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Research Article – Veterinary Anatomy Case Report

A case of congenital left brachium agenesis (amelia, brachiomelia monobrachium) in Sahel goat ecotype

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Abstract

This rare case of amelia in a doe-goat was observed in Tarka local government area, Benue State, middle belt region of Nigeria. The congenital deformity consisted of complete agenesis of the affected fore limb; the defect is commonly unilaterally manifested. The present congenitally impaired goat was approximately one and a half years old, and was a second kiddling of a normal multiparous dam. The left fore limb was grossly vestigial in development, while the homologous right hoof was splayed; the hind limbs were anatomically normal. Radiographs revealed morphological aberrations in intergumentary, skeletal, vascular, nervous systems and musculature of the affected limb. Sahel goat is alien to this developmental syndrome and this is to the best of our knowledge - the first case report of left sided brachial agenesia, (amelia) in a doe-goat of this breed. By season of occurrence, the hypothesis of interplay between genetics, climate and environment at large in the pathogenesis of this hereditary anomaly is raised and supported by the abundance of phytoteratogens in alternative diets in the dry seasons. The condition is compatible with life but may contribute to reproductive and economic loss in farms.

Keywords

Goats, Congenital abnormalities, Amelia, Brachiomelia monobrachium, Ecotoxicology, Climate phenomena.

Introduction

Genetic constitution in man and animals forms the basis of hereditary disorders (Binanti and Riccaboni, 2011; Olopade et al., 2011) and damage in genomic architecture forms a substrate for the observed phenotypic expressions (Elliot, 2006) in a morphologically abnormal individual. Dysmorphology caused by genetic events such as gene mutations, chromosomal aneuploidy and translocations is called malformation (Szczerbal et al., 2006). Malformations may appear as syndromes involving several embryonic systems in which abnormalities are observed concurrently (Bowers, 2011). Hereditary defects of limbs probably arise from aplasia of limb buds from about the fourth to eighth week of gestation (Corbera, 2002). A missing limb is defined as monobrachia or monopodia (Leipold, 1997 and Szczerbal et al., 2006), as in the cur-

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rent case report.

Although developmental 'disorder' case reports are comparatively scarce in veterinary literature (Corbera et al., 2010), small domestic ruminants suffer from monstrous malformations (Samuel et al., 2014). Recent literary information on comparable reports in small ruminants includes phocomelia in sheep (Sonfada et al., 2010), brachiomelia in West African Dwarf triplet goat (Olopade et al., 2011) and peromelia in a Simmental calf (Smolec et al., 2011).

Case report

A pregnant one and half year old Sahelian doe goat from a farmer in Wanunen, Tarka local government area, Benue State of Nigeria had no history of abnormal previous kiddling. Available records revealed that the goat, born around February 2012, had the right fore and hind limbs fully developed, while the left fore-limb was vestigial and consisted of a remnant button-sized protrusion on the skin which on palpation was a mass of soft tissue.

The animal was kept solitary in the hospital goat stable for four weeks with access to food and water ad libitum. Prior to commencement of this investigation, vital systemic parameters and general physiological status of the body was evaluated to ascertain functional integrity. She died after parturition for causes unrelated to the present investigation and was therefore subjected to necropsy

Necropsy findings

Integumentary system

The proximal area of the forelimb was covered by comparatively scanty hair and is relatively underpigmented at the axilla, the dermis showed sparsely distributed hair follicles with subcutis consisting mainly of poorly developed connective tissue and terminal blood vessels.

Skeletal system

Ribs on the affected side were comparably asymmetric and slender, a morphologically malformed and attenuated left scapula bone was present of about 2 cm^2, no evidence was observed of a suprascapular cartilage, spinous process or recognizable medial or lateral surfaces. The ventral portion of this structure was reduced to a bulbous formation without a demonstrable glenoid cavity, nor an acromion process. There was absence of a formed functional joint cavity, scapulo-humeral joint and humerus.

