ARTHROGRYPOSIS AND ASSOCIATED DEFECTS IN A NEWBORN CALF

Department of Veterinary Anatomy,
College of Veterinary and Animal Sciences, Mannuthy-680 651, India.

ABSTRACT

Clinical, gross and histological changes of a newborn calf affected with arthrogryposis are discussed. Examination of the foetus revealed muscular dystrophy and generalized articular rigidity of head, neck and the joints of limbs. There were severe strictures with deformed joints and ankylosis of the limbs. Hypoplasia of the skeletal muscles was another feature. The vertebral column was strongly curved to the right side and the anal opening was located in the dorsal midline, about 2 cm anterior to the line joining the points of buttocks. The thoracic cavity was very short and showed lung hypoplasia. Histologically, the spinal cord showed severe atrophic changes. The ependymal lining of the central canal was not continuous. Ventral horn cells were very few and showed degenerative changes. In the skeletal muscle, the sarcoplasmic area was replaced by lipids and in stained preparations, peripherally located nuclei and vacant sarcoplasm without any myofibrils could be located. The possible etiological factors are discussed.

Key words: Arthrogryposis, Newborn calf

INTRODUCTION

Congenital anomalies are abnormalities of structure or function present at birth and account for a high percentage of calf mortality before to just after calving. The frequency with which different parts of the body may be affected varies. One of the common defects in all breeds of cattle seems to be arthrogryposis or congenital articular rigidity (CAR). This syndrome is a congenital malformation characterized by curvature of limbs, multiple articular rigidity and muscular dysplasia (Selvaraju et al., 2009). The present report describes the clinical, gross and histological changes of this neonatal deformity in a calf.

MATERIAL AND METHODS

The study was conducted on a female deformed newborn calf collected from the Veterinary Hospital, Vilvattom, Thrissur. A pluriparous Jersey crossbred cow was reported to the hospital with a history of difficulty in parturition. The water bags had ruptured four hours before and pervaginal examination revealed fully dilated cervix. Foetus was in longitudinal posterior presentation. After careful palpation, the two rigid ankylosed hind limbs were found. Since the foetus was small, judicial traction was applied after generous lubrication of the birth canal with liquid paraffin and the foetus was delivered. It was dead and weighed 4.5 kg. After recording the gross features, the calf was perfused with 10% formalin. The musculoskeletal system was thoroughly examined by careful dissection and the viscera were also examined for their topographic features. Samples of skeletal muscle and spinal cord were collected and standard procedures were adapted for histologic examination. The sections were stained using Haematoxylin and Eosin and that of the spinal cord with Holme’s silver nitrate luxol fast blue method also (Humason, 1972).

RESULTS AND DISCUSSION

Gross Observations

Examination of the foetus revealed muscular dystrophy and generalized articular rigidity of head, neck and the joints of limbs (Fig. 1). The head and neck were flexed to the right side and the neck was stiff. The head was fully developed and the skull was complete. The lower jaw was small in size (Micrognathia inferior) and was deviated to the right side. Micrognathia inferior condition has been

*Veterinary Hospital, Vilvattom, Thrissur.
reported in a buffalo calf by Nanda et al. (1987). According to Leipold et al. (1970), arthrogryposis in new born calves was often associated with cleft palate. But in the present case, there was no cleft palate but a deep groove could be identified in the left lateral aspect of the upper jaw.

There were severe strictures with deformed joints and ankylosis of the limbs. In the limbs, most of the muscles were not developed. Left shoulder region was closely adherent to the lateral surface of the neck and thorax and the shoulder joint was fixed at 90° angle. The joint was attached to the lateral surface of the neck and was in level with the angle of mandible. The elbow joint was also strongly flexed (about 45°) and the arm and forearm regions were connected by fibrous tissue (Fig. 2). Caudal border

Fig 1: Arthrogryposis in a day-old calf.

Fig 2: Flexed elbow joint of the left fore limb (skin removed)
1) Humerus, 2) Fibrous tissue, 3) Radius, 4) Elbow joint.
of the arm region was attached to the lateral thoracic wall. Fixation of the joints might be due to lack of extensibility of the muscles, ligaments or atrophy resulting from neuropathy (Tyagi and Singh, 1996). The forearm region ran parallel to the neck. A short ligament connected the olecranon tuberosity to the lateral thoracic wall. The carpal joint was curved medially and was partially flexed due to the contracted flexor tendons. Metacarpals and digits appeared normal. In shoulder and arm regions, the muscles were partially developed whereas in the forearm region, little muscular tissue could be located.

In the right forelimb, the scapula was inclined transversely to the median plane and was closely attached to the neck. The scapula and humerus were shorter than those of the left limb.

Fig 3: Strongly flexed stifle joint of the left hind limb (skin removed)
1) Femur, 2) Fibrous tissue, 3) Tibia 4) Stifle joint, 5) Hock joint.

