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COMPARISON OF TWO METHODS IN THE DETERMINATION OF HEART'S MEAN ELECTRICAL AXIS IN DOGS

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SUMMARY: In the process of interpreting an electrocardiogram (ECG) the mean electrical axis of the heart needs to be determined. In veterinary electrocardiography the mean electrical axis (MEA) is figured in the frontal plane and can be calculated by using several different ways. In this study, values of the MEA, calculated by two methods (the isoelectric lead method and the vector method), were compared. The aim of this study is to establish whether different methods give different values for MEA. German shepherd dogs of different age, presenting in sinus rhythm, were used in the study. Electrocardiograms (ECGs) were recorded while the dogs were in standard position (right lateral recumbency). The determination of mean electrical axis were performed by examining the QRS complexes in each of the peripheral leads (I, II, III, avR, aVL, aVF). Mean values of the MEA were calculated by two methods were $\bar{x}1 = 76{,}50^o \pm 19{,}83$ *i* $\bar{x}2 = 80{,}17^o \pm 11{,}44$*. Values of the MEA determined by two methods were not statistically different (p = 0,384). These results show that value of the MEA in healthy dogs is not under significant influence of the method chosen for calculation.*

Key words: *mean electrical axis, calculation, German Shepherd dogs.*

INTRODUCTION

An interpretation of electrocardiogram implies the assessment of heart rate and rhythm, and determination of heart's mean electrical axis (MEA) and ECG's parameters. Determination of the MEA means the determination of the average (mean) direction that the wavefront of depolarization moves in the heart. The MEA can be applied to atrial depolarization (P wave), ventricular depolarization (QRS) or ventricular repolarization (T wave), but most commonly determined only for ventricular depolarization. The direction of net vector of electrical activity is determined by examining the QRS complexes in each of the six basic leads of Bailey's hexaxial lead system. In veterinary electrocardiography the mean electrical axis is usually figured in the frontal plane. According to this only the six peripheral leads of ECG recording are used to calculate the MEA (Edwards, 1987).

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Calculation of the MEA with an ECG is non - invasive diagnostic method, easy and chip, which evaluates how the heart is oriented in the chest, what is the size of cardiac chambers (increase or loss of ventricular myocardium), and are there conduction defects in bundle branches. These changes could be the result of variety of heart diseases (congenital and acquired heart diseases, myocardial infarct, heart base tumors). Normally, the MEA for the dogs is between +40° do +100°. Shiftings of the MEA direction can be left axis deviation (myocardial hypertrophy, conduction defects of left bundle branch) and right axis deviation (right ventricle enlargement, right bundle brunch block) (Kittleson, 1998).

The former studies have evaluated values of MEA due to different positioning of the patients (Detweiler, 1993; Rishniw et al., 2002; Harvey et al., 2005; Ghită et al., 2007). Studies have shown that position of the heart in thorax and changes of electrodes placement influence the MEA value. In dogs MEA shifts to the left when dog is placed in standing (Rishniw et al., 2002) or sitting position (Coleman et al., 2005), because of the changes of heart position in thorax. Due to all these a posibility of incorrectly diagnosing left heart enlargement in a normal dog is increased. There are different methods for calculating MEA (Edwards, 1987; Kittleson 1998; Rishniw et al., 2002; Harvey et al., 2005; Farasin et al., 2006; Singh, Athar, 2003; Singh, Athar, 2006). In this work two methods, commonly used in clinical practice, are compared: the isoelectric lead method and the vector method. The aim of this study is to establish is there any difference of MEA value if different methods of MEA calculation are used.

MATHERIALS AND METHODS

In this study 31 German Shepherd dogs were used. Dogs' age were from 1 – 13 years. All dogs considered healthy based on history of no cardiac disease and normal cardiovascular physical examinations. The dogs enrolled in this study were in sinus rrhythm. The assessment of the MEA is performed with examination of standard 6-lead electrocardiogram (I, II, III, aVR, aVL, aVF). During ECG recordings all dogs were placed in standard recording position (right lateral recumbency). For calculation of the MEA two methods are used: the isoelectric lead method and the vector method.

The isoelectric lead method: first, the isoelectric lead is found. The isoelectic lead is one in which the sum of all the positive and negative deflection of the QRS complex equals zero. The six- axis system is used to find the lead which is perpendicular to the isoelectric lead. The MEA is oriented toward the direction of QRS of the perpendicular lead. If QRS is positive the MEA is oriented toward the positive pole of that lead and if it is negative, the MEA is oriented toward the negative pole of that lead.

The vector method for determining the MEA involves selecting any two limb leads (I, II or III). The algebraic sum of positive and negative deflection of the QRS complex is calculated for each of the two selected leads. Values are plotted on graphical display of each of the two selected leads. Afterwards, perpendiculars are drown from each lead. The MEA is represented by the line drown from the center of the axis chart to the point at which the two perpendicular lines meet.

