Hydranencephaly in Newborn Calves in Zambia

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ABSTRACT. Hydranencephaly without arthrogryposis was observed in three newborn Holstein-Friesian calves, born during one week in a 400-cow dairy herd in Zambia. The affected calves were blind and exhibited nystagmus and depressed behavior. Akabane virus infection was suspected based on the pathological findings and etiological data, however, we could not determine the exact causative agent.—KEY WORDS: hydranencephaly, Zambia.

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Hydranencephaly is defined as a complete or almost complete absence of cerebral hemispheres, leaving only membranous sacs filled with cerebrospinal fluid. It occurs in many domestic animals, but is most common in calves, either sporadically or as minor epizootics [12]. As hydranencephaly in calves has a high incidence in specific geographic locations in certain years only, viral infections are considered as possible etiologic factors [5]. The viruses that are well established as potential causes of hydranencephaly in calves are Akabane [8], bovine virus diarrhea-mucosal disease (BVD-MD) [2], bluetongue (BT) [9], Wesselsbron (WD) [4], and Chuzan virus [10]. The present paper describes an occurrence of hydranencephaly in Holstein-Friesian calves in Zambia, and discusses possible etiologies.

Three Holstein-Friesian calves aged 27 to 34 days exhibited clinical symptoms including blindness, nystagmus, and depressed behavior soon after birth. All three calves were born within one week during September 1989 from dams that calved for the first time, in a 400-cow dairy farm located 30 kilometers northeast of Lusaka, Zambia. The same dams gave birth to normal calves after the subsequent pregnancies. On the same farm, three calves born between June and July 1987, were reported to have manifested hydranencephaly. Moreover, on the neighboring farm with two stud herds of 250 purebred Boran cows and 200 purebred Hereford cows, four arthrogrypotic calves have been found between August and November 1987 (M. Schneebeli, unpublished data).

The calves were sacrificed by bleeding under anesthesia and samples for histological examination were fixed in 10% formalin and processed routinely, sectioned, and stained with hematoxylin and eosin (H.E.) in case 1 and 2. Serum antibodies against Akabane, BVD-MD, BT, WD, and Rift Valley fever (RVF) viruses were titrated in the serums of the three calves, collected after colostrum ingestion. The dams of three calves were vaccinated against RVF approximately three months before insemination.

Macroscopical findings were mainly observed in the central nervous system. Case 1 showed hydranencephaly and porencephaly of the cerebellum, case 2 and 3 had hydranencephaly. The basal ganglia, hippocampus, thalamus, and midbrain were slightly reduced in size and were exposed due to the almost complete loss of the cerebral hemispheres (Fig. 1). Mild to moderate decubitus was a common finding in all cases. Case 1 showed enlargement of lymph nodes and case 2 showed lobar pneumonia of the right middle lobe, respectively. However, none of the calves had arthrogryposis.

Microscopically, the remaining cerebrum, interbrain, and midbrain were hypoplastic (hypoplasia of the neural components of the cerebral hemispheres was most severe) and dilatation of the third ventricle and the mesencephalic aqueduct were apparent, but no inflammatory lesions were observed. The thalamus contained some small foci of mineralization. In the cerebellum, focal cerebellar cortical dysplasias and aplasias in some folia, especially near the cerebellar peduncles, were common findings in both cases. In case 1, there were rarefaction of nerve fibers and cavitations that lacked organized cellular margins in the medullary corpus and the folial white matter (Fig. 2). No



Fig. 1. Hydranencephalic brain in the cranium. Remnants of thin cerebral tissue and exposed basal ganglia, hippocampus, thalamus, and midbrain. Proencephaly of the cerebellum.

