

Cardiac Arrhythmias in Clinically Healthy Newborn Iranian Fat-Tailed Lambs

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Abstract: The present study was performed to find out the prevalence of cardiac arrhythmias in 62 clinically healthy newborn Iranian fat-tailed lambs in three different ages, lesser than 5 days old (Group 1, n=20), 6 to 15 days old (Group 2, n=17) and 16 to 30 days old (Group 3, n=25). The electrocardiograms (ECGs) were recorded from all lambs. Studied animals had not any clinical signs of cardiac diseases. Assessment of ECGs showed that three types of cardiac arrhythmias were detected in this study, compromising sinus tachycardia, sinus arrhythmia and second degree atrioventricular block. Sinus tachycardia was recorded from all newborns. Ten percent of Group 1 had shown second degree atrioventricular block. Some of the ECGs had both cardiac arrhythmias, simultaneously. The proportion of different cardiac arrhythmias between the three ages of studied newborns was not significantly different. Since none of the lambs with cardiac arrhythmias showed any clinical signs of heart disease at the time of ECG recordings, the arrhythmias observed in this study could be considered as physiological ones.

Key words: Cardiac arrhythmia • Electrocardiography • Iranian fat-tailed lamb • Physiological arrhythmia

INTRODUCTION

Arrhythmias can be noticed incidentally in the newborn because of bradycardia, tachycardia or irregularity of rhythm, but the most common presentation is with heart failure, usually as a result of sustained tachycardia. In human beings, fetal arrhythmias might be noted incidentally or because of the presence of heart failure [1]. Electrocardiographic evaluation is most useful for sheep and goats with cardiac arrhythmias and the base-apex lead is the most common in large animal electrocardiography [2]. The majority of arrhythmias and conduction disturbances can be detected on clinical examination. However, some may be undetected on clinical examination and could be found only on electrocardiographic examination [3]. Variations in cardiac rate and rhythm include tachycardia (increased rate), bradycardia (decreased rate), arrhythmia (irregularity in rate and rhythm) and gallop rhythms. Variation in the rate and rhythm can occur in normal animals due to strong or varying autonomic influence but can also be a reflection

of primary myocardial disease. Other factors such as acid-base and electrolyte imbalances can influence rate and rhythm [3]. A review of the veterinary literature shows that the majority of cardiac arrhythmias in large animals are physiological and symptomatic neonatal arrhythmias are rare [4], i.e. they have no deleterious effects on the heart and no lesions can be found in the cardiovascular system at necropsy [5, 6]. Functional and pathologic cardiac arrhythmias in sheep due to diseases are listed in several literatures [3, 7], but there are little reports on cardiac arrhythmias within physiologic states in this animal. Birth is an important physiological change that may elicit electrocardiographic anomalies [8]. Electrocardiographic studies were done on newborn foals [9, 10] and calves [11] but the study on newborn lambs is not yet adequate; therefore, the present study was undertaken, for the first time, to record electrocardiograms from numbers of apparently healthy newborn Iranian fat-tailed lambs in three different ages to detect and compare cardiac arrhythmias in this breed.

