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RESEARCH NOTE

BLUETONGUE VIRUS AS A CAUSE OF HYDRANENCEPHALY IN CATTLE

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ABSTRACT

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Hydranencephaly was produced in a foetus and a calf by intra-uterine infection with an attenuated Type 10 bluetongue virus. Laparotomy was performed on the respective dams and the foetuses, respectively 126 days and 138 days old, were inoculated intramuscularly through the uterine wall with 1 ml of a virus suspension containing 5×10^3 tissue culture infective doses. The younger foetus was aborted on Day 262, while the other one was born alive on Day 273. Both foetuses showed marked hydranencephaly.

Résumé

HYDRANENCÉPHALIE CHEZ LE VEAU DUE AU VIRUS DE LA PESTE OVINE

Les auteurs ont pu reproduire l'hydranencéphalie chez un foetus et un veau en les infectant par voie intra-utérine avec un virus atténué de la peste ovine de type 10. Au moyen d'une laparotomie les foetus de 126 et 138 jours ont étés inoculés par voie intramusculaire à travers la paroie utérine avec 1 ml de suspension virale contenante 5×10^3 doses infectieuses de culture de tissu. Le foetus le plus jeune a subi un avortement au 262 ème jour, tandis que l'autre a été né au 273 ème jour. Les deux ont étés atteints d'hydranencéphalie.

INTRODUCTION

Hydranencephaly is relatively rare in cattle, but during 1973 a number of cases in new-born calves came to our notice. Although the condition had not previously been reproduced experimentally, bluetongue virus was incriminated in an outbreak of bovine hydranencephaly in California (McKercher, Saito & Singh, 1970), and it was also isolated from other natural cases in the U.S.A. (Luedke, Jochim, Bowne & Jones, 1970).

The aim of this investigation was to determine the effect of an attenuated bluetongue virus on the bovine foetus.

MATERIALS AND METHODS

Laparotomy was performed on 2 Friesland cows which were respectively 126 days and 138 days pregnant. Each foetus was injected intramuscularly through the uterine wall with 1 ml of a virus suspension containing 5×10^3 tissue culture infective doses of a Type 10 bluetongue virus which had been attenuated by serial passage through embryonated eggs for 80 generations.

The cows were kept under close observation. After abortion or calving specimens were collected and extracts for virus isolation prepared from the brain, liver, spleen, lung and placenta of both the calf and the foetus. These extracts were inoculated onto primary calf kidney cultures in roller tubes maintained in Hanks' medium, and into embryonated eggs, according to a method described by Alexander (1947). The isolated virus was identified by the method employed by Howell, Kumm & Botha (1970). Serum for a complement fixation test was collected from the new-born calf before suckling. Extensive post mortem examinations were conducted in order to determine the nature and extent of the abnormalities and to make a comparison with natural cases.

RESULTS

The cow which was 126 days pregnant at inoculation, aborted on Day 262, while the other cow, 138 days pregnant, calved on Day 273. Because of posterior presentations, both cows had to be assisted at calving.

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The aborted foetus showed a marked enlargement of the cranium which gave the frontal part of the head a "dome-like" appearance (Fig. 1). On the cranium being opened, typical hydranencephaly was found (Fig. 2 & 3). The cerebral meninges, though intact, appeared to be thickened, and the cerebral hemispheres were completely replaced by a straw-coloured fluid (Fig. 4