CONGENITAL CHONDRODYSPLASIC DWARFISM IN LAMBS: A DIFFERENT CONSIDERATION OF DYSTOCIA

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ABSTRACT

In this study, we report three chondrodysplasic anomalous lambs obtained from 2 Akkaraman sheep with dystocia. According to the flock history, the incidence of congenital skeletal anomalies among lambs was 14.28 % and 11.66 % in 2005 and 2006, respectively. The same two rams had been used to obtain natural mating and no new animals had been bought into the flock over the last 5 years. Affected lambs showed typical macroscopic features of a compressed and flattened face, domed head, narrow thorax, swollen abdomen and extremely short paddle like extremities. Radiological examination of extremities of the long bones revealed that diaphyses were extremely shortened and distance between diaphysis and epiphysis was increased. Long bones such as antebrachium, humerus, tibia and femur were short and thick. Histopathologically, immature chondrocytes were present at the articular surface and defective epiphyseal plates were detected in the extremities of the bones and sternum. Persistent cartilage showed irregular strands containing groups of two or four chondrocytes localized in the basophilic matrix. In conclusion, chondrodysplasia of lambs should be added to the list of differential diagnoses of dystocia especially in inbreed sheep.

INTRODUCTION

Chondrodysplasia is a congenital skeletal anomaly characterized by short extremities, tracheal collapse, and domed shaped head due to developmental failures in bone, cartilage or primitive mesenchymal tissue. The whole skeletal system can be affected by congenital chondrodysplasia and osteodysplasia (1, 2). In animals, the term "disproportionate dwarfism" has been used frequently to describe this kind of congenital skeletal anomaly (3). Hereditary chondrodysplasia is a well known skeletal anomaly of various cattle breeds (3). A mild form of hereditary chondrodysplasia known as brachycephalic dwarfism is phenotypically characterized by domed head, cubic face appearance, swollen abdomen and short-paddle like limbs (3-5). Chondrodysplasia in the appendicular and axial skeletal system has also been reported in dogs in Poodles, Scottish Terriers, Alaskan Malamutes, Basset Hounds and Dachshunds. Notably, appendicular chondrodysplasia is an important feature in Basset Hounds and Pekingese breed dogs (6).

In another anomaly seen in Dexter cows, heterozygous mutant individuals show a mild dwarfism phenotype, while, homozygous-affected calves are born with short paddle like limbs and severe craniofacial defects. This typical appearance is known as Bulldog calves. Heterozygous phenotype is similar to achondroplastic dwarfism in phenotype.

In humans, achondrogenesis type 1B, a fatal genetic disorder, is characterized by flatten face, short extremities, hypoplastic thorax, enlarged abdomen and edematous appearance of the fetus. Individuals with respiratory distress syndrome, as a consequence of immature cartilage development in the respiratory system, generally die before delivery or shortly after birth. It is believed that mutations in fibroblast growth factor receptor-3 genes are responsible for such cartilage defects (7).

There is a different chondrodysplasia phenotype in sheep known as spider lamb syndrome in which a recessive gene is responsible for skeletal anomalies including long and splayed legs, curved spines, platy-thorax and abnormally long neck (6, 8). An infrequent and unique chondrodysplastic syndrome in lambs has been reported in England by Duffell et al. (1). The authors described different characteristics of dwarfism as a consequence of chondrocyte dysplasia, defective endochondral ossification and presence of abnormal cartilage development in the respiratory tract. The affected lambs had great similarities to human achondrogenesis type 1 B phenotype, rather than spider lamb syndrome. According to the report by Duffell et al (1), 27 out of 110 lambs were born with severe skeletal anomalies including a short and plump body with a flattened face, short paddle-like limbs, a narrow thorax and swollen abdomen, and relatively mild dystocia was evident. Severely affected lambs were born alive, however, they became moribund and died within few minutes after birth because of tracheal collapse and lung hypoplasia. In the present study, we describe gynecologic, radiographic, macroscopic and histological features of a

chondrodysplastic syndrome in three lambs submitted from an inbred flock of sheep.

MATERIALS AND METHODS

Three anomalous lambs were obtained from two pregnant Akkaraman ewes, one of which delivered a pair of anomalous twins, which were referred to the Department of Gynecology and Reproduction, Faculty of Veterinary Medicine, Kirikkale University, Turkey. According to the flock history given by the owner, the incidence of congenital skeletal anomalies among lambs was 14.28 % (10 out of 70 lambs) and 11.66 % (7 out of 60 lambs) in 2005 and 2006, respectively. The ewes in the flock had been mated by the same two rams for the past 5 years. No other animals were brought into the flock during this five years period. No vaccines or medications were administered and no clinical signs of any disease were noted in the pregnant ewes.

Gynecologic Examination

The first ewe was referred to the clinic on October, 2005 with a history of dystocia. Ultrasound examination revealed the presence of dead twin lambs (Cases# 1, 2), one of them in the birth canal with a normal presentation-position.