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MATERIALS AND METHODS

The present study was accomplished in February 2011 on 62 apparently healthy newborn Iranian fat-tailed lambs at the Teaching Barn, Agricultural College, Shiraz University, Badjgah region (latitude of 29° 32' N and longitude 52° 35' E, 1810 m above sea level), southwest Iran. The animals were assigned into 3 groups, comprising Group 1 (lesser than 5 days old; n=20), Group 2 (6 to 15 days old; n=17) and Group 3 (16 to 30 days old; n=25). The animals were examined prior to ECG recording and were proved to be clinically healthy. None of the lambs used in this study had any clinical signs of heart diseases (edema, jugular distension or pulsation). The ECGs were recorded on a bipolar base apex lead, using limb lead I. Animals were kept in a standing position without sedation and minimal restraint. When the animals were calm (decreasing of panting behavior and muscle tremors), the ECGs were recorded, using alligator electrodes which were fixed to the skin after cleaning it with ethanol and applying jelly to improve skin contact. The positive electrode (left arm) was placed over the cardiac apex in the left fifth intercostals space at the level of the elbow. The negative electrode (right arm) was placed in the left jugular furrow at the height of the base of the heart. The ground (right leg) was placed on the dorsal spine or another site distant from the heart [3]. All ECGs were recorded 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. By this method of measuring, the precision of duration was 0.02 sec. and amplitude was 0.05 mv. The heart rate of all animals was recorded. In the present study, the heart rate higher than 120 beats/min was considered as tachycardia. Statistical method used in this study, was Fisher's exact test using SPSS software (SPSS for Windows, version 11.5, SPSS Inc, Chicago, Illinois). $P < 0.05$ was considered as statistically significant.

RESULTS

Three types of cardiac arrhythmias were detected in this study, compromising sinus tachycardia (Figure 1, record A), sinus arrhythmia (Figure 1, record 2) and second degree atrioventricular block (Figure 1, record C). The types and distribution of cardiac arrhythmias in these animals are given in Figure 2. Sinus tachycardia was recorded from all newborns. Ten percent of newborns that aged lesser than 5 days had shown second degree atrioventricular block; this cardiac arrhythmia was not seen in the other groups. Some of the ECGs had both cardiac arrhythmias, simultaneously (Figure 1, records B and C). The proportion of different cardiac arrhythmias between the three ages of studied newborns was not significantly different.

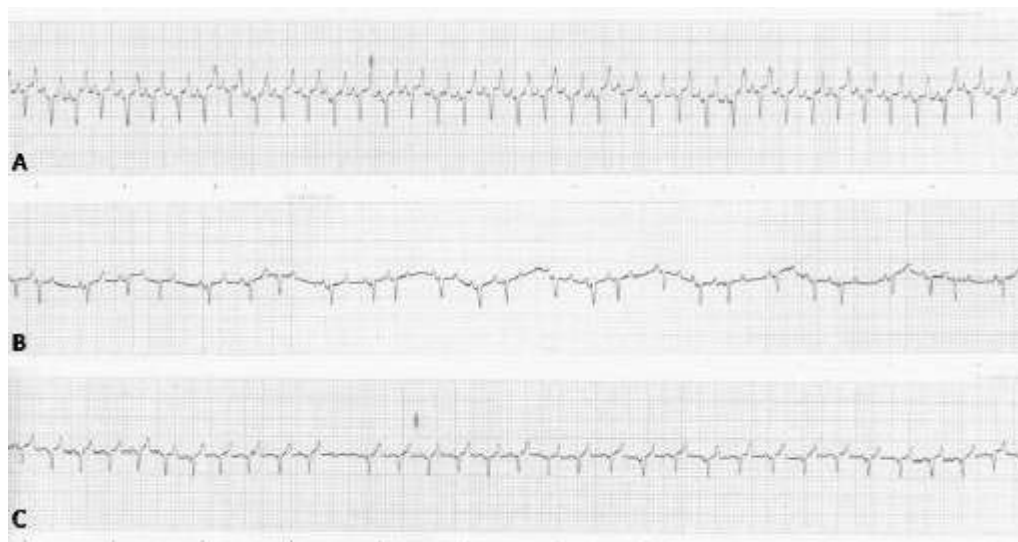


Fig. 1: The electrocardiograms tracing from 3 clinically healthy newborn Iranian fat-tailed lambs in base apex lead system (paper speed 25 mm/sec, sensitivity 10 mm/mV). A: Sinus tachycardia in 20 days old lamb; B: Sinus arrhythmia in 12 days old lamb; C: Second degree atrioventricular block and sinus tachycardia in 3 days old lamb, simultaneously; the 12th P wave from left is not followed by a QRS complex.

