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Congenital hydrocephalus condition in calves: A case report

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Abstract
The hydrocephaly can be defined as dropsically condition of the brain owing to abnormal accumulation of cerebrospinal fluid (CSF) in the cranial cavity. In the present study four samples were taken. The external hydrocephalus calf consists of football shaped head and internal hydrocephalus calf consists of dome shaped head. The length of the body was more in internal hydrocephalus calf due to kyphosis condition. The cephalic index is more in case of internal hydrocephalus calf compared to both external and normal calves is due to internal pressure on cranium. In both types of hydrocephalus calf, incomplete and thinner bones were present along with ankylosis of limbs. The age and weight of foetuses also less compared to normal calf due to nutritional imbalance.

Keywords: Gross anatomy, hydrocephalus, congenital and calves

1. Introduction
The hydrocephaly can be defined as dropsically condition of the brain owing to abnormal accumulation of cerebrospinal fluid (CSF) in the cranial cavity and has been encountered as an infrequent congenital anomaly in mammals. The site of production of cerebrospinal fluid (CSF) includes the ventricular plexuses, the ventricular lining ependymal cells, the pia-glial membrane covering the external surface of the brain and the pia- arachnoid blood vessels. The cerebrospinal fluid (CSF) flows from the lateral ventricles to the third ventricle through the foramen of Monro and from the third ventricle moves to the fourth ventricle through the aqeduct of Sylvious, later the fluid exits the fourth ventricle through the foramina of Luschka, one located on either side at the cerebellopontine angle, into the subarachnoid space. There are two types of hydrocephalus conditions in which first one is internal/ non communicating type in which accumulation of cerebrospinal fluid may occur either in ventricular system alone (Malik *et al*, 2017) [1] or due to an occlusion of one of the interventricular canals, usually the acqueduct of Sylvius, and as a result fluid accumulates in the ventricles anterior to the occlusion. Second one is external/communicating type in which fluid accumulates outside the brain in the subarachnoid spaces. A simple autosomal recessive gene (Roberts, 1986) [2] and also hypo vitaminosis A (Jubb and Kennedy 1970) [3] have been reported to be linked with hydrocephalus in cattle.

3. Materials and Methods
The present study was conducted on hydrocephalus condition of four calves. The foetuses were separated from foetal membranes then the shape and type of hydrocephalus were noted. The approximate age of foetuses were measured by using Solimans formula *i.e.,* CVRL< 20CM = 28.66 + 4.496X and CVRL> 20CM = 73.544 + 2.256X, where X is the crown - rump length in centimetre measured using scale with the help of thread. The Cephalic index is calculated using the formula *i.e.,* breadth / length × 100 Krasinska (1988) [4], where breadth is the space between supra orbital process and length is prosthion (midpoint of the rostral margin of dental pad) to torus frontalis (central raised point on frontal eminence) and also taken the measurement from prosthion to raised point of hydrocephalus and then compared these measurements with normal calf. The body length also measured from spinous process of 1st thoracic vertebrae to the pin bone (Tuber ischii) Blackwell *et al.* (1959) [5].

3. Result
In the present study enlargement of the head in two fetuses were located in occipital and excessive accumulation of watery fluid firmed the condition to be internal hydrocephalus.

In third fetus, the sac of fluid was hanging over the head and on excision, it was found to be in the subarachnoid space hence this was external hydrocephalus are compared with normal calf (Fig.1C). The affected calves have been dead at birth or have died shortly thereafter. Small body size and a bulging forehead are characterized by all affected calves. The incomplete ossification of the skull is encountered. The external hydrocephalus calf consists of football shaped head (Fig.1A). The internal hydrocephalus calf consists of dome shaped or bull dog shaped head and incomplete development of cranium (Fig.1B). The crown rump length in external hydrocephalus is 55cm, in internal hydrocephalus 77cm (Fig.2B) and 80cm in normal calves (Fig.2A), (Table.1). The incompletely developed teeth and small size indicated prematurity, but most calves were only a few days premature.

Normally body length was less in hydrocephalus affected calves compared to normal due to dwarfism (Fig.3A) but the internal hydrocephalus calf body length was higher due to kyphosis condition (Fig.3B). The cephalic index is more *i.e.*, 52cm (Table.1) in case of internal hydrocephalus calf (Fig.5A) compared with both external (Fig.5B) and normal calves (Fig.4) is due to internal pressure on cranium. Bulging of forehead in both hydrocephalus calves so that the length from dental pad to frontal bone is short compared to normal calf. The cranial bones were found markedly thin in both types of hydrocephalus calves. In addition to hydrocephalus some other defects also observed such as ankylosis of both forelimbs and hind limbs in both external and internal hydrocephalus calves.