Fig 4: Heart and lungs showing lung hypoplasia.
1) Right lung, 2) Left lung, 3) Heart.
The shoulder joint was deeply seated and extended to the neck region and the humerus lay close to the right cheek. In comparison to the left arm, the muscles were better developed on the right arm region. Other features were almost similar to that of the left side. Flexed scapulohumeral, humeroradial and metacarpophalangeal and extended carpal joint on both the limbs have been reported by Leipold et al. (1970) in calves and Amit et al. (2006) in a buffalo calf.

The vertebral column was strongly curved to the right side and measured 42 cm. Torticollis, scoliosis and kyphosis were described as being associated with arthrogryposis in calves by Leipold et al. (1970). A peculiar feature noticed was that the anal opening was located in the dorsal midline, about 2 cm anterior to the line joining the points of buttocks. There was no external genital opening near the anus but the teats were present in the inguinal region. Absence of external genitalia and

---

**Fig 5:** C.S. of the spinal cord. H&E. × 400  
1) Central canal, 2) Ependymal lining.

---

**Fig 6:** C.S. of the spinal cord. H&E. × 100  
1) Gray mater, 2) White mater
hind gut opening has been reported by Napolean et al. (2008) in a perosomus horridus buffalo foetus. The tail was 11 cm long. Practically there was no lumbar region as such and the os coxae extended almost to the level of the last rib especially on the right side. Arthur et al. (1996) opined that rudimentary lumbar vertebrae and rear quarter muscles might be due to lack of movement by developing foetus.

Gluteal muscles on both sides were least developed. On the left hind limb, the greater trochanter of femur was lying close to the tuber ischii and head of the femur was located subcutaneously. Point of hip lay close to the last rib. Stifle joint was strongly flexed and the thigh region was fused to the leg by a thin band of muscular and fibrous tissue (Fig. 3). Patella was cartilaginous and smaller. The hock joint was partially flexed and the tarsal bones were arranged in an arched manner (Fig. 3). Distal portions of the hind limb appeared normal. On the right side, since the whole foetus was flexed to the right, the point of hip was lying near the caudal angle of scapula. Thigh and leg regions were attached throughout their length by muscular tissue. Unlike the left hind limb, this fused mass was closely adherent to the ventral abdominal wall.

The thoracic cavity was very short especially on the right side. The heart was fully developed. A peculiar feature noticed was that the lungs were poorly developed especially on the right side (Fig. 4). Only the apical lobe was developed in both the lungs and the left one was relatively larger. The left apical lobe measured 9.5 cm and showed a cardiac notch. The cranial division of the left apical lobe was more developed than the caudal division. The right lung was only 7 cm long and its apical lobe was only partially developed with no cardiac notch. Other lobes were least developed. Lung hypoplasia has been reported to be associated with arthrogryposis in human beings (Hall, 1997). Organs in the abdominal cavity showed corresponding changes in position in response to the right lateral flexion of the vertebral column. Liver was placed transversely just caudal to the diaphragm.

**Histological Changes**

Section of the spinal cord from the thoracic region showed severe atrophic changes. The ependymal lining of the central canal was not continuous (Fig. 5). Ventral horn cells were very few and showed degenerative changes (Fig. 6). Furthermore, the white matter showed demyelination.

In the skeletal muscle, there was severe atrophy. The sarcomplasmic area was replaced by lipids and in stained preparations, peripherally located nuclei and vacant sarcomplasm without any myofibrils could be located in cross section (Fig. 7). Lymphatic infiltration was also observed in some
regions. Similar changes have been reported by Leipold et al. (1970) in calves affected with severe arthrogryposis. Amyoplasia, characterized by fatty and fibrous tissue replacement of the limb muscles, is the most common form of arthrogryposis reported in human beings (Hall, 1997).

Numerous etiological factors have been recognized, which include viral (Akabane virus), plants (Lupinus species), teratogens and a heritable recessive trait in cattle (Singh and Little, 1972). Environmentally induced cases are caused by vitamin A deficiency in pigs and manganese deficiency in cattle. Cryptorchidism, ankylosis and death of the foetus in the last trimester of pregnancy have been reported to be genetically transmitted in cattle (Roberts, 1971). Hydrocephalus, arthrogryposis conjoined with facial cleft has been reported in a new born cross bred Jersey calf by Vijayanand et al. (2009). Since many conditions are inherited, it is suggested that breeding of parents of such offsprings should be avoided. Extremes of temperature during pregnancy and endocrine disturbances are also included among the etiological factors.

The skeletal muscles were pale and soft and had various microscopic changes which are probably secondary to the underlying neurologic lesions. The motor unit of the skeletal muscle consists of the ventral motor neuron, the neuromuscular junction and the muscle fibre innervated by the neuron. If there is any defect in the lower motor neuron, it will lead to muscular hypoplasia or dystrophy (Leipold et al., 1970). The muscular rigidity might have been caused by impaired neurogenic functions and motor activity of neurons in the spinal cord (Selvaraju et al., 2009). According to Chester (2008), the muscle weakness and imbalance of muscle power around the joints elicits a physiological compensatory collagenic response, which replaces atrophied muscle fibres with connective tissue and thickens the joint capsule sufficiently to result in prenatal fixation of limb segments at the joint.

REFERENCES