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A rare case of Holocardius acephalus monster with fetal anasarca in a non-descriptive goat kid

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Abstract
A four years old female non-descriptive doe kidded one live female kid normally and a monster dead male kid during cesarean section. Based on gross and post-mortem findings the malformation kid was identified as holocardius acephalus with fetal anasarca. Holocardius acephalus is an imperfect individual in which the cranial part and thoracic cavity are absent. Monster may be due to error in the cell division at the embryonic stage or expression pattern of an abnormal gene or may arise when early pregnant doe exposed to the teratogens. A rare case of dystocia due to holocardius acephalus fetal monster along with fetal anasarca in a non-descriptive doe and its delivery by cesarean section is reported and described.

Keywords: Dystocia, holocardius, acephalus, monster, cesarean

Introduction
Developmental abnormalities of the ovum, embryo or fetus occur in all species of domestic animals which result in structural abnormalities in the fetus leading to *monstrosities*. Monstrosity is a disturbance of the development that involves various organs and systems which can cause great distortion of the individual (Vegad, 2007) [39]. The monstrosities are associated with either infectious disease or congenital defects (Arthur *et al*., 2001) [2] which may or may not interfere with birth. Abnormal duplication and/or disruption of the inner cell mass in an embryo give rise to congenital fetal abnormalities with partial duplication of body structures (Roberts, 2004; Purohit *et al.*, 2011) [31, 30]. It is important to know various types of monsters in animals that usually cause dystocia, which cannot be easily delivered and require a cesarean section or a fetotomy most of the time (Patil *et al*., 2004; Sharma, 2006) [27, 34]. Monsters can result in dystocia in sheep and goats (Purohit, 2006) [29]. Several factors are influenced by genetic and environmental conditions for the formation of monsters. Fetal monsters arise from adverse factors affecting the fetus in the early stages of its development. The adverse factors are mostly of genetic origin but may also include physical, chemical, and viral factors (Jackson, 2004; Chandrasekaran *et al.*, 2015) [17]. Dystocia in goats due to fetal oversize was (3.2%) and monsters were (1.4%) (Ali, 2011) [1].
Holocardius acephalus is an imperfect individual in which the cranial part and thoracic cavity is absent. Acardius acephalus (Synonyms: Holocardius acephalus) is a form of detached asymmetric conjoined twinning where one of the two twins, the parasite, is joined to an otherwise relatively normal fetus, the autosite, in one of the same sites of union as intact conjoined twins (Spencer 2001) [35]. Acardius acephalus is connected by the chorionic or cord vessels to the autosite twin, which provides, therefore, circulation and feeding to the parasitic one, often devoid of a heart and head. At birth, only the autosite twin survives after umbilical cord division as the parasitic one has no independent circulation once separated (Baldwin 1992; Tovar 2009) [4, 37]. In human medicine acardius acephalus is one of the most severe and rare congenital malformations and it occurs approximately once in 35,000 births (James 1977) [18]. In veterinary medicine, only a few cases of acardius acephalus in cows (Matteuzzi and Cianti 1988; Dunn *et al.*, 1967; Czarnecki 1976; Mee 1990; Santos *et al,*. 2008) [22, 16, 13, 23, 32], five cases of acardius acephalus in sheep (Cole and Craft 1945, Dennis 1965; Uccheddu *et al.*, 2009) [11, 14, 38] and one acardius acephalic in a buffalo (Dhami *et al.*, 2000) [15], Three cases of acardius acephalic in a goat (Balasubramanian *et al.*, 2015; Palanisamy *et al.*, 2018; Macri *et al.*, 2013) [3, 26, 21] have been described. Fetal anasarca is the general dropsy of the tissue beneath the skin of the fetus and less commonly reported in small ruminants (Prabharan *et al*., 2016) [28]. Fetal anasarca has been observed mainly in the calf, but occasionally in kids and foals (Craig, 2000).

Fetal anasarca cases in goats previously reported by Tamuli *et al*., 1987 [36]; Sharma *et al*., 2002 [33]; Laiju *et al*., 2012 [20]; Jayachandra *et al*., 2013 [19]; Chandrasekaran *et al*., 2015 [9]; Prabaharan *et al*., 2016 [28]; Borakhatariya *et al*., 2017 [8]; Baruti *et al*., 2018) [5]

Case history and clinical observations

A four years old non-descript pluriparous doe in her third gestation with the history of completed full-term gestation was straining after normal kidding of one female kid. The owner complained that the kidding signs started 10 hours before, the water bag ruptured 3 hours later and delivered female kid normally followed by a delay in the subsequent kidding process and unproductive straining. Dystocia was attended at the doorstep of a farmer house in Puthiyamputhur, Tuticorin, Tamilnadu, India. On clinical examination, the goat was dull and depressed with a congested mucus membrane, a rectal temperature of 39.9°C. Vulval lips were edematous and congested. In the vaginal examination, there was a clear vaginal discharge, a fully dilated cervix, and an irregular mass tightly engaged near the internal os of the cervix. The absence of fetal reflexes indicated that the fetus was dead. Further, attempts were made to deliver the fetus by forced traction but did not yield, therefore; it was decided to perform a cesarean section.