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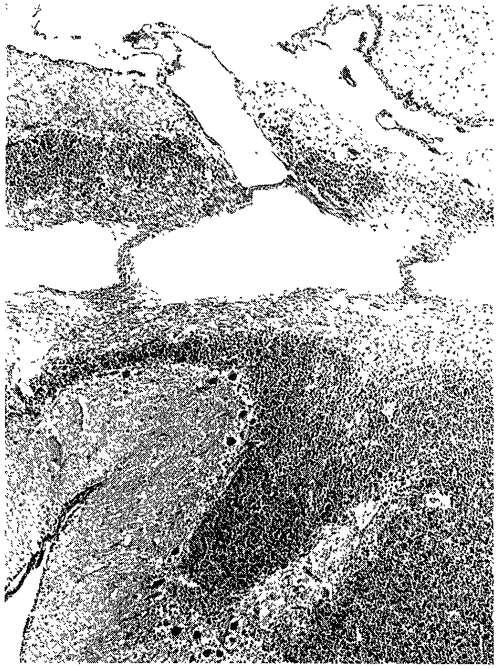


Fig. 2. Low power view of the lesion. Focal cerebellar cortical aplasia. Cavitation in the folial white matter. H.E. × 46.

significant changes were found in the pons, the medulla oblongata, and the spinal cord.

In the serological study, antibodies to Akabane virus in two calves and Wesselsbron virus in one calf were demonstrated, respectively (Table 1). Further serological survey performed on 100 dairy cows from the same farm that we got present three cases and 90 cows from the neighboring farm with Boran purebred cows showed a positive result for Akabane virus in 43% and 30%, respectively (S. Inoue, unpublished data).

In cattle, toxic plants, nutritional deficiencies, and infectious diseases are considered as possible causative factors for hydranencephaly, however, genetic predisposition to hydranencephaly has no evidence in farm animals, including cattle [13]. The occurrence of encephalic malformation and the failure of dams to produce more than a single abnormal calf were in keeping with recognized criterion for viral teratogens [1]. The well-established potential viral causes of hydranencephaly include Akabane [8], BVD-MD [2], BT [9], WD [4], and Chuzan virus [10]. We examined serum antibody titers for the above mentioned four viruses except Chuzan virus. However, the three calves had already ingested colostrum before serum samples were collected. Therefore, we could not clarify the relationship between the present malformation and the Akabane virus infection, serologically.

In bovine hydranencephaly cases, the remaining cerebrum has little diagnostic value, because of the resemblance of the macroscopical and microscopical findings in each viral infection. While, the lesions of the cerebellum associated with hydranencephaly have some value for differential diagnosis.

Table 1. Serological findings with hydranencephaly[a)]

	Akabane[b)]	BVD-MD[c)]	WD[d)]	BT[c)]
Case 1	1:8	Neg	Neg	Neg
Case 2	1:8	Neg	1:40	Neg
Case 3	Neg	Neg	Neg	Neg

a) Serum test against RVF is all positive for above three samples because of vaccination.
b) Virus Neutralization Test.
c) Indirect Immonofluorescent Antibody Test.
d) Hemagglutination Inhibition Test.
e) Agar Gel Diffusion Test.

There are two types of cerebellar lesions associated with bovine virus induced hydranencephaly: 1) normal cerebellum or slightly small-sized cerebellum (hypoplasia) with or without only rare minor microscopic changes and 2) hypoplasia of the cerebellum with severe microscopic changes. The former includes Akabane [8], WD [4], and BT virus infection [9], and the latter includes BVD-MD [2] and Chuzan virus infection [10]. In Akabane disease, the cerebellum was sometimes reduced its size, but never less than two-thirds of the diameter of the normal cerebellar hemisphere [8]. If the cerebellum had some lesions, it contained only rare minimal microscopic changes [14]. However, there is a controversial description in the cerebellar lesion of the Akabane virus infection [6]. Hartley *et al.* [6] grouped the lesions suspected Akabane virus infections into five groups. Group 5 included the calves born with hydranencephaly and cerebellar cavitation. The pathological findings of the present cases in Zambia resembled those of the Akabane disease epizootic which Hartley *et al.* [6] had observed in Australia.

In southern African countries, the main vector for Akabane virus transmission, the zoophilic species of *Culicoides,* is distributed in Zambia [7], suspected Akabane virus infection cases have been reported in lambs in Rhodesia [11], and the Akabane virus has been isolated from *Culicoides milnei* and *Culicoides imicola* in Zimbabwe [3]. We also found a high percentage of Akabane virus antibody in cattle in Zambia as mentioned above. There is a possibility that our present cases were Akabane virus infection, however, we could not determine the exact causative agent. Further study will be necessary for etiological agents of hydranencephaly in calves in Zambia.

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