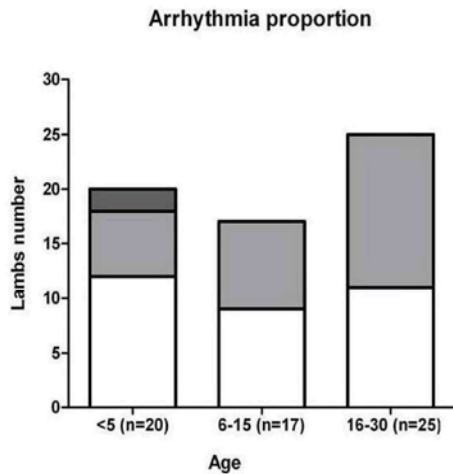


Fig. 2: Distribution and proportion of cardiac arrhythmias in three different ages (day) of clinically healthy newborn Iranian fat-tailed lamb tracing in standard base apex lead system electrocardiography (paper speed 25 mm/sec, sensitivity 10 mm/mV).
 □ Sinus tachycardia; ■ Sinus arrhythmia and ■ Second degree atrioventricular block

DISCUSSION

At the birth, significant hypoxemia and acidaemia may develop [12]. Moreover, after the onset of breathing, the change in pulmonary vascular resistance with expansion of the lungs results in a great increase in pulmonary blood flow, accompanied by a rise in left atrial pressure [13, 14]. This generates distension of the atrial walls and stretching of the atrial muscles and these might be related to the occurrence of cardiac arrhythmias [10]. It was suggested that the development of hypoxia was relative to the arrhythmias. It was considered that a hypoxic condition during delivery may contribute to the occurrence of neonatal arrhythmias in horses [9]. Belenky *et al.* [15] demonstrated that the hypoxic carotid chemoreflex, in lamb, is present at birth, but has a significantly longer response time than later in the newborn period. Moreover, the CNS-mediated ventilatory response to hypoxia was also noted to be present in the newborn animal through at least 12 days or longer times of postnatal age [15]. Also, the results of the present study showed that the lambs from birth to 30 days old had at least one cardiac arrhythmia and it may be mentioned that CNS-mediated ventilatory response to hypoxia was active till 30 days after birth.

Cardiac arrhythmias also occur commonly in association with gastrointestinal disorders in the dairy cow and less commonly in the horse and resolve without specific antiarrhythmic treatment when the primary gastrointestinal disorder is corrected [3]. At birth the rumen is a rudimentary nonfunctional sac. Normal development of the rumen requires the establishment of a viable microbial population and the formation of volatile fatty acids [16]. Establishment of ruminal microbial fermentation begins between two to four weeks of age as a result of the initiation of solid feed intake [17, 18]. Changes in physiological states of gastrointestinal tract, feed intake and alterations in energy metabolism, may affect the cardiac performance and changes in ECG parameters. Furthermore, changes in food regimen and electrolyte profile may affect cardiac musculature and its activation.

The results of the present study showed that sinus tachycardia was the most frequent cardiac arrhythmia in the studied animals. Sinus tachycardia means an increase in heart rate that is initiated by the sinoatrial node. The term sinus tachycardia is used to describe an increase in heart rate caused by detectable influences such as pain, excitement, exercise, hyperthermia, a fall in arterial blood pressure or the administration of adrenergic drugs [3]. The heart rate returns to normal when the influence is removed or relieved. It may be suggested that the higher heart rates might be due to stress and excitation resulting from isolation of lambs from their dams as well, but since the animals were placed in a quiet state, it is unlikely to be the origin for this higher heart rate in studied animals. Because there were no clinical signs of cardiac problems (edema, jugular distension or pulsation) in all studied animals, this cardiac rhythm irregularity could be categorized as physiologic arrhythmias. Matsui *et al.*, reported an elevation of the heart rate in newborn pony foals with administration of a combined blockade with atropine and propranolol [19]. These observations indicate the possibility of high vagal activity in the newborn Thoroughbred foal at birth [10]. Sustained tachycardia is an important clinical problem in the fetus and newborn. The physiological properties of the fetal and neonatal myocardium make it intrinsically more vulnerable to high heart rates [20]. Fetal tachycardia is an important cause of fetal morbidity and mortality [1]. The rate of fetal tachycardia is of no real help in defining the mechanism, as most tachycardia occurs at about 240 beats/min [1]. The heart rate in studied animals was higher than 120 beats/min and average of this parameter was 170 beats/min at the time of ECG recordings.

