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Research Article

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Effect of Acute Haemorrhage on Lead-II Electrocardiogram of Nigerian Dogs

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Abstract Acute loss of massive amounts of blood has been associated with disturbances of cardiovascular homeostasis. In this study, we evaluated the Lead-II electrocardiogram of Nigerian local dogs following acute loss of massive amounts of blood. Six local dogs aged between 6 and 8 months were used in this study. An estimated 30% of total blood volume was removed to simulate acute haemorrhage. About 30 min prior to the removal of blood, Lead-II electrocardiogram was recorded and subsequently at 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 6, 12, 24 and 48 h. From each animal, a 120-second electrocardiogram was recorded and parameters such as heart rate, R-amplitude, QRS-duration and QT/QTc values. Statistical analysis was carried out using descriptive statistics and ANOVA at a significance level of $p<0.05$.

Induction of acute haemorrhage led to a significant ($p<0.05$) increase in heart rate and R-amplitude. Significant reduction ($p<0.05$) in QT/QTc values were observed from 0 hrs up till the termination of the study.

Acute hemorrhage corresponding to about 30% of estimated blood volume caused tachycardia and increased QRS-amplitude in Nigerian dogs. Increase in R-wave amplitude suggests that the Brody effect does not occur in Nigerian dogs.

Keywords Acute haemorrhage, Lead-II ECG, Nigerian dogs

Introduction

In recent years, transfusion medicine has found great use as a form of therapy in canine medicine [1-2]. However, after donation of blood, the welfare of donor animals is scarcely mentioned [3] and the effects of collection methods on donors is scarcely known [4]. In situations of moderate loss of blood, there is a fall in blood pressure which is compensated by a baroreceptor mediated rise in heart rate and vasoconstriction, while severe haemorrhage leads to fall in blood pressure accompanied by bradycardia [5]. In a study on retired racing Greyhounds, Torre et al., (1999) [6] reported a reduction in R-wave voltage on surface ECG following blood loss corresponding to about 30% of blood volume. This was attributed to reduced cardiac filling which consequently results in a diminished left ventricular end diastolic volume resulting in a smaller cardiac action potential through the Brody effect [7]. This study was conducted to evaluate the effect of acute loss of about 30% of the estimated blood volume on the Lead-II electrocardiogram of Nigerian local dogs.

Materials and Methods

A total of six local dogs, aged between 6 and 8 months of age were obtained from household units in Ibadan, Nigeria. They were housed at the boarding kennels of the Veterinary teaching hospital, VTH, University of Ibadan. The dogs were placed on various recipes of home cooked food and water was provided ad libitum. Prior to the commencement of the experiment, the dogs were clinically examined and adjudged clinically normal. They were thereafter allowed to acclimatize for a period of 2 weeks. On the day of the commencement of the study, a 120-

second electrocardiographic recording(ECG) was taken from each dog as earlier described by Tilley et al., (1992) [9]. Briefly, dogs were placed on right lateral recumbency with the limbs positioned perpendicularly to the long axis of the body. The limb electrodes were attached to the appropriate locations. About 30 minutes later, an estimated 30% blood volume was removed from each dog through jugular venipuncture. This was designated 0hr. The procedure was repeated at 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 6, 12, 24 and 48 h of the study. Parameters such as heart rate, R-amplitude, QRS complex, QT/QTc measurements were recorded from lead-II. Data obtained were analyzed using descriptive statistics and one-way ANOVA at a confidence interval of 95%.

Results

Following the induction of hemorrhage, there was a reduction in the heart rate from 103.0±18.2 /min to 101.8±4.5 /min. As early as 0.5 h post-induction of hemorrhage, statistically significant $p<0.05$ increase in heart rate was observed. The heart rate did not return to pre-induction values by the termination of the study at 48 h post-induction (Figure 1). There was a gradual increase in the R-amplitude post-hemorrhage. Statistically significant ($p<0.05$) increases were observed at 3, 4, 4.5 and 6h post-hemorrhage. Reductions in R-amplitude were recorded at 12, 24and 48 h post-hemorrhage (Figure 2). QRS duration reduced from 76.8±16.5 to 67.0±4.6 by 0 h post-hemorrhage. By 3 h post-hemorrhage, a significant ($p<0.05$) reduction in the QRS duration was observed (Figure 3). Significant reduction ($p<0.05$) in QT/QTc values were observed from 0hrs up till the termination of the study (Figure 4 and 5).

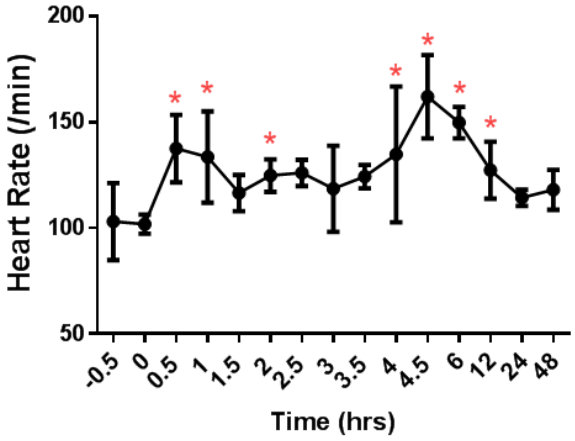

*Figure 1: Effect of hemorrhage on heart rate in Nigerian dogs. * represents statistical ($p<0.05$) when compared with baseline parameters*