The mother of third anomalous lamb (Case# 3) was referred to our clinics on April 2006, with a complaint of dystocia following twelve hours of labour and delivery attempts. At ultrasound examination, neither fetal movements nor heartbeat were detected. After a failed extraction attempt, cesarean section was performed.

Gross Morphology

All three lambs were similar in gross appearance: they had flattened face, domed head, extremely short fore- and hind-limbs that were attached to the body in the form of a short flipper. Furthermore, an extremely narrow thorax and distended abdomen was also evident. The scrotum of the third lamb appeared as an empty pouch with dimensions of 6.5 x 6.2 x 2.0 cm in size (Figs 1, 2).

Radiologic Examination

The skull, the body and limbs of three affected lambs and a newborn healthy Akkaraman lamb were radiographed in dorsoventral and lateral planes in order to compare their skeletal systems (Figs 3, 4).

Histopathologic Examination

The whole body of the lambs was fixed in 10% buffered formalin and tissue samples of long bones, sternum, trachea, larynx and lungs were collected. Subsequently, tissues were embedded in paraffin wax, sectioned at a thickness of 4-5 µm and stained with hematoxylin and eosin.

RESULTS

Radiologic examination of extremities long bones revealed that the diaphyses were extremely shortened with the distance between diaphysis and epiphysis increased. Long bones such as antebrachium, humerus, tibia and femur were short and thick. The head was domed shape and naso-maxillar and basal bones of the cranium were perpendicular to the vertebral axis (Fig. 3) when compared to oblique angle of control radiographs of the normal lamb (Fig. 5).

On post-mortem examination the epiphyses and diaphyses of the long bones were prominent while their metaphyses were gelatinous in consistency. Ossification and consistency of the metacarpal/metatarsal bones and phalanges were normal.

Histopathologically, the long bones, epiphyses and diaphyses showed a normal ossification pattern however in some areas there were irregular chondrocytes remaining representing immature bone formation. Epiphyseal plate cartilages were extremely narrow and contained irregular columns of chondrocytes (Figs 6, 7). Immature and hypertrophic chondrocytes were seen in tracheal and laryngeal cartilages.

DISCUSSION

Chondrodysplasia is a rare congenital anomaly in lambs and its etiology is still unclear. In a previous study, genetic and hereditary factors were investigated because of inbreeding in the flock, albeit there is no molecular evidence to confirm this suggestion. It is possible to speculate the relationship between inbreeding and chondrodysplasia due to the fact that the ewes had been mated by the same two rams over a long period of time. However, further genetic analysis is necesssary to clarify the hereditary nature of the condition and furthermore it would be difficult to discern which ram and/or ewe is responsible for this kind of anomalies.

The cases reported here had a great similarity in phenotype to bulldog calves (4, 5, 9) and to some types of human dwarfism, especially achondrogenesis type 1 B. The genes responsible from the achondrogenesis type 1 B and Bulldog calves have been determined during the last decade (10,11). In sheep, congenital skeletal anomalies resembling human chondrodysplasia phenotype were reported in two different sheep flocks in New Zealand and in England (1, 2). To the best of the authors' knowledge, there are no other reported cases of chondrodysplasia or dwarfism in lambs.

The most frequent causes of dystocia are extremely big and/or disproportional size of fetuses and abnormal fetal presentations. However, incomplete cervical opening, synchronous presentation of twin fetuses in the birth canal and uterine inertia may also play an important role in the etiology (12, 13). In sheep, the normal presentation during parturition is considered longitudinal anterior presentation and dorso-sacral position (14, 15). Some abnormal presentations and postures of fetuses may not result in dystocia. For example, ewes might deliver healthy lambs if a fetus enters the birth canal with a single limb and head (13, 14). In the present report, although the normal position of two lambs (Case # 1, 3) in the birth canal was normal the occurrence of dystocia might have been closely related to the skeletal anomalies of the lambs. All three dwarf chondrodysplasic lambs had short body length and extremely shortened extremities. However, we still assert that dystocia could have originated as a result of short and paddle like fore- and hind-limbs, flattened face and disproportionately large head size of chondrodysplasic lambs.

In conclusion chondrodysplasia in lambs, an uncommon congenital syndrome should be taken into account as a cause of dystocia especially in flocks of inbred sheep.