Sinus arrhythmia was the most common arrhythmia observed in this study in clinically healthy newborn lambs. This arrhythmia has been reported in cattle which have been deprived of food or had anorexia due to some gastrointestinal problems [5, 21]. None of the lambs with sinus arrhythmia in this study had any clinically obvious systemic problems or were suffering from anorexia. High vagal tone could be suggested as the cause of this arrhythmia in any ages of these animals [22]. Sinus arrhythmia is a normal physiological arrhythmia that occurs at slow resting heart rates and is associated with variation in the rate of discharge from the sinoatrial node associated with variation in the intensity of vagal stimulations. It is commonly correlated with respiration so that the discharge rate and heart rate increase during inspiration and decrease during expiration. Sinus arrhythmia is more clinically obvious in tame sheep and goats [3]. It may be possible to link the genesis of the sinus tachycardia and sinus arrhythmia in apparently healthy newborn lambs to the increased load imposed on the heart or the fluctuation of the sympathetic or parasympathetic tone associated with excessive exertion during the stage of the birth [6]. The most frequent arrhythmias in the newborn foal were sinus arrhythmia, also (64%) [10].

Second-degree atrioventricular block also called partial heart block, this occurs when there is periodic interference with conduction at the atrioventricular node so that some atrial contractions are not followed by ventricular contraction (Figure 1, record C). The underlying rhythm is still sinus in origin and is thus regular. The electrocardiogram shows the presence of a P wave but complete absence of the subsequent QRS and T waves at the blocked beat (Figure 1, record C). Second degree atrioventricular block is extremely common in horses and occurs as a normal physiological variation due to variations in vagal tone [3]. This arrhythmia is commonly breed dependent in horse and time of day induced this irregularity [3]. Second degree atrioventricular block can be abolished by exercise or the administration of atropine. Second degree atrioventricular block can be associated with myocarditis in the horse and its presence has been associated with decreased racing performance by some clinicians. Atrioventricular conduction disturbances can be associated with electrolyte imbalance in all species, overdosing with calcium salts, digoxin toxicity, cardiomyopathy and myocarditis associated with nutritional and infectious disease [3]. There is usually no necessity to treat this

arrhythmia specifically and treatment is generally directed at the underlying cause. Yamamoto et al., reported this arrhythmia in newborn foals, as well [10].

It was concluded that the arrhythmias resulted from transient physiological hypoxia during birth and that their occurrence should be considered as part of the normal adaptive process to extra-uterine life, as normal sinus rhythm was recorded after birth and the animals subsequently developed normally [9, 10]. Furthermore, parturition is a time of hemodynamic, hormonal and catecholamine fluctuations, which may provoke cardiac arrhythmias [8]. It may be suggested that the cardiac arrhythmias observed in the clinically healthy newborn Iranian fat-tailed lambs in this study could be accepted as the physiological arrhythmias and so no treatment is necessary. Furthermore, the results of this study may be used as the criteria and guideline for the assessment of any cardiac rhythm irregularities in lambs suffering from cardiac problems.

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REFERENCES

1. Wren, C., 2006. Cardiac arrhythmias in the fetus and newborn. *Seminars in Fetal and Neonatal Medicine*, 11: 182-190.
2. Cebra, C. and M. Cebra, 2002. Diseases of the cardiovascular system. In *Sheep and goat medicine*, edited by Pugh, D.G., 1st ed., Saunders, pp: 393-396.
3. Radostits, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2007. Diseases of the cardiovascular system. In *Veterinary medicine: a Text Book of the Diseases of Cattle, Horses, Sheep, Pigs and Goats*, 10 ed. Elsevier, pp: 399-438.
4. Long, W.A., E.G. Frantz, G.W. Henry, M.D. Freed and M. Brook, 2000. Evaluation of newborns with possible cardiac problems. In *avery's diseases of the newborn*, H.W. Taeusch and R.A. Ballard, 7th edn. Noida; Harcourt Asia Pte Ltd., pp: 711-763.

