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Olgu Sunumu ***Case Report***

Atrial Fibrillation in a Diarrheic Holstein Dairy Calf

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Abstract

Cardiac auscultation of a 10-day-old diarrheic female Holstein dairy calf revealed irregularities in rhythm and absence of 4th heart sound. Electrocardiogram (ECG) and blood sample were obtained before and after the treatment. Based on ECG and cardiac auscultation findings, atrial fibrillation (AF) was diagnosed. Serum sodium, calcium and magnesium before treatment were significantly lower than their reference ranges and potassium was significantly higher. One day after treating this patient, serum electrolytes were reached to reference ranges and AF was changed to normal sinus rhythm. Based on resolving the AF after treating the patient and correcting the electrolyte imbalances, it can be suggested that electrolyte imbalances were the main cause of the occurrence of AF in the present case.

Özet

Diareli Bir Holştayn Buzağıda Atriyal Fibrilasyon

10 günlük yaşta diareli dişi bir Holştayn buzağıda kalp oskültasyonu ile ritim düzensizliği ve 4. kalp sesinin noksanlığı tespit edilmiştir. Tedavinin öncesi ve sonrasında elektrokardiyografi (EKG) ve kan örnekleri alınmıştır. EKG ve kardiyak oskültasyon bulguları doğrultusunda atrial fibrilasyon (AF) teşhis edilmiştir. Tedavi öncesinde serum sodyum, kalsiyum ve magnezyum değerleri referans değerlerinden önemli düzeyde düşük olarak, potasyum ise referans değerinden önemli düzeyde yüksek olarak tespit edilmiştir. Bir günlük tedavi sonucunda hastanın serum elektrolitleri referans değerlere ulaşmış ve AF normal sinus ritmine dönmüştür. Bu çalışmada elektrolit dengesizliğinin düzeltilmesi sonucunda hastanın tedavi edilmesi ile AF'nin giderilmesi, elektrolit dengesizliğinin AF'nin oluşumundaki temel neden olarak göstermektedir.

Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia which can irregular heart rhythm and may cause no clinical signs in large animals. This arrhythmia can be identified clinically by cardiac auscultation, taking a pulse, and recording an electrocardiogram (ECG) that demonstrates the absence of P waves and an irregular ventricular rate. In AF, the electrical impulses originated from sinoatrial node are overwhelmed by electrical impulses from the roots of the pulmonary veins (Guyton, 1981; Radostits et al., 2007). During AF, the ventricles usually depolarize and contract in a normal manner but at an irregular rate and rhythm. The rate, rhythm and amplitude of the heart sounds and the amplitude of the peripheral pulse may vary significantly, and pulse deficits are frequently detected. On the ECG, there are no P waves but the baseline shows multiple waveforms (f waves) that occur with a frequency of between 300 and 600 beats/min. QRS-T complexes are normal in configuration but there is wide variation and no pattern in the R-R intervals (Radostits et al., 2007).

AF has been recorded in many of the large animal species (Brightling and Townsend, 1983; Deem and Fregin, 1982; Patteson, 1996; Pourjafar et al., 2011; Radostits et al., 2007) but there are no reports of its

occurrence in dairy calves. In the present report, an occurrence of this cardiac arrhythmia in a diarrheic Holstein dairy calf is presented.

