

## Scientific Report

# A report on bovine fetal *Ectopia cordis cervicalis* associated with two cervical sacs

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## Summary

A Holstein heifer with symptoms of dystocia was admitted in the Large Animal Clinic at the University of Tabriz. In the vaginal examination, the fetus was found at posterior presentation and by doing some obstetrical maneuvers, a male calf was delivered. An interesting phenomenon was the presence of two skin sacs in dimensions of 12 × 12 cm and 12 × 18 cm at the right and left upper cervical regions, respectively; and also the heart beats under the neck skin at the lower cervical region. Due to severe dyspnea, after 2 min the calf died. At necropsy, the heart was located outside of the thoracic cavity, under the neck skin. The direction of the heart axis was reversed as the base was directed caudoventrally and the apex craniodorsally. Unlike a normal calf's heart, the shape of its apex was rounded like a dog heart. Histopathologic examination revealed severe congestion, edema and hemosiderosis in the lungs, passive venous congestion and scattered foci of cardiomyolysis in the myocardium. Based on anatomical and histopathological findings, the disorder was diagnosed as bovine fetal *Ectopia cordis cervicalis* associated with two cervical sacs.

**Key words:** Calf, Cervical sacs, Congenital disorder, Dystocia, *Ectopia cordis cervicalis*

## Introduction

Ectopic heart is a condition in which the heart is located outside the thoracic cavity, usually in the ventral cervical area. However, sternal (or pectoral) and abdominal forms have also been reported (Bowen and Adrian, 1962; Herzog and Wiedeking, 1970). The cervical type of *Ectopia cordis* is the most common (82%), the pectoral type is next (14%) and the abdominal type is rare (3%). Many calves affected with cervical *Ectopia cordis* live for over 6 weeks (Jirina *et al.*, 1956; Wyrost, 1981).

*Ectopia cordis* occurs most commonly in cattle. Displacement through a defective sternum or through ribs usually results in neonatal death, although long term survival is also possible with other types of displacement (Cynthia and Kahn, 2008).

A number of factors can influence

embryonic development. The conceptus may be exposed to harmful agents during the pre-attachment, embryonic or fetal stages of development, and vulnerability to these agents varies with these different stages. For example, during the pre-attachment stage the embryo is very resistant to teratogens and the zona pellucida is an efficient barrier to many viruses. By contrast, the embryonic stage, with rapid cell growth and differentiation, is most susceptible to teratogens. Furthermore, each organ has a critical period of development. For example, the palate, cerebellum and urogenital systems develop relatively late in the fetal period. It should also be remembered that the membranes are part of the conceptus and so any impairment to their development will affect the fetus. Embryonic or fetal deaths, together with the birth of abnormal offspring, represent a considerable biological and economic waste (Noakes *et*

*al.*, 2009).

Congenital cardiac anomalies occur in all species including the human (Kabbani *et al.*, 2002), cattle (Lilleengen, 1934; Hiraga and Abe, 1986) goats (Nagarajan *et al.*, 1993) and horses (Reppas *et al.*, 1996), but are not common in any one of them. The prevalence is probably highest in cattle and lowest in horses (Rooney and Franks, 1964).

The relative frequency of individual cardiac defects in 36 calves at postmortem examination in one study was: interventricular septal defect-14%, ectopic heart-13%, right ventricular hypoplasia-13%, dextraposed aorta-10%, valvular hematomas-9%, patent foramen ovale-6%, endocardial fibroelastosis-4%, other cardiac defects-10% (Gopal *et al.*, 1986).

Animals with some congenital cardiac defects can survive to maturity. Acute heart failure or congestive heart failure may occur when the animals are subjected to a physical stress such as the first pregnancy or activity on the pasture. The primary appearance of signs of cardiac disease when an animal is 2 or 3 years of age should not eliminate congenital defects from consideration (Radostitis *et al.*, 2007).

The aim of the present study was to report a case of calf *Ectopia cordis cervicalis* with two cervical sacs and to discuss the probable causes of this defect.

## Case presentation

A black and white Holstein heifer from a traditional dairy herd located in a suburb of Tabriz city, with symptoms of dystocia was admitted in the large animal clinic at the University of Tabriz.

According to the herdsman, the amniotic sac had been ruptured 2 h before, but she had not been able to deliver her fetus. Moreover, the heifer had been bred by artificial insemination and was fed with corn, hay and soybean, similar to the other animals in the same herd (including 32 dairy Holstein cows and 19 calves). It had no history of disease, vaccination or drug administration. However, in the vaginal examination, the fetus was found in the breech 20 presentation (bilateral hip flexion posture) and by doing some obstetrical

maneuvers and traction, a male calf was delivered. The very strange phenomenon was the presence of two skin sacs, similar to elephant ears at the upper cervical region just behind the calf's ears, and also the presence of the heart beat under the neck skin at the lower cervical region. Due to severe dyspnea the calf died after 2 min and resuscitation was not effective. For further investigation the calf's carcass was referred to the Pathobiology Department.