The data are reported as the mean ± SD. Student t- test for independent samples is used to compare values of the MEA calculated by two different methods. Difference in the incidence of MEA deviation from normal reference values was assessed by Fisher probability test. Values of $p < 0,05$ were considered significant.

RESULTS AND DISCUSSION

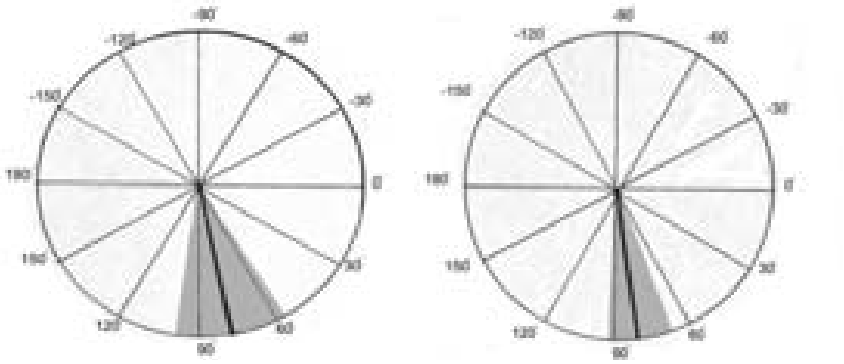
In one dog, axis could not be determined in frontal plane due to fact that QRS complexes was isoelectric in all peripheral leads (Figure 1). This dog is excluded from the study.

Figure 1. Electrically vertical heart
Slika 1. Električno vertikalno srce

Analysis of MEA value of each dog calculated by the isoelectric lead method, has shown the devitation from the reference values in two dogs. If MEA was calculated by the vector method, deviation from the reference values has existed in one dog. The incidence of MEA deviation from normal reference values assessed by different method of the MEA calculation, were not statistically significant.

Interpretation of ECGs of many dogs' breeds shows that differences among them could exist. The studies performed in German Shepherd dogs (Rezakhani et al., 1990; Rouholamin et al., 2000; Spasojević Kosić, 2009) points some specificity of this breed. The mean heart rate is significantly different in dogs less than 12 months of age compered with dogs older than 12 months (Rouholamin et al., 2000). The most common arrhythmias in German Shepherd dogs are either sinus arrhythmia and wandering pacemaker (Rouholamin et al., 2000) or sinus arrhythmia and sinus pause (Spasojević Kosić, 2009). The mean duration of the P wave, and of the PR interval differed significantly between dogs younger and older than 12 months (Rouholamin et al., 2000). In the former study in German Shepherd dogs similar values of ECG's parameters are obtained, exept in the amplitudes of P and R waves in lead II and in the duration of PR interval in lead II (Rezakhani et al., 1990; Spasojević Kosić, 2009). These differences can be explained by different avarage age of dogs included in the studies. Although no significant incidence of phisiologic or benign arrhythmias is shown, the apperance of AV block 1° is registered in one third of dogs older than 8 years (Spasojević Kosić, 2009).

The normal MEA in the dog is 40 degrees to 100 degrees, or 40 degrees to 90 degrees for toy breeds (Edwards, 1987). The values of MEA obtained in the former studies of German Shepherd dogs are 81,19 ± 7,59° (Rezakhani et al., 1990), 81,97 ± 1,87° (Rouholamin et al., 2000) and 80,34 ± 2,80° (Spasojević Kosić, 2009). In this study, similar values of MEA are obtained irrespective of the method of calculation. The mean values of MEA calculated by the isoelectric lead method and the vector method were 76,50 ± 19,83 ° and $\bar{x}2 = 80,17 \pm 11,44$ ° respectively. There was no significant difference among values of MEA calculated by these two methods ($p = 0,384$). Since patient's position during ECG recording affects the obtained values of MEA, all dogs during ECG recordings were in standard position. Application of different methods of calculating MEA in healthy dogs does not result in significant differences in MEA.



A B

Figure 2. Mean (dark line) ± SD (shaded area) mean electrical axis (MEA) recorded from 30 German Shepherd dogs according to (A) the isoelectric lead method and (B) the vector method.
Slika 2. Srednja vrednost (tamna linija) ± SD (osenčena površina) srednje električne osovine srca snimnjene od 30 nemačkih ovčara prema (A) metodu izoelektričnog odvoda i (B) metodu vektora.

In humans, in instances of the left axis deviation of about -30°, differentiation between left ventricular enlargement and left incomplete hemi block and of minimal right axis deviation, accurate assessment of MEA is of paramount importance considering the management of the case (Singh, Athar, 2003).

The main limitation of this study is the fact that it is performed in healthy dogs. ECG changes could be more prominent in the dogs with heart disease, so it is necessary to further verify the results of this research among dogs with cardiac diseases.

