

## Case Study

# A case of diprosopus monauchenos in a day old calf (White Fulani × Friesian cross) in an integrated dairy farm

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A rare case of 'diprosopus monauchenos' is reported in a newborn calf that died soon after birth. The 'diprosopus' consisted of four eyes (tetraophthalmus), two pairs of nostrils, two mouths, each with a tongue and two pinnae. The two faces were fused caudally by a single parietal bone and joined ventrally by the medial ramus of the mandible. It was delivered from a five year-old multipara cow. Necropsy revealed normal thoracic and abdominal viscera. The limbs were also normal.

**Key words:** Cranial duplication, diprosopus monauchenos, cow, calf.

## INTRODUCTION

Congenital defects are structural and functional abnormalities present at birth. They may affect an organ, parts of a system, or an entire system (Noden and De Lahunta, 1985). Cranial duplication is a form of congenital defect that affects cranial and facial structures. It is usually referred to as diprosopus dicephalus in articles (Hiraga and Dennis, 1993). This classification is based on the location and extent of the duplication; whereas diprosopus involves only duplication of the facial structures, dicephalus involves complete cranial duplication resulting in two distinct heads. A rare case of 'diprosopus monauchenos' is reported in a newborn White Fulani × Friesian calf that died soon after birth. The morphological features of the cranial duplication in the diprosopus calf are described in this report.