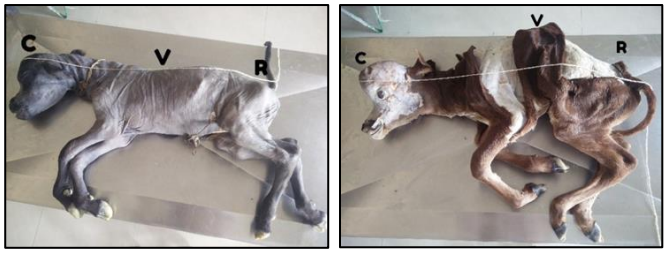
Table 1: Measurements of hydrocephalus calves.

S.no	Characteristic feature	Normal foetus	External hydrocephalus	Internal hydrocephalus
1	Weight	14.370kg	6.20kg	14.260kg
2	Cephalic index	45.4	42.8	52
3	Crown Rump Length	80cm (244.1 D)	55cm (193.5 D)	77cm (238.9 D)
4	Body length (Thoracic spine to pin bone)	40cm	36.4cm	50cm
5	Raised frontal bone	12cm	7cm	10cm

Cm- Centimetre, D- Days, Kg- Kilogram

A **B** **C**

Fig 1: Photographs showing charecterstics shape of the heads of external hydrocephlus calf (A), normal calf (B) and internal hydrocephalus (C).



A **B**

C-Crown, V-Vertex R- rump

Fig 2: Photographs showing the measurements of crown rump length in normal calf (A) and in internal hydrocephalus calf (B).

A **B**

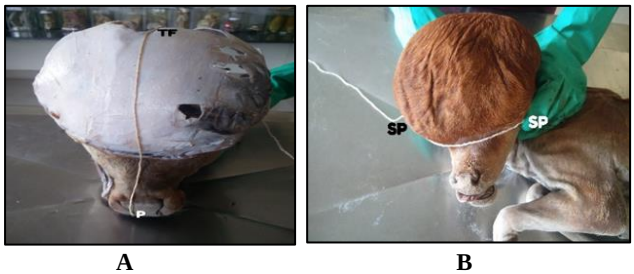
TS- Thoracic spine TI-Tuber ishii

Fig 3: Photographs showing the measurements of body length in external hydrocephalus calf (A) and internal hydrocephalus calf (B).

A **B**

P-Prosthion TF-Torus frontlis SP-Supraorbital process

Fig 4: Photographs showing the measurements of cephalic index in normal calf.



A **B**

P-Prosthion TF-Torus frontlis SP- Supraorbital process.

Fig 5: Photographs showing the measurements of cephalic index in internal hydrocephalus calf (A) and external hydrocephalus calf (B).

Discussion

The internal hydrocephalus calf consists of dome shaped as reported by the Mohammed *et al.* (2015) [6] in calf and external hydrocephalus calf consist of football shaped head. Sastry (1971) [7] suggested that external hydrocephalus resulted from either too much fluid formed and not rapidly drained by the arachnoid villi or due to a hindrance to the drainage of a normally produced fluid. The condition appears as a flaccid liquid-filled sac covered with skin and contains clear serous fluid. Similar findings were noticed in the present case. The cephalic index was more in case of internal hydrocephalus calf compared with both external and normal calves is due to internal pressure on cranium. Crown rump length is very less in external hydrocephalus followed by internal hydrocephalus and normal calves this observation accompany the dwarfism as reported by Johnson *et al*. (1950) [8] in calves. Normally body length was less in hydrocephalus affected calves compared to normal but in present case the internal hydrocephalus calf was higher is due to kyphosis condition. The length from dental pad to frontal bone is short compared to normal calf due to bulging of forehead in hydrocephalus condition. The cranial bones were found markedly thin in both types of hydrocephalus calves as reported to the Sharma *et al.* (2015) [9] in calf. Contrary to the present study the Blunn and Huges (1938) [10] reported abnormalities regarding tail, eyes and ears in pig. Body measurements indicated that the axial skeleton was more adversely affected than the appendicular skeleton in calves. In addition to hydrocephalus some other defects also observed such as ankylosis of both forelimbs and hind limbs in both external and internal hydrocephalus calves.

Conclusion

In conclusion, the reported anomalies had an anatomical significance on the calves. Hydrocephalus may cause increased intracranial cerebral pressure, progressive enlargement of the head leads to increase the cephalic index and causes convulsions, mental disability and even death. The incompletely developed teeth and small size indicated prematurity and other abnormalities are also associated with hydrocephalus such as ankylosis, kyphosis. The present study recorded that the congenital anomalies of the axial and appendicular skeleton.

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