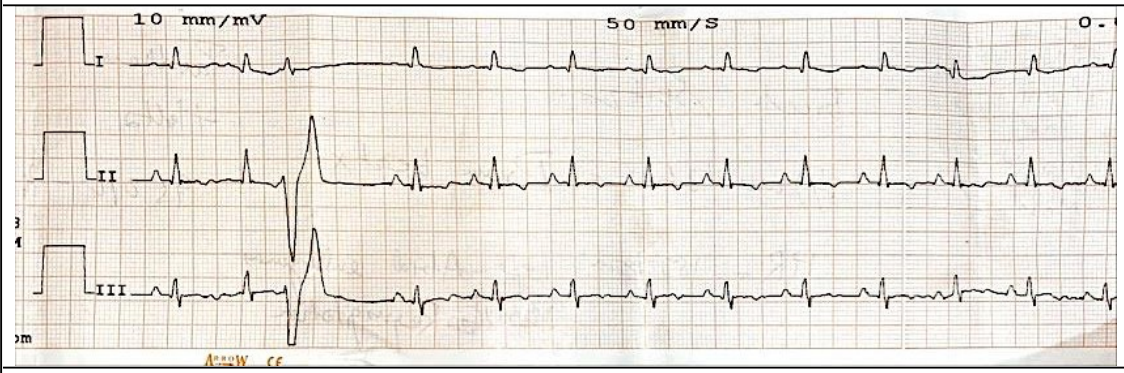

Fig 9: ECG of a Pomeranian 13-year-old, showing a single VPC later diagnosed with MMVD (paper speed @50mm/sec, 10mm/mv standardization).

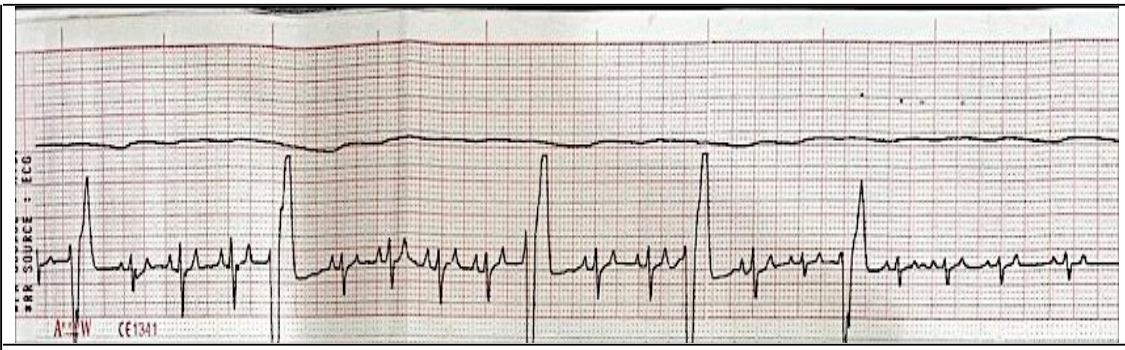

Fig 10: ECG of a Mongrel dog, 9-year old with history of respiratory distress and nocturnal coughing, representing VPCs at irregular intervals, with bizzare morphology of QRS-T wave (paper speed @25mm/sec, 10mm/mv standardization).