Treatment

Considering the condition of the doe, it was decided to perform a cesarean section to remove
the kid. The animal was stabilized with intravenous fluids and a cesarean section was performed as per the standard procedure. The local anesthesia was achieved using 3ml of 2% lidocaine as an inverted L block. An oblique skin incision was made in the left paralumbar fossa and continued through the subcutaneous tissue as well as the internal and external abdominal oblique muscles. The transversus abdominus muscle was also exposed and incised with the scissors. The peritoneum was tented and then incised with the scissors. This exposes the uterus which was exteriorized and incised on its greater curvature. A dead monster male kid was removed during the cesarean section. The uterus and surrounding area were flushed with 300 ml of normal saline and returned into the abdominal cavity. The uterine incision was closed with chromic catgut size 1-0 using two layers of lambert suture pattern. The peritoneum and transversus abdominis muscle were closed with chromic catgut size 1-0 using simple continuous suture pattern. The subcutaneous tissue was closed with chromic catgut size 1-0 using subcuticular suture pattern. The skin incision was closed with nylon size 1-0 using horizontal mattress suture pattern because of tension on the incision line. The doe was treated with 5% Dextrose normal saline (300 ml, I/V), Enrofloxacin (5mg/kg, I/M), Meloxicam (0.2mg/kg, I/M) and Oxytocin (15 IU, I/V) Post-operatively. The antibiotic therapy was continued for five days and the suture was removed on 12th day. The animal had an uneventful recovery.

Gross examination

Gross examination of the fetal monster revealed a male kid had generalized anasarca (subcutaneous oedema) without head (acephalus) and forelimbs (abrachia). The monster kid has weighed around 1.5 Kg. The anterior portion of the fetus was absent. Head, neck, and forelimbs were completely absent. The posterior half of the fetus was developed with distinct hind limbs. The hind limbs were normally developed over their entire length but adactyly (absence of digits) observed. The complete mass was lack of skeletal support.

Fig 1: Holocardius acephalus monster with fetal anasarca

Post-mortem examination

While opening the skin generalized anasarca was noticed on the fetus. On examination of thoracic cavity revealed that the absence of lung except for excessive soft tissues. An abdominal cavity examination revealed that coiled recognizable size mass without a clear stomach and intestine. In the lower abdomen only a rudimentary kidney with no urinary bladder and other structures.

Discussion and conclusions

The non-genetic anomalies or monsters may be of many types and degrees. The non genetic anomalies are similar to genetic anomalies are referred to as phenocopies. Mostly the nongenetic anomalies are caused by a variety of teratogens. The differentiation of germ layers is more susceptible to teratogens. The early pregnant animal when exposed to the teratogens such as insecticide, pesticide in the cultivable lands during grazing would have probably caused the monster. Hence the present case report of the monster could be due to error in the cell division at the embryonic stage or expression pattern of the abnormal gene since the dam had delivered a live fetus along with holocardius acephalus monster. However, toxicity studies and gene expression studies are required to confirm the hypothesis. The fetal monster plays an important role in deciding the ease of delivery. Even though the majority of fetal organs were absent, the position and size of the fetal monster resulted in dystocia and end up in the cesarean section. (Holocardius acephalus synonyms: Acardius acephalus). In human medicine, acardius is a rare and severe abnormality reported as a unique complication of monozygotic twin pregnancies and is known as twin-reversed arterial perfusion (TRAP) (Cohen *et al*., 2010) [10]. Acardius twins are subdivided into four morphologic categories: Acardius acephalus, in which the head, as well as the upper extremities, are lacking; Acardius anceps, the most highly developed form in which the body and extremities are developed and the head is partly developed; Acardius acormus, in which there is a head without a body; Acardius amorphous, which is the least form and is not recognizable (Napolitani and Schreiber 1960) [25]. The pathogenesis of this abnormality is thought to be due to reversed arterial perfusion. Oxygen- and nutrient-depleted umbilical artery blood leaves the normal twin and is driven into the abnormal twin by way of anastomoses with its umbilical artery. Two pathogenetic hypotheses are currently accepted. The first hypothesis

suggests that there is a primary defect in the development of the heart and that the acardius twin only survives as a result of the compensatory anastomoses that develop. The second states that the acardius twin begins life as a normal fetus and that a reversal in the circulatory blood flow results in atrophy of the heart and other organs (Blenc *et al.*, 1999) [7]. Roberts (2004) [31] stated that fetal anasarca may develop in a single fetus or one of the twins and was due to a simple autosomal recessive gene. Rarely mild hydrops of the amnion or allantois and edema of the placenta may accompany fetal anasarca (Jayachandra *et al.*, 2013) [19]. The fluid effusion accumulation in subcutaneous space might be due to lack of lymph nodes and the existence of an autosomal recessive allele which affects the embryological development of normal lymph nodes (Chandrasekaran *et al.*, 2015; Monteagudo *et al.*, 2002) [9, 24]. Based on gross and postmortem findings the malformation was classified as Holocardius acephalus monster with fetal anasarca in a non-descriptive goat kid and its delivery by cesarean section is summarized. The present case report represents an addition to the very few scientific literatures on this topic.

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