## Results

At necropsy, the heart was located in the right side within the pericardium under the muscles and skin at the ventral cervical area and its vertical axis was turned 180 toward the head. Its shape, unlike a ruminant's heart, was rounded, the apex directed craniodorsally, and the base pointed caudoventrally (Fig. 1).

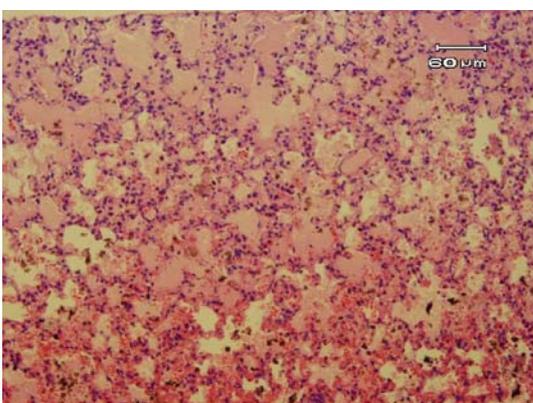
The branching patterns of the veins and arteries from the heart were similar to those of carnivore animals. Double azygos veins and double cranial vena cava were observed. The aorta had started from the base of the left ventricle and branched off the brachiocephalic trunk and the left subclavian artery. The pulmonary trunk originated from the right ventricle and the ligamentum arteriosum had connected it to the aorta. Its size seemed rather larger than normal. The vertical diameter of the thoracic cavity was shorter than that of normal calves.

Sac-like folds, which were distended portions of the skin, were observed in the cervical dorsal region at the right (12 × 12 cm) and left (12 × 18 cm) sides. The cavity of the sacs was considerably deep and covered by a serous membrane. No physical connection was found between the pericardium and these sacs.

Histopathologic examination revealed focal hemorrhages in the spinal cord and brain, severe congestion, edema and hemosiderosis in the lungs, passive venous congestion and periarterial fibrosis with thickening of the wall of the central vein (cardiac fibrosis) in the liver and scattered foci of cardiomyolysis in the myocardium (Fig. 2). The other tissues were congested.



**Fig. 1: Rounded shape of the apex (note to the lungs)**



**Fig. 2: Severe passive congestion and edema in the lung is seen (H&E, ×200)**

## Discussion

Congenital defects are abnormalities of structure or function present at birth. They may affect a single anatomic structure or function, an entire system, parts of several systems (cardiovascular and integumentary systems in our case) or both a structure and a function (Morrow, 1986). They may be lethal, as occurred in the present case, semilethal or compatible with life and may impair viability, or have an esthetic effect and thus, lower economic value. Susceptibility to injurious environmental or genetic agents varies with the stage of development and decreases with fetal age. In cattle, during the embryonic period (day 14 to 42), the embryo is highly susceptible to teratogens, but this decreases with embryonic age as the critical developmental periods of various organs or organ systems are passed (Noakes *et al.*, 2009).

Congenital defects are caused by

different factors including the chemical teratogens (ethanol, cocaine and mercury), genetic and chromosomal abnormality (genes of polydactyly), teratogen plants (*Veratum californicum*), environmental irradiation and some infectious (viral, bacterial, protozoal, clamidial and...) agents such as BVD/MD virus in cattle (Radostitis *et al.*, 2007). These teratogenic agents can cause a variety of malformations and developmental defects including contracted tendons, ankylosis, spina bifida, cleft palate, arthrogyriposis, cyclopia and many more (Beasley, 1999). Confirmation of each factor needs numerous trials. For example, confirmation of a genetic defect and mode of inheritance is possible by mating tests among suspected carriers or close relatives.

There are many reports about the *Ectopia cordis* in cattle from other countries (Hughes, 1934; Bowen and Adrian, 1962; De Boom, 1965; Herzog and Wiedeking, 1970; Green *et al.*, 1973; Droomer, 1976; Van Nie *et al.*, 1980) in which location, direction and shape of those hearts and in some instances, those vascular branching patterns, were similar to our discussed case (Hiraga and Abe, 1986). In all of them, long axis of the heart had been turned at an angle about 180 craniodorsally around the base, and the shape of the apex compared with a normal calf's heart was rounded.