CONCLUSION

Calculation of the MEA should be seen as an integral part of ECG's interpretation. In healthy dogs, calculation can be done by any of proposed methods, because the chosen method does not significantly affect MEA value. Additional studies are needed to evaluate the accuracy of calculating the MEA in dogs with heart disease.

REFERENCES

COLEMAN, M.G., ROBSON, M.C.: Evaluation of six – lead electrocardiograms obtained from dogs in a sitting position or sternal recumency. Am. J. Vet. Res., 66(2)233 – 237, 2005.

EDWARDS, N.J.: Interpreting the electrocardiogram. In: Bolton's handbook of canine and feline electrocardiography (D. Pederson, ed.). WB Saunders, Philadelphia, pp 32 – 60, 1987.

FARASIN, L., AMODIO, A., MURRAY, J.: Validation of 2 tehniques for electrocardiographic recording in dogs and cats. J. Vet. Intern. Med., 20:873 - 876, 2006.

GHITĂ, M., COTOR, G., BRĂSLAŞU, C., BOTEZATU, R.: Researches on the variation of the mean electrical axis in dogs depending on the ECG recording position. Lucrări ştiintifice medicină veterinară, 40:389 – 392, 2007.

HARVEY, A.M., FAENA, M., DARKE, P.G.G., FARASIN, L.: Effect of body position on feline electrocardiographic recordings. J. Vet. Intern. Med., 19:533 – 536, 2005.

KITTLESON, M.D.: Electrocardiography: basic concepts, diagnosis of chamber enlargement and intraventricular conduction disturbances. In: Small animal cardiovascular medicine (M.D. Kittleson, R.D. Kienle, eds.). Mosby, StLouis, pp. 72 – 95, 1998.
REZAKHANI, A., ATWELL, R.B., WEBSTER, J.: Electrocardiographic values of German shepherd dogs. Aust. Vet. J., 67(8)307 – 309, 1990.
RISHIW, M., PORCIELLO, F., ERB, H.N., FRUGANTI, G.: Effect of body position on the 6-lead ECG of dogs. J. Vet. Intern. Med., 16:69 – 73, 2002.
ROUHOLAMIN, R., REZAKHANI, A., SHIRANI, D.: A study on electrocardiographic parameters of the normal German Shepherd dogs in Iran. Journal of the Faculty of Veterinary Medicinie, University of Tehran, 55(4)21 – 25, 2000.
SINGH, P.N., SAJJAD ATHAR, M.: Application of Einthoven's law in calculating mean QRS axis. Indian J. Physiol. Pharmacol., letter to the editor, 50(1)90, 2006.
SINGH, P.N., SAJJAD ATHAR, M.: Simplified calculation of mean QRS vector (mean electrical axis of heart) of electrocardiogram. Indian J. Physiol. Pharmacol., 47(2)212 – 216, 2003.
SPASOJEVIĆ KOSIĆ LJ.: Heart rhythms and electrocardiographic values in German Shepherd dogs of different age. International symposium on canine arrhythmias, short communications, Turin, Italy, 2009.

POREĐENJE DVA METODA ODREĐIVANJA SREDNJE ELEKTRIČNE OSOVINE SRCA KOD PASA

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Izvod

Pri interpretaciji elektrokardiograma (EKG) potrebno je odrediti vrednost srednje električne osovine srca (SEO). U veterinarskoj elektrokardiografiji SEO srca se prikazuje u frontalnoj ravni, a može se izračunati korišćenjem različitih metoda. U ovom radu poredili smo vrednosti SEO kod pasa koje su dobijene pomoću dva metoda izračunavanja: metod izoelektričnog odvoda i metod vektora. Cilj ovog ispitivanja je da utvrdi da li postoji razlika u vrednosti SEO srca ukoliko se za njeno određivanje koriste različite metode. Psi rase nemački ovčar različite starosti, koji su imali sinusni srčani ritam su obuhvaćeni ovim ispitivanjem (n = 31). Svi psi su prilikom snimanja elektrokardiograma postavljeni u standardni položaj za snimanje (desni lateralni ležeći položaj). Poređenje dve metode izračunavanja SEO obavljeno je korišćenjem perifernih odvoda snimnjenih elektrokardiograma (I, II, III, avR, aVL, aVF). Prosečne vrednosti SEO bile su $\bar{x}1 = 76,50 \pm 19,83^{o}$ i $\bar{x}2 = 80,17 \pm 11,44^{o}$. Nije postojala statistički značajna razlika u vrednosti SEO srca koje su dobijene korišćenjem dve metode izračunavanja ($p = 0,384$). Dobijeni rezultati ukazuju da kod zdravih pasa na vrednost SEO ne utiče značajno odabrani metod njenog izračunavanja.

Ključne reči: srednja električna osovina, izračunavanje, nemački ovčari.

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