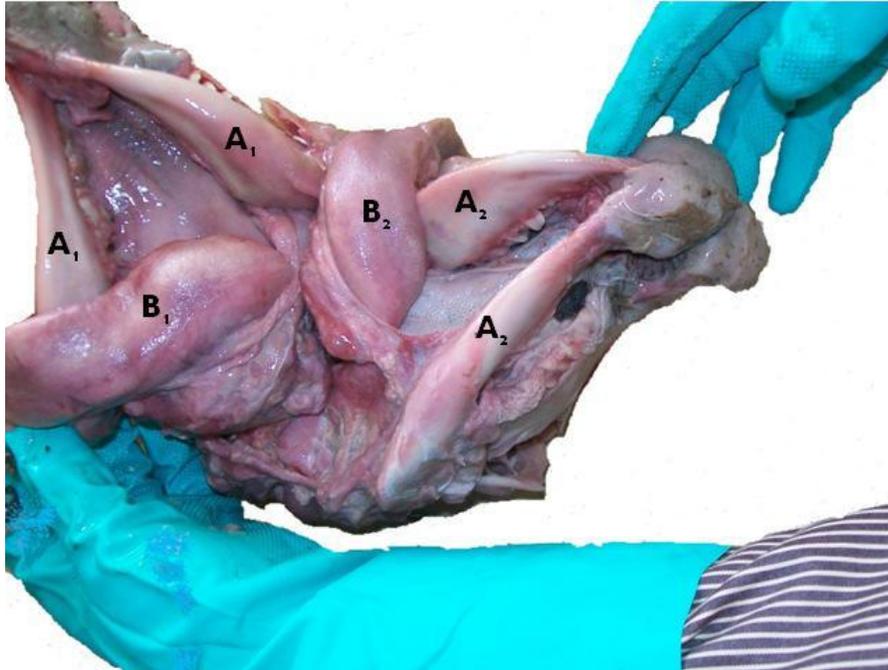
## CASE DESCRIPTION

The attention of the Large Animal Ambulatory Unit of the

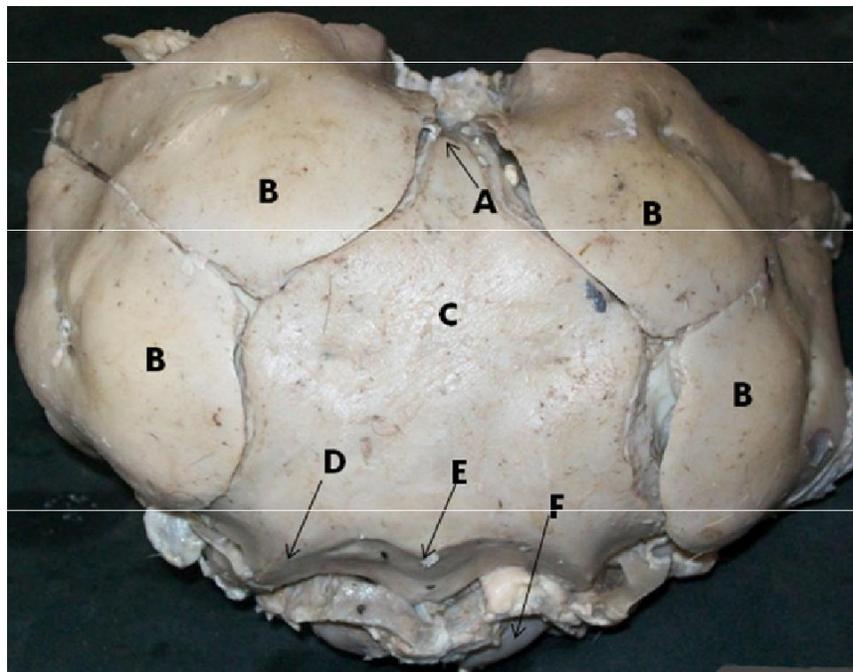
Veterinary Teaching Hospital, Ahmadu Bello University Zaria was called upon to a five year-old pregnant White Fulani cow with the chief complaint of dystocia. Physical examination revealed abnormal fetal position. The calf, which was removed through intravaginal manipulation, revealed the first case of congenital diprosopus monauchenos in the farm. The dam of the diprosopus calf was a pure white Fulani breed, cross bred with a pure Friesian bull; the gestational age was full term. The dam had given birth to four normal calves previously.

The calf was weak, depressed and recumbent with severe hypothermia (37°C), and irregular pulse. Unsuccessful attempts were made for feed the calf but the animal died soon after birth. Physical examination of the calf revealed duplicated facial structures (Diprosopus) on one neck (monauchenos). These included four eyes (tetraophthalmus), two pairs of nostrils and two mouths, each with a tongue (Figure 1: B<sub>1</sub> and B<sub>2</sub>). The pinnae were not duplicated. Necropsy results revealed that the thoracic and abdominal viscera were not duplicated. The limbs were also normal. The skin and the underlying muscles of the head were carefully removed for proper examination of the skull. Cranial bones (Figures 2C and F) were not duplicated. The cranium had only one cranial

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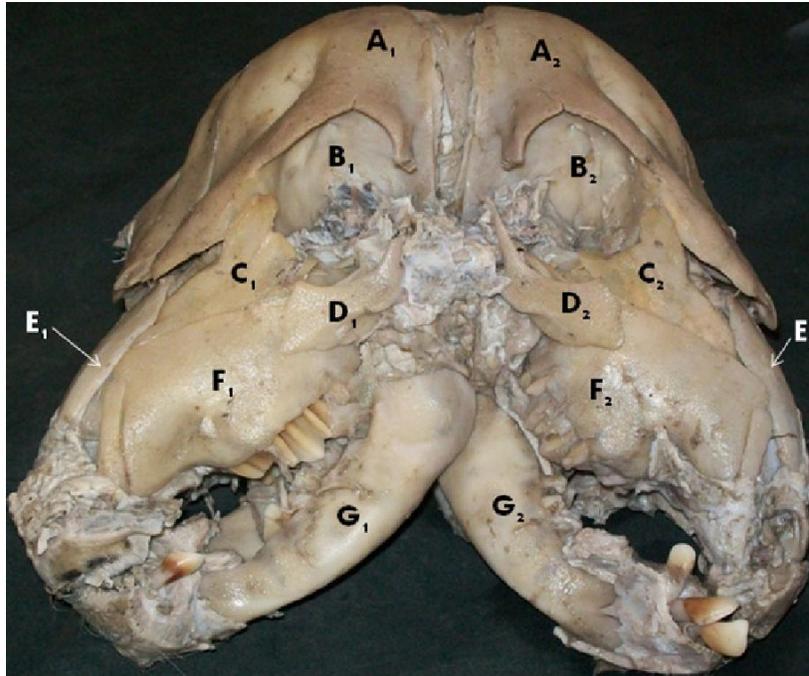
**Figure 1.** Buccal cavity of the diprosopus calf illustrating double tongue (B<sub>1</sub> and B<sub>2</sub>) and mandibular bones (A<sub>1</sub> and A<sub>2</sub>).



**Figure 2.** Caudal view of the skull of the diprosopus calf, illustrating A: Intercornual protuberance, B: Duplicated frontal bones, C: Unduplicated parietal bone, D: Nuchal line, E: External occipital protuberance, and F: Occipital condyle.

cavity and one foramen magnum. Although the brain could not be extracted intact, examination revealed an

unduplicated brain tissue. Facial bones such as frontal, nasal, zygomatic, lacrimal, maxillary and mandibular



**Figure 3.** Lateral view of the skull of the diprosopus calf illustrating A: Frontal bones, B: Eye sockets, C: Lacrimal bones, D: Zygomatic bones, E: Nasal bones, F: Maxillary bones, G: Mandibular bones.

bones were duplicated (Figure 3). The two faces were fused ventrally at the level of the rami of mandibles, and joined caudally by a single parietal bone. The vertebral column was not duplicated, so that the skull rested on a single atlas.

