

Ectopia Cordis in a Male Holstein Friesian Calf

S. Shirian^{*,1}, A. Oryan¹ and M.R. Samadian²

¹Department of Pathobiology, School of Veterinary Medicine, Shiraz University, Shiraz, Iran

²Esfahan Ghiam Farm, Esfahan, Iran

Abstract: A male Holstein Friesian calf affected with superior cervical ectopia cordis was examined macroscopically and histologically to assess the severity and elucidate other anomalies. This calf died 10 minutes after birth. The heart was round, weighed 380gm, was enveloped in the pericardium, and situated in the swollen part of the ventrocervical region underneath the skin. Inside the spacious pericardial cavity, the heart was characterized by a duplicated and cranioventral apex. The heart was histologically normal. The cranial vena cava and vena azygos were also duplicated. The sternum was short, especially in the body and xyphoid process. No other anomaly was seen in association with this case.

Keywords: Ectopia cordis, heart, Holstein calf, congenital development.

INTRODUCTION

Ectopia cordis (EC) or congenital development of the heart at an abnormal site outside the thoracic cavity [1] could be total or partial depending on the amount of the cardiac volume presenting outside the thoracic cavity [2]. It could be classified into three types: cervical (lower and upper types cervical EC), pectoral, and abdominal ectopia cordis [3]. Affected animals may live up to 3 minutes to several years [4]. It is reported that the prevalence of this anomaly is 7.9 per million births in human beings [5], and even much lower in calves [4]. However, the causative agents of this anomaly initiation are not identified yet but there is a report indicating an increase in the incidence of EC after calcium antagonist therapy in chicken embryos [6].

CASE REPORT

A male Holstein Friesian calf with sever superior cervical ectopia cordis was born in Isfahan Ghiam Farm. This calf had normal growth and its body weight was 47 kg (usual size for a male neonate Holstein calf). The skin of the calf was intact, and the hair coat was normal. However, pronounced torticollis of the neck to the right was evident, and a swelling was apparent in the caudal cervical region of the left side. The calf showed tachycardia and tachypnea. This calf died 10 minutes after birth. The heart was round, weighed 380 gm, was enveloped in the pericardium, and situated in the swollen part of the ventrocervical region underneath the skin. Inside the spacious pericardial cavity, the heart was characterized by a double and cranioventral apex (Fig. 1). The two apexes were completely separate from each other, so that the apex of the heart was duplicated (arrow). In contrast to apex, however, the base of the heart somewhat anchored. Histologically, the heart was evaluated and it was normal. The cranial vena cava and vena azygos were duplicated. The sternum of this calf was short, especially in

body and xyphoid process. The aorta, pulmonary artery, ventricular walls, and heart valves were normal. However, it is reported that ectopia cordis is mostly associated with patent foramen ovale and ventricular septal defects, these anomalies were not seen in this case.

DISCUSSION

The complications found in the present calf, including double apex of the heart, and duplication of the cranial vena cava and vena azygos, and the sternum anomalies are in accordance with other studies of the bovine cervical EC [7, 8, 9]. Large sac of pericardial cavity permitted a higher range of movement of the apex¹⁰. The mechanism responsible for cervical EC has been identified as the delayed descent of the heart during embryonic development [9, 10]. The etiology of this anomaly is unknown but this condition has also been seen more frequently in human beings⁵. There are three theories regarding the pathogenesis of this congenital defect: 1) primary failure of descent and midline fusion of the lateral body folds 2) failure of midline fusion due to early rupture of chorion and/or yolk sac 3) amniotic band syndrome [8]. The abnormalities of the vessels near the heart may be attributable to the developmental failure in the early embryological stages. In a calf without EC, double cranial vena cava was said to be extremely rare, while it is probably developed when the anastomosis between the left and right anterior cardinal veins failed to be formed [11]. Double azygos vein observed in the present calf might resulted due to a lack of anastomosis between the left and right supracardinal veins. These abnormalities of the vessels near the heart may be caused by the failure of development of these vessels in the early embryological stage, as suggested by some authors [9, 12]. The existence of the paired ligaments, which originated from the fibrous pericardium at the apex and attached to the mandibles close to parotid fasciae, drew much attention. These ligaments may interrupt the descending of the heart [9, 13]. The developmental process of the sternums in the normal bovine fetuses are as follows: (1) The precursor of the sternum is identified as bilateral cores of cartilaginous cells (fetus of 50 days);

*Address correspondence to this author at the Department of Pathobiology, School of Veterinary Medicine, Shiraz University, Shiraz, Iran; Tel: 00987112286950; Fax: 00987112286940; E-mail: shirian@shirazu.ac.ir



Fig. (1). A male Holstein Friesian calf affected with superior cervical ectopia cordis. The heart is characterized by a double and cranioventral apex and the two apices were completely separate from each other (arrow).