Case

In July 2014, a 10-day-old diarrheic female Holstein dairy calf was referred to the author's large animal clinic in Zarghan, Fars province, Iran. This calf was recumbent sternally and had 10 percent dehydration according to skin elasticity test. Core body temperature and respiratory rates were 38.1°C and 22 beats/min., respectively. Cardiac auscultation revealed irregularities in rhythm and absence of 4th heart sound. An ECG was recorded by use of a bipolar base apex lead (Radostits et al., 2007). ECG was obtained on a single channel electrocardiographic machine (Kenz-line EKG 110, Suzuken Co., Ltd., Japan) with the paper speed 25 mm/sec and calibration of 10 mm equal to 1 mV. Blood sample was obtained from the jugular vein. Treatment plan included intravenous sodium bicarbonate 1.3% (2 liters at 20 ml/kg/h), dextrose 5% plus sodium chloride 0.45% (Shahid Ghazi Pharmaceutical Co., Tabriz, Iran; 2 liters at 20 ml/kg/h), flunixin meglumine (Meganix® 5%, Erfan Pharmaceutical Co., Tehran, Iran; 2.2 mg/kg), penicillin G potassium (20,000 IU/kg) and gentamicin (Gentaject® 5%, Erfan Pharmaceutical Co., Tehran, Iran; 5 mg/kg). An oral rehydration salt (ORS; Aras Rehydratan®, tid), was used, subsequently. At the next day, the patient had not clinical signs of diarrhea and described problems. The evidences of dehydration were absent and core body temperature and respiratory rate were 39.4°C and 33 beats/min., respectively. Cardiac rhythm on auscultation was regular and another ECG and blood sampling were obtained. Sera were separated by centrifugation (for 10 min at 3,000×g) and stored at −22°C until the analyses on sodium, potassium, calcium and magnesium levels. The serum concentrations of sodium and potassium were measured by the flame photometric method (Flame Photometer, FLM, Ontario, Canada). The samples were analyzed for magnesium and calcium by atomic absorption spectroscopy (Shimadzu AA-670, Kyoto, Japan). One samples t-test was used to determine differences between reference ranges (Chalmeh et al., 2014) and serum electrolyte concentrations by using SPSS software (SPSS for Windows, version 11.5, SPSS Inc, Chicago, Illinois). $P<0.05$ was considered statistically significant.

Based on the cardiac auscultation findings, AF was suspected. ECG studies confirmed the presence of AF, in which there were no P waves, multiple f waves and irregular R-R intervals (Figure 1A). Clinical examination showed no cardiovascular insufficiency problems such as edema and jugular distension or pulsation. The results of serum electrolytes analyses of this calf before and after treatment in comparison to reference ranges (Chalmeh et al., 2014) are presented in Table 1. Sodium, calcium and magnesium before treatment were significantly lower than their reference ranges and potassium was significantly higher. One day after treatment, serum electrolytes reached to reference range (Table 1).

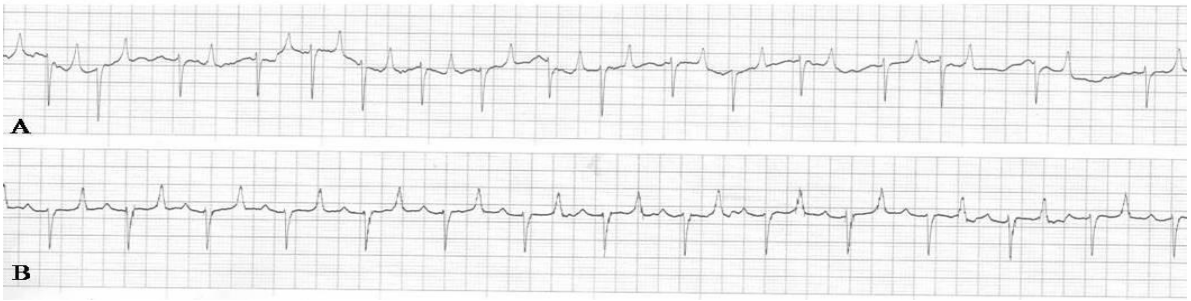

Figure 1. Electrocardiograms tracing from a 10-day-old female Holstein dairy calf (25 mm/sec, 10 mm/mV). A: Atrial fibrillation in the diarrheic state; P waves are absent and the baseline shows multiple f waves. There is wide variation in R-R intervals and QRS-T complexes. B: Normal sinus rhythm one day after treatment.

Şekil 1. 10 günlük yaştaki dişi bir Holştayn buzağıya ait elektrokardiyogramlar (25 mm/sec, 10 mm/mV). A: Diyareli durumda atriyal fibrilasyon; P dalgaları eksik ve taban çizgisi çoklu f dalgaları göstermekte. R-R aralıklarında ve QRS-T komplekslerinde izlenen geniş varyasyonlar. B: Tedaviden bir gün sonra normal sinus ritmi.