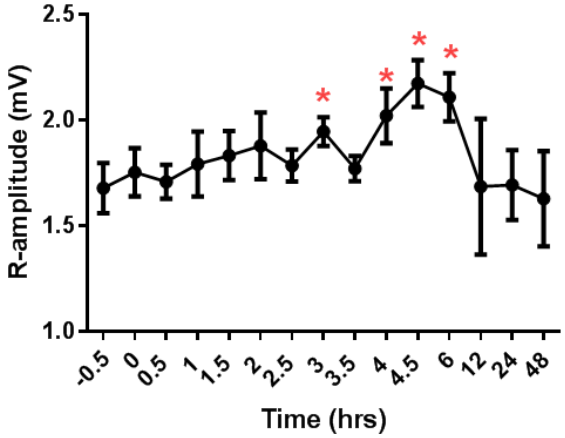

*Figure 2: Effect of hemorrhage on R-amplitude in Nigerian dogs. * represents statistical ($p<0.05$) when compared with baseline parameters*

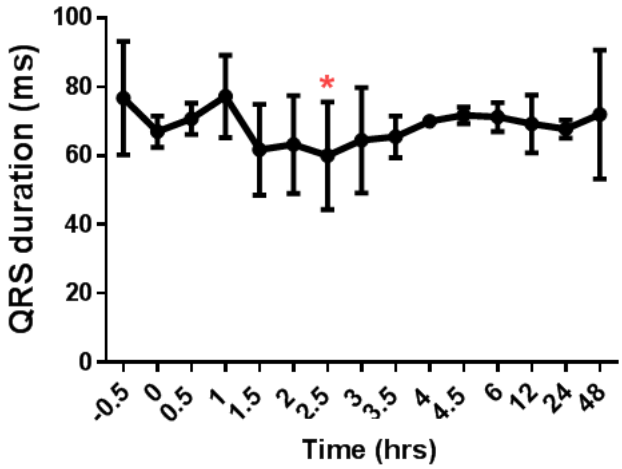

*Figure 3: Effect of hemorrhage on QRS duration in Nigerian dogs. * represents statistical (p<0.05) when compared with baseline parameters*

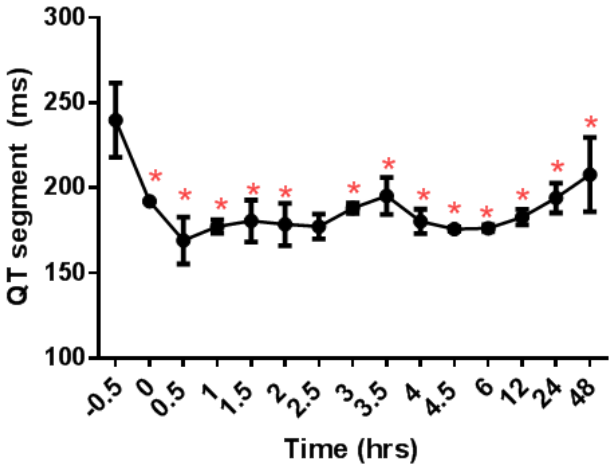

*Figure 4: Effect of hemorrhage on QT-interval in Nigerian dogs. * represents statistical (p<0.05) when compared with baseline parameters*

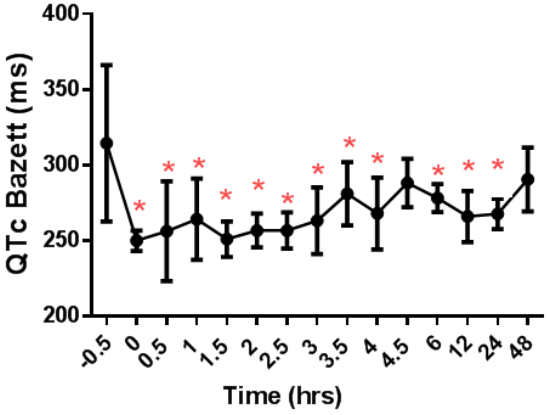

*Figure 5: Effect of hemorrhage on QTc values in Nigerian dogs. * represents statistical (p<0.05) when compared with baseline parameters*

Discussion

In this study, we evaluated lead-II ECG of dogs following the withdrawal of an estimated 30% circulating blood volume during baseline rest and at different intervals over a period of 48 h. Increase heart rate recorded in this study is similar to those reported in earlier studies [5, 9-10]. This is probably due to the initiation of a hemodynamic response during rapid loss of blood, which is characterized by an increase in sympathetic nervous system activity, elevation of plasma catecholamine levels, peripheral vascular resistance and heart rate [11-12]. In the cardiovascular system, the sympathetic nervous system plays a regulatory role. The activity of the sympathetic nervous system is regulated in the brain stem and transmitted to organs and vessels that are innervated by sympathetic nerve endings [13]. In this study, we observed an increase in R-wave amplitude following haemorrhage. While this agreed with earlier studies reporting an inverse relationship between blood volume and QRS amplitude [14-16], it was however contrary to the findings of Hunt et al. (1992) [17] and Torre et al. (1999) [6] who reported a reduction in R amplitude following induction of haemorrhage. Brody (1956) [7] through a theoretical analysis had proposed a direct relationship (now known as the Brody effect) between the voltage of the QRS complex and ventricular blood volume. According to the theory, blood is an excellent conductor of electricity and a decrease in blood volume would consequently reduce myocardial dipoles which serve as a source of surface potential for the ECGThe shortening of the QRS duration as well as shortening of the QT/QTc values appears to be consistent with tachycardia which was induced by hemorrhage.

Conclusion

From this study, we have been able to establish the effect of acute hemorrhage on the Lead-II electrocardiogram of Nigeria dogs. Tachycardia and increased R-amplitude appeared to be the most significant findings. Our study therefore tends to suggest that the Brody effect does not occur in the Nigerian dog following acute haemorrhage.

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