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FIGURE LEGENDS

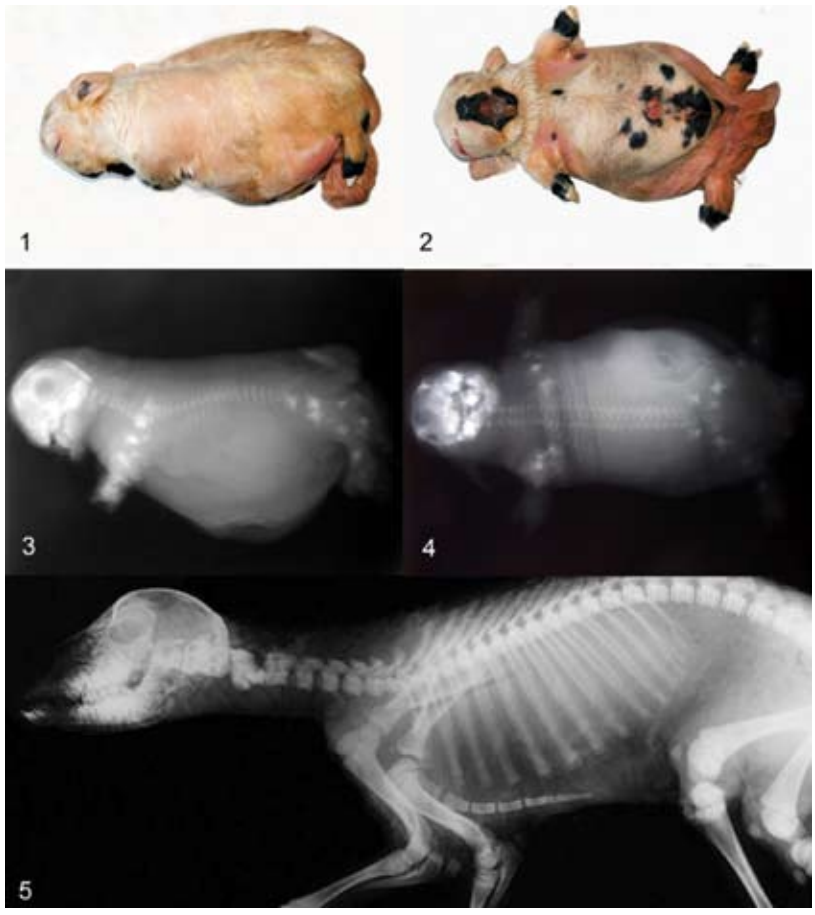

Fig.1 Lateral macroscopic appearance of the affected lamb, flatten face, domed head, extremely short fore- and hind-limbs, narrow thorax and swollen abdomen. (Case#3).

Fig. 2 Dorso-ventral view of the same lamb in Figure 1. (Case#3).

Fig. 3-5 Lateral and ventro-dorsal radiological view of lamb case #3. The head is domed shape and naso-maxillar and basal bones of the cranium are perpendicular to the vertebral axis (Figs. 3, 4) when compared to oblique angle of control radiographs of the healthy newborn Akkaraman lamb (Fig. 5).

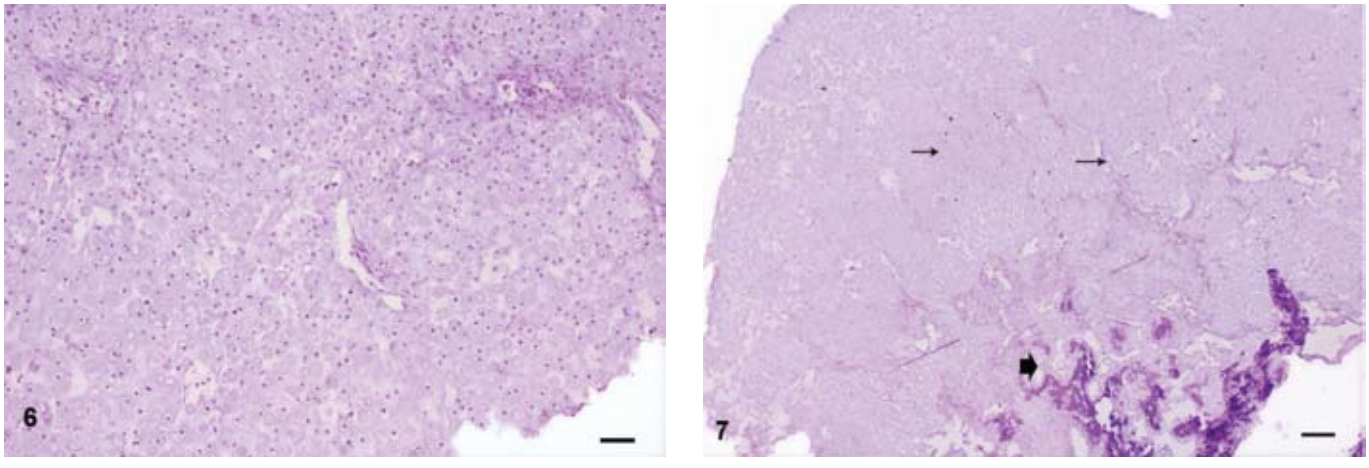

Fig. 6 Sternum, loose and irregular chondrocyte strands. Severe cytoplasmic vacuolar degenerations are prominent. Hematoxylin-eosin. Bar= 50 μm.

Fig. 7 Femur, epiphysis. Loose appearence becuse of scarce chondrocytes and abundant basophilic extracellular matrix. At the metaphysis border, some normal histologic calcifications (arrows). Hematoxylin-eosin. Bar= 320 μm.