(2) the cartilaginous sternal bars are completely formed at 53 days and fused almost completely at 64 days; (3) the first ossification center appears unpaired in the central region of the seventh sternal segment (75 days); and (4) the appearance of the loci of the first segment is the last (90 days) [14]. Vitums also pointed out that a normal descensus of the herat was completed before the bilateral sternal primordia met and fused in the ventral midline [9]. Drommer reported a wide manubrium and paired sternbrae of the body in two dicephalic calves associated with cervical EC and assumed that these abnormalities were caused by the mechanical action of the EC [15]. Abnormal ossifications of the manubrium is reported in calves affected with several kinds of congenital anomalies [16, 17]. Malformation of the sternum suggested that the manner of attachment of the bilateral cervical muscles to the cranial projection of the sternum plays a crucial role in sterno-morphogenesis [9]. Consequently, shortening of the length, widening of the manubrium, hypoplasia of the xyphoid cartilage, the paired appearance of sternbrae and existence of many sternbrae are obviously the characteristic findings in the sternums of the calves with cervical EC.

REFERENCES

- [1] Van Vleet JF, Ferrans VJ. Cardiovascular System. In: McGavin MD, Zachary JF, Eds. Pathologic Basis of Veterinary Diseases 4th ed. Mosby, Missouri, USA: Elsevier Publication 2007: p. 572.
- [2] Anderson RH, Shinebourne EA, Macarteny FJ, Tynan M. Abnormal position and relationship of the heart. In: Anderson RH, Shinebourne EA, Eds. Paediatric Cardiology, 2. London: Churchill Livingstone 1987; pp. 1057-72.
- [3] Herzog A, Wiedeking JF. Ectopia cordis congenital beim Rind. Giessener Beitr Erbpäthol Zuchthyg 1970; 1: 1-24.
- [4] Murakami T, Hagio M, Moritomo Y, Hamana K, Nakai M. Anatomical observation on five case of ectopia cordis. Adv Anim Cardiol 1996; 29: 85-90.
- [5] Amato J, Douglas W, Desai U, Burke S. Ectopia cordis. Chest Surg Clin N Am 2000; 10: 297-316.
- [6] Jaffee OC, Jaffee AL. Ectopia cordis in the chick embryo heart. Teratology 1990; 41: 737-42.
- [7] Abe M, Shimizu T, Hiraga T, Iwasa K, Takehana K, Kobayashi K. A case of sternal ectopia cordis in a calf. J Coll Dairying 1981; 9: 101-6.
- [8] Abi B, Giamberti A. Ectopia Cordis: A case report and review of related embryology. Winter scientific meeting of British association of clinical anatomy, The School of Medicine, Health policy and Practice, Norwich: University of East Anglia, 2008.
- [9] Vitums A. Ectopic heart of shorthorn bull. Anat Anz 1964; 114: 48-61.

- [10] Hiraga T, Abe M. Eight calves of cervical ectopia cordis and their sternum. *Jpn J Vet Sci* 1986; 48: 1199-206.
- [11] Sekeles E. Double cranial vena cava in a cow: case report and review of literature. *Zentralbl Veterinärmed* 1982; 29: 494-503.
- [12] Wyrost P, Radek J. Congenital cervical situs of the heart in a 2.5 years-old cow. *Folia Morphol* 1982; 41: 73-87.
- [13] Bowen JM, Adrian RW. Ectopia cordis in cattle. *J AM Vet Med Assoc* 1962; 141: 1162-7.
- [14] Lindsay FEF. Observation on the loci ossification in the prenatal and postnatal bovine skeleton. II. The sternum. *Br Vet J* 1969; 125: 422-8.
- [15] Drommer W. Morphologische und röntgenologische Untersuchungen an dicephalen Doppelmissbildungen beim Rind. *Zentralbl Veterinärmed* 1967; 14: 515-27.
- [16] Abe M, Hiraga T, Iwasa K. A case of bovine thoracopagus. *J Coll Dairing* 197; 7: 331-6.
- [17] Hiraga T, Abe M. A bovine of anencephaly. *J Jpn Vet Med Assoc* 1985; 38: 456-60.

Received: December 17, 2009

Revised: February 7, 2010

Accepted: February 23, 2010

© Shirian *et al.*; Licensee *Bentham Open*.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.