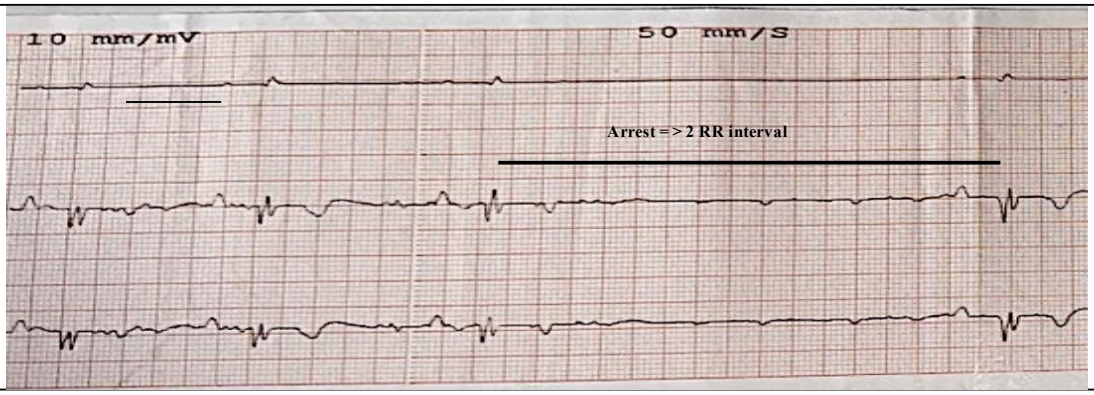

Fig 11: ECG in a geriatric (14-year old) Golden Retriever with history of frequent syncope, exercise intolerance and shortness of breath, revealing sinus arrest with RR interval > twice the sinus RR interval preceding.

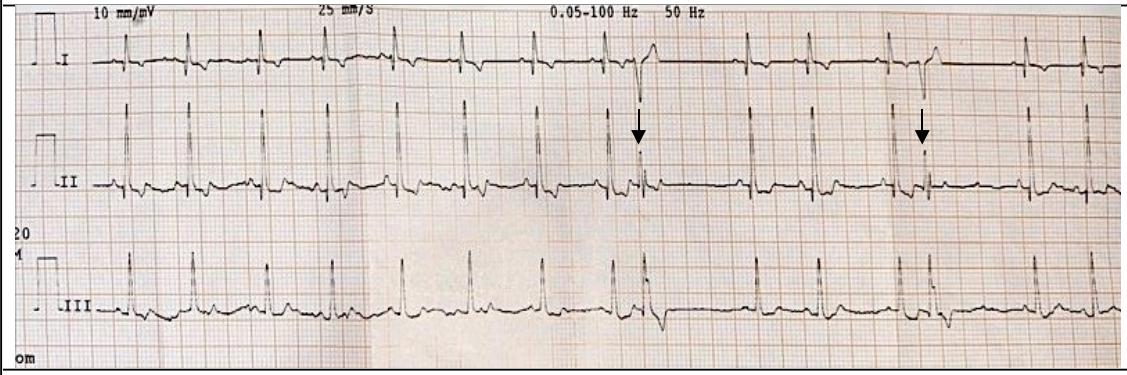

Fig 12: ECG in a 8-year old Labrador cross with pericardial effusion and CHF, representing either VPC or JPC/Junctional Premature Complex (paper speed @25mm/sec, 10mm/mv standardization).

Age-wise incidence of arrhythmias was highest in > 6-years age group 68 (59.64%), followed by 2-6 years age group 32 (28.07%) and was least in <2-year age group 14 (12.28%). Data is presented in (Table III). This result is in line with observations made by Kavitha *et al*., (2022) and Mukherjee *et al*., (2020) that arrhythmic patterns were more common in older dogs as opposed to results made by Kumar *et al*., (2014) and Noszczyk- Nowak *et al*., (2017) that this pattern was more common in young dogs. In Rajendranagar, Hyderabad, Haritha *et al*., (2017) did a study and discovered that dogs between the ages of 5 and 10 had the highest prevalence of arrhythmias compared to dogs of other ages, which is consistent with our study. Similar incidence (57.1%) was discovered by Tejaswi *et al*.,(2023) in dogs older than 7 years and it could be as of result of the high occurrence of heart illnesses in older canines.