Vascular system

The left brachiocephalic artery was of normal morphological caliber as emerged from the thoracic cavity to become left axial, but beyond this level it was profoundly attenuated, weak and covered with fibrous tissue leading to terminal subcutaneous

Figure 1 – A: Left antero-lateral view of brachiomelia goat showing absence of left forelimb and medial rotation of right forelimb (B) Close up view of the vestigial forelimb

connective tissue mass. Dorsal, deep cervical and intercostal arteries were not traceable to any significant extent. The accompanying veins had a similar size.

Nervous system

A remnant of the brachial plexus was observed as this emerged from the scalenus. The thoraco-dorsal and cervical nerves as well as the dorsal spinal accessory nerve originating from the medulla as it emerged from the jugular foramen of the foramen magnum in the skull and courses through the brachiocephalicus, serratus dorsalis cervicalis pectoralis descendens, supraspinatus terminating in an indistinguishable trapezius with no grossly noticeable ganglia while the ventral branch (both motor) supplying both parts of the sterno-cephalicus were miniature-sized.

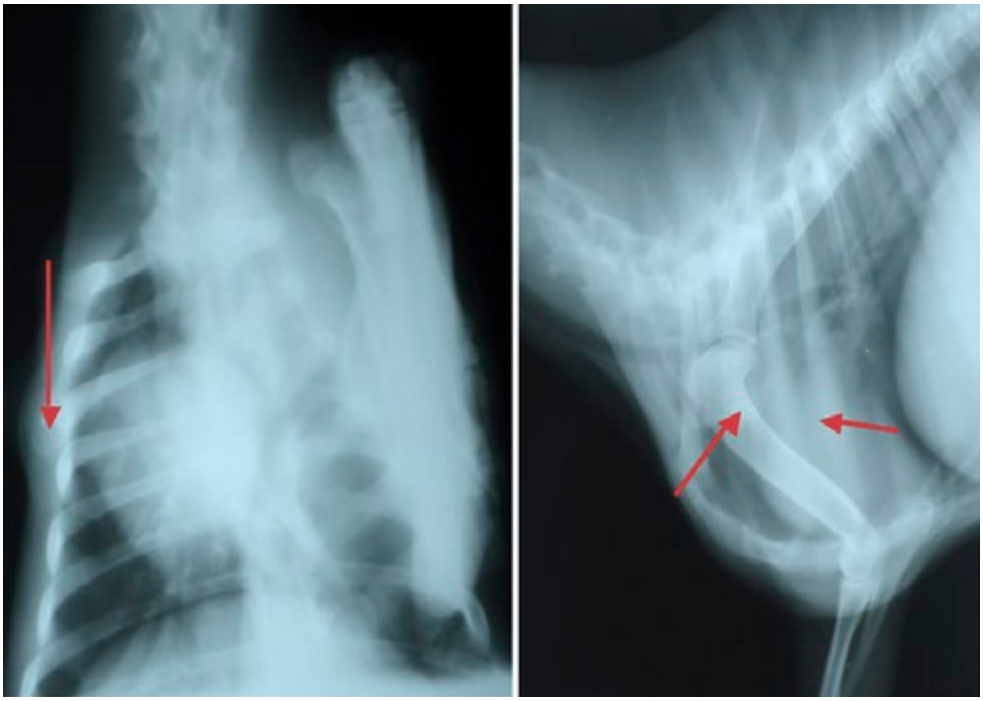

Figure 2 – Radiographs of left forelimb (left panel: dorso-ventral; right panel: left lateral) showing remnant bony structures of the limb.