In the present case, we did not find any familiar relationship between the dam and the bull from which the semen had previously been used for artificial insemination. The history of the defect including the dam breed, geographic region, exposure to or suspected exposure to teratogenic plants, feeding and management practices, maternal medical and vaccination records, disease status of herd, drug administered, congenital defects observed previously and history of similar congenital defects in neighboring herds was evaluated. However, like other researchers, we found no direct relationship between the above mentioned items and this defect. On the other hand, histopathological examinations revealed that, the fetus had suffered from chronic congestive heart failure during the fetal period, which in turn, led to pathological effects in the other organs such as the liver and lungs. The causes of

congenital cardiac defects are unknown, but according to Radostitis's *et al.* (2007) suggestions, it is assumed that they result from prenatal injuries during development or from single recessive genes or polygenic sets that have lesion-specific effects on cardiac development. Further investigations are necessary to determine of the real causes of bovine *Ectopia cordis* congenital defect.

## References

- Beasley, V (1999). Teratogenic agents. In: *Veterinary toxicology*. Published by International Veterinary Information Service, Ithaca, New York, USA. <http://www.ivis.org/advances/Beasley/Cpt8a/IVIS.pdf>
- Bowen, JM and Adrian, RW (1962). *Ectopia cordis* in cattle. *J. Am. Vet. Med. Assoc.*, 141: 1162-1167.
- Cynthia, M and Kahn, MA (2008). Congenital and inherited anomalies of the cardiovascular system. *The Merck veterinary manual*. (9th Edn.), Published by Merck and Co. Inc., Whitehouse Station, N.J. USA, In cooperation with MerialLtd. [http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/toc\\_11100.htm](http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/toc_11100.htm)
- De Boom, HPA (1965). Anomalous animals. *S. Afr. J. Sci.*, 61: 159-171.
- Droemer, W (1976). Morphologische und rontgenologische untersuchungen an dicephalen. Doppelmisbildungen beim rind. *Zentralbl. Veterinaermed.*, 14(A): 515-527.
- Gopal, T; Leipold, HW and Dennis, SM (1986). Congenital cardiac defects in calves. *Are. J. Vet. Res.*, 47: 1120-1121.
- Green, HJ; Leipold, HW; Huston, K; Noordsy, JL and Dennis, SM (1973). Congenital defects in cattle. *Irish Vet. J.*, 27: 37-45.
- Herzog, A and Wiedeking, JF (1970). *Ectopia cordis* congenital beim rind. *Giessener Beitr. Erbpathol. Zuchthyg.* 1-2: 1-24.
- Hiraga, T and Abe, M (1986). Eight calves of cervical *Ectopia cordis* and their sternums. *Jpn. J. Vet. Sci.*, 48: 1199-1206.
- Hughes, HV (1934). *Ectopia cordis* in the calf. *J. Comp. Pathol. Ther.*, 47: 141-151.
- Jirina, K (1956). Einige abnormitäten am herz beim rind. *Monatsh. Veterinaermed.*, 11: 327.
- Kabbani, MS; Rasheed, K; Mallick, MS; Abu-Hassan, H and Al-Yousef, S (2002). Thoraco-abdominal *Ectopia cordis*: case report. *Ann. Saudi Med.*, 22: 5-6.
- Lilleengen, K (1934). Hjärtmissbildningar hos djuren. *Scand. Vet. Tidskr.*, 24: 493-555.
- Morrow, DA (1986). *Current therapy in theriogenology*. 2nd Edn, Philadelphia, W. B. Saunders Co., PP: 177-199.
- Nagarajan, L; Manikarajan, DA; Wilfred, RJ and Gopal, MS (1993). *Ectopia cordis* with sternal cleft in a kid. *Indian J. Vet. Surg.*, 14: 32-33.
- Noakes, DE; Parkinson, TJ and England, GCW (2009). *Arthur's veterinary reproduction and obstetrics*. 9th Edn., Philadelphia, W. B. Saunders Co., PP: 132-136.
- Radostitis, OM; Gay, CC; Hinchcliff, KW and Constable, PD (2007). *Veterinary medicine*. 10th Edn., Spain, W. B. Saunders Co., PP: 432-434.
- Reppas, GP; Canfield, PJ; Hoffmann, KL; Hartley, WJ and Hutchins, DR (1996). Multiple congenital cardiac anomalies and idiopathic thoracic aortitis in a horse. *Vet. Rec.*, 138: 14-16.
- Rooney, JR and Franks, WC (1964). Congenital cardiac anomalies in horses. *Vet. Pathol.*, 1: 454-464.
- Van Nie, CJ; Wyrost, P and Vennemann, W (1980). *Ectopia cordis* congenita in cattle and hog. *Zentralbl. Veterinaermed. C. Anat. Histol. Embryol.*, 9: 367-368.
- Wyrost, P (1981). The results of studies on congenital cervical situs of the heart in domestic animals. *Folia Morphol. (Praha)*, 29: 220-223.