5. Machida, N., Y. Okamoto, S. Minami, Y. Yamaga and K. Kagota, 1991. Cardiac arrhythmias in normal Holstein heifers. *Journal of the Japan Veterinary Medical Association*, 44: 1176-1179.
6. Machida, N., T. Nakamura, K. Kiryu and K. Kagota, 1993. Electrocardiographic features and incidence of atrial fibrillation in apparently healthy dairy cows. *Zent Vet Med A*, 40: 233- 239.
7. Kojouria, G.A., A. Rezakhani and H. Ahmadi, 2009. Arrhythmias in advance stiff lamb disease. *Small Ruminant Res.*, 84: 65-69.
8. Murphy, J. and M. Slodzinski, 2008. Right ventricular outflow tract tachycardia in the parturient. *International J. Obstetric Anesthesia*, 17: 275-278.
9. Takayuki, I., 1990. A study of arrhythmias in thoroughbred newborn foals immediately after birth. *Japanese J. Veterinary Res.*, 38: 57.
10. Yamamoto, K., J. Yasuda and K. Too, 1992. Arrhythmias in newborn Thoroughbred Foals. *Equine Veterinary J.*, 23(3): 169-173.
11. Rezakhani, A. and A.A. Papahn, 2002. Study on the prevalence of cardiac arrhythmias in dairy calves. *Iranian J. Veterinary Res.*, 3: 257-262.
12. Comline, R.S. and M. Silver, 1975. Placental transfer of blood gases. *British Medical Bulletin*, 31: 25-31.
13. Dawes, G.S., J.C. Mott, J.C. Widdicombe and D.G. Wyatt, 1953. Changes in the lungs of the newborn lamb. *J. Physiol.*, 121: 141-162.
14. Dawes, G.S., 1961. Changes in the circulation at birth. *British Medical Bulletin*, 17: 148-153.
15. Belenky, D.A., T.A. Standaert and D.E. Woodrum, 1979. Maturation of hypoxic ventilatory response of the newborn lamb. *The American Physiological Society*, pp: 927-930.
16. Tamate, H., A.D. McGilliard, N.L. Jacobson and R. Getty, 1962. Effect of various dietaries on the anatomical development of the stomach in the calf. *J. Dairy Sci.*, 45: 408-420.
17. Baldwin, R.L.V.I. and B.W. Jesse, 1992. Developmental changes in glucose and butyrate metabolism by isolated sheep ruminal cells. *J. Nutrition*, 122: 1149-1153.
18. Baldwin, R.L., 2000. Sheep gastrointestinal development in response to different dietary treatments. *Small Ruminant Res.*, 35: 39-47.
19. Matsui, K., S. Sugano, L. Masuyuna, A. Amada and Y. Kano, 1984. Alterations in the heart rate of Thoroughbred horse, pony and Holstein cow through pre- and post-natal stages. *Japanese J. Veterinary Sci.*, 46: 505-510.
20. Rudolph, A.M., 2001. Congenital diseases of the heart: clinico-physiological considerations. Armonk, NY: Futura.
21. Gentile, A., C. Guglielmini and M. Cipone, 1993. Alterazioni del ritmo cardiaco nel bovino in rapporto col digiuno. *Archivio Veterinario Italiano*, 44: 100-107.
22. Rezakhani, A., A.A. Papahn and H.R. Gheisari, 2004. Cardiac dysrhythmias in clinically healthy heifers and cows. *Revue de Médecine Vétérinaire*, 155: 159-162.