Table 1. Serum electrolyte concentrations in the present 10-day-old Holstein dairy calf affected with atrial fibrillation at diarrheic state and one day after treatment in comparison to reference ranges (Mean±SD) (Chalmeh et al., 2014).

Tablo 1. 10 günlük yaşta Holştayn bir buzağının diyareli durumda atriyal fibrilasyonlu ve bir günlük tedavi sonucunda serum elektrolit konsantrasyonlarının referans değerlerle (Ort±SS) karşılaştırılması (Chalmeh et al., 2014).

	Na (mEq/L)	K(mEq/L)	Ca (mg/dL)	Mg (mg/dL)
Healthy newborns calves	141.5±3.5[a]	5.0±0.2[a]	2.7±0.3[a]	0.8±0.1[a]
At diarrheic state	95.2[b]	6.9[b]	1.7[b]	0.4[b]
One day after treatment	132.0[a]	4.9[a]	2.3[a]	0.7[a]

[a, b]: Different letters indicate significant differences between reference ranges and other samples in each columns (P<0.05).

Discussion

AF in large animals has been previously reported in several literatures (Deem and Fregin, 1982; Pourjafar et al., 2011; Radostits et al., 2007). This cardiac rhythm irregularity is the most common arrhythmia causing poor performance in the horse (Patteson, 1996) and cattle (Brightling and Townsend, 1983). The presented report is the first documented case of AF in the diarrheic Holstein dairy calf.

AF can convert to sinus rhythm spontaneously without any treatment; however, when it is sustained it should be treated (Deem and Fregin, 1982). Various factors have been incriminated in the production and maintenance of AF in large animals, such as, high vagal tone, atrial dilatation or hypertrophy due to mitral and tricuspid insufficiency, gastrointestinal disorders, atrial myocardial lesions, electrolytes and acid base imbalances, infection, a macerated fetus and premature atrial contractions (Pringle et al., 1990; Radostits et al., 2007; Wijnberg et al., 1998).

Diarrhea is a common cause of electrolyte abnormalities in newborn calves (Chalmeh et al., 2014). The results of the serum electrolyte analyses in this case revealed the marked electrolyte imbalances. At the time of referring this patient to author, sodium, calcium and magnesium were significantly lower than reference ranges; but serum concentration of potassium was significantly higher than its reference value. One day after treating this calf, serum electrolyte levels were placed in normal ranges and AF was changed to normal sinus rhythm (Figure 1B).

Serum electrolyte concentrations, commonly potassium and magnesium imbalances, play an important role in the development of AF (Chelazzi et al., 2011; Christians et al., 2001). The role of potassium in maintaining cardiac rhythm is well established. Auer et al. (2004) mentioned that hypokalemia causes cellular hyperpolarity, increases resting potential, hastens depolarization, and increases automaticity and excitability. Thus, potassium imbalances may contribute to the etiology of AF (Švagždienė et al., 2009). In this patient, hyperkalemia may be suggested that changing the potassium levels to lower or higher than base line values can be a cause of AF.

The relationship between hypomagnesemia and AF after cardiac surgery suggests that serum magnesium levels should be kept within normal ranges. The changes in serum magnesium level and their relation with the rate of postoperative AF usually are analyzed by most publications (Inoue et al., 2004; Shiga et al., 2004). The opinion that magnesium supplementation is helpful to reduce the rate of postoperative AF is predominant. However, there is some evidence suggesting that administration of magnesium may be detrimental. The patients with high serum magnesium levels had a higher incidence of AF and that supra-physiological concentration of magnesium lead to slowing of sinus rhythm rate that can predispose to AF. Inhibition of the sinus node by magnesium is most probably offset by inhibition of acetylcholine release at the vagal nerve terminals (Švagždienė et al., 2009). In the present case, the lower magnesium concentration than the reference range, can also be a cause of AF.

Finally, based on resolving the AF after treating the patient and correcting the electrolyte imbalances, it can be suggested that electrolyte imbalances were the main cause of the occurrence of AF in the present case.

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