Table III: Table representing age wise incidence of arrhythmias in dogs

S.No.	Age Group	Animals Affected	% Incidence (n=114)
1	<2y	14	12.28
2	2-6y	32	28.07
3	>6y	68	59.64

The breed wise incidence of arrhythmias in dogs is presented in (Table IV). The highest incidence was recorded in Labrador retriever 34 (29.82%) followed by Pomeranian 25 (21.92%), Mongrel 14 (12.28%), German Shepherd 13 (11.40%), Golden Retriever 8 (7.02%) and Gaddi 7 (6.42%), with lowest in Dobermann3 (2.63%). Breed wise incidence of arrhythmias ranged from 2.63% to 29.82%, the highest incidence was recorded in Labrador retriever 29.82% followed by Pomeranian 21.92%, Mongrel 12.28%, German Shepherd 11.40%, Golden Retriever 7.02% and Gaddi 6.14% each, giant breeds 5.26% , toy breeds 3.51% and Dobermann 2.63 %, respectively. These results are in line with those of Mukherjee *et al*., (2020), who found that Labradors had the highest incidence of arrhythmias, and Kumar *et al*., (2014), who found that the Pomeranian breed had the highest incidence of CA (30.70%) and suggested that this may be because these breeds have a greater tendency than other breeds to develop a variety of cardiac conditions that lead to arrhythmias. Haritha *et al*., (2017) concluded that the incidence of arrhythmias to be highest in Labrador retrievers than in any other breed which is in accordance with our study. This may be due to the fact that Pomeranians being small breeds may have significant genetic component to cardiac diseases such as HCM, DCM and MMVD and related arrhythmias. Labradors being the most widely kept pet dogs all over India can be the reason for their most prevalence in any disease factor.

Table IV: Table representing breed wise incidence of arrhythmias in dogs

S.No.	Breed	Animals affected	% Incidence (n=114)
1	Labrador	34	29.82
2	Pomeranian	25	21.92
3	Mongrel	14	12.28
4	German Shepherd	13	11.40
5	Golden Retriever	8	7.02
6	Gaddi	7	6.14
7	Dobermann	3	2.63
8	Toy Breeds (Shi Tzu, Lhasa, Pug)	4	3.51
9	Giant Breeds (St. Bernard, Rottweiler, Bully)	6	5.26

The incidence of arrythmias was relatively higher in male dogs 93 (81.58%) when compared to that of females 21 (18.42%). The data is presented in (Table V). These findings are consistent with Noszczyk-Nowak *et al*., (2017). Tejaswi *et al*., (2023) found near similar observation with 75% incidence of cardiac arrhythmias in male and 25% in female dogs. According to Noszczyk-Nowak *et al*., (2017), male dogs were more frequently affected by cardiac rhythm disorders overall. The findings of Gupta *et al*., (2007) and Kumar *et al*., (2014) who reported that it was more prevalent in females are in contradiction to this finding. Male dogs were shown to be more likely than female dogs to develop cardiac disorders, which could be a potential explanation for the higher prevalence of arrhythmias in males, according to Vishnurahav *et al*., (2018). Also, the population of male dogs (328) under screening process

was more than female dogs (82), as more male dogs are kept by the people of Palampur area than the female dogs.

Table V: Table representing gender wise incidence of arrhythmias in dogs

S.No.	Gender	Animals affected	% Incidence (n=114)
1	Male	93	81.58
2	Female	21	18.42

This discrepancy in the results may be the result of differences in the inclusion criteria for dogs, sample size, and duration of the study.

Conclusion

To conclude, it can be said that cardiac arrhythmias affect a sizeable amount of the morbidity in the canine population. According to the aforementioned studies, arrhythmias are primarily observed in geriatric dogs, with AF being the most common arrhythmia in canines with generalised illnesses. The Labrador retriever breed and male dogs, respectively, had the highest prevalence of arrhythmias. Therefore, conducting random ECG analysis in adult dogs may assist in both preventing fatal outcomes, and in early detection of cardiac abnormalities as well as pathological arrhythmias. Efforts must be made to incorporate the practice of taking ECG in routine examination of dogs in order of the early detection of any abnormality related or unrelated to cardiac condition.

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