## DISCUSSION

Congenital abnormalities are sequel to arrested development of the different segments of the Müllerian ducts or incomplete fusion of the ducts during embryogenesis (Jainudeen and Hafez, 2000), leading to the death or malformation of the foetus. Although the cause of such defects is still not fully understood, they are either inherited or caused by environmental teratogens or an interaction between the animal's genetic makeup and its immediate environment (Dennis and Leipold, 1979). Inherited anomalies of development, which occur most commonly in cattle, is usually due to a single autosomal recessive gene (Bale and Richard, 2009). Inbreeding or line breeding between parents with history of congenital anomalies will usually result in the expression of the defect in the progeny, as the recessive gene responsible for the defect is homozygous in the inbred parents (Olsen, 2008). However, there are some teratogenic defects that are not inherited. In such defects, abnormalities of the ovum, embryo, or foetus is the probable cause. Some of these abnormalities could be

due to radiation exposure (Juberg, 1983), aging of the ovum prior to fertilization (Tarin et al., 2000), chronic poisoning (De Silva et al., 2006), hormonal disturbances (Rittler and Castilla, 2002), hyperthermic conditions in the environment of the oviduct or uterus (Graham et al., 1998), altered blood supply and oxygen tension to the foetus (Danielsson et al., 2003), deficiencies of folate, vitamin C and riboflavin (Smithells et al., 1976), viral infections (Gulbahar et al., 2005), or imperfect implantation (Baskar et al., 1985). Teratogens may act simultaneously or successively upon various tissues during development (Camón et al., 1990). Johnson et al. (1985) reported that if the injury or arrested development occurs early in gestation period, the defect is more likely to be severe. Also, if the gestation of such foetal monster continues to term, obstetrical difficulties that culminate in dystocia may emerge, as the foetus becomes unable to adjust to the normal posture prior to parturition, as observed in the present case.

Wu et al. (2002) stated that the pathogenesis of diprosopus monauchenos involves duplication of the notochord while Noden and De Lahunta (1985) considered incomplete division of the zygote at a considerably late stage of embryonic development as the reason for congenital duplication like diprosopus. Schulze et al. (2006) suggested that diprosopus could be an oligogenic inheritance as the parent stock and their ancestors usually show no signs of diprosopus and the frequency of its occurrence in a herd is presumably low.

Thus, such abnormalities can be avoided by reducing the frequency of inbreeding as well as culling any parent stock with history of producing diprosopus calf.

Congenital head defects involving duplications such as diprosopus, dicephalus and schisoprosopia occur more frequently in cattle than in sheep and pigs, and are rare in goats (Hiraga and Dennis, 1993). Its occurrence is extremely rare in horses (Shojaei et al., 2006). Duplication of frontal bones prevails in cattle, in contrast to cranial bones duplication found in sheep and pigs (Hiraga and Dennis, 1993). The degree of facial duplication varies from a partial doubling of the nostrils and upper jaw to a complete duplication of the face with formation of two mouths, four eyes and four ears. Sekeles et al. (1985) reported a case of partial diprosopus in a kitten in which the duplication of the ocular, oral and nasal cavities and their contents was partial. Bähr et al. (2004) and Schulze et al. (2006) reported cases of complete diprosopus in different German breeds of calves. Partial diprosopus is associated with fewer anomalies, and the prognosis is better than that of complete diprosopus (Wu et al., 2002).

*Diprosopus* is usually presented with unaffected or normal internal organs. This is unlike what is seen in cases of dicephalus in which duplication always involves internal structures (Hiraga et al., 1989). In the present case, the thoracic and abdominal viscera as well as limbs were not affected. A similar case of diprosopus in which the visceral and abdominal organs as well as the extremities were grossly normal has been reported in a calf (Kudo and Toda, 1970) and in a lamb (Mazzullo et al., 2003). Similarly, Ramadan (1996) and Gulbahar et al. (2005) reported cases of dicephalus in a goat and calf, respectively, in which thoracic and abdominal viscera such as oesophagus, heart, lungs, spleen and liver were duplicated.

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