Muscles

Arrested isomeric growth of the left side muscles was apparent in the lateral group, supraspinatus, infraspinatus, teres minor and medially the biceps brachialis, triceps and subscapularis. The dorsal shoulder muscles, trapezius, lattissimus dorsi, rhomboideus and brachiocephalicus, at the level of the 6th cervical vertebra were also remarkably reduced without insertion of the latter in a subscapula fossa. The muscles of the ventral group, sternocephalicus, pectoralis superficialis, pectoralis profundus pars scapularis (pars humeralis absent), serratus dorsalis caudalis, serratus ventralis cervicis, serratus ventralis thoracis caudalis, scalenus, were grossly compromised (Sisson and Grossman, 1975).

X-ray finding

A left lateral radiograph revealed the absence of an anatomical scapula; only a rudimental bone was observed embedded in tissue fascia among fusiform strands of muscle.

Discussion

The present case study is a first report in its kind, but is the fifth monstrosity within a year in the same geographic area within the state and brings to fore a concern for nomadic migrations of cattle rearers, for extensive method of farming and for environmental effects of climate and weather phenomena in this region. Earlier reports in the same area include omphalo-ischiopagus (dicephalic, dithoracic abdomino-ischiopagus tetrascelus tetrabrachius) in lambs (Samuel et al., 2014), congenital phenotypic haemaphroditism in a piglet, congenital bovine fetal anarsarca and an incidence of cyclopia in a calf; all in different stages of reporting.

About 2% of human infants are born with a readily observable anatomical abnormality (Bowers, 2011), including missing limbs, which occurs because of disruption of genetic instructions (Samuel et al., 2014). Co-option (recruitment) of existing genes and pathways for new functions is a fundamental mechanism for creating new phenotypes (Binanti and Riccaboni, 2011). Duplication and divergence at gene level may allow these to assume divergent functions (Szczerbal et al, 2006). Stability defects in the expressivity of genes (Szczerbal et al, 2006) responsible for the development of limbs might be implicated in the pathogenesis of this type of phocomelia observed (Smolec et al., 2011; Olopade et al., 2011).

Some birth defects are produced by mutant genes or chromosomes, while some depend on toxic, viral, environmental factors or a combination of these that impede development (Saperstein, 2002; Samuel et al., 2014).

Exogenous agents responsible for such disruption include chemicals, viruses, radiations, hyperthermia and toxic plants which may lead to allometric growth of body parts in in-born developmental errors (Corbera et al., 2002). Also phytoteratogens contribute to livestock losses through embryonic death, upon passing the placental barrier, and may be species specific (Knight and Walter, 2012). Veratrum californicum (containing phytoestrogens, swainsonine and anagyrine, an alkaloid of quinolizidine) has been incriminated for the occurrence of cyclopia and arthrogryposis in lambs and goats (Binns et al., 1972).

The observed developmental errors in the present case led to reduced respiratory and ambulatory competence occasioned by compromised anatomical caliber of primary and secondary muscles for respiration as well as the primary movers of the forelimb (Sisson and Grossman, 1975). As a probable compensation to locomotion and balance we observed medial rotation of the right forelimb hoof. Precautionary mechanisms against such mutilating conditions should be adopted and enforced for migrating herdsmen; accidental breeding with domestic goats kept on extensive mode should be curtailed. Furthermore, in abnormal weather events with deviations of 1.9-2.9°C from daily mean temperature (NIMET, 2010) and prolonged dry period, adequate supplemental feeding of pregnant does may discourage the use of alternative stored feed in breeding seasons. Furthermore, scrutiny of feed ingredients utilized in rations should be done to avoid low value feeding due to high cost of better substitutes. Higher percentages of low quality and toxic feed alternatives exist in stomach compartments of ruminants during prolonged hyperthermic weather events (Happold, 1987). Scarcity of high quality forage exposes domestic species to phytoteratogen.

Bridging research gaps in monstrosities in farms can be achieved through improved livestock surveillance policy and education services; estrus synchronization may be also beneficial.

Breeding such dams should be discouraged and adequate record keeping for epidemiological surveys will be helpful against future occurrences (Nottidge et al., 2007).

Conflict of interest statement

The authors declare that there is no conflict of interest as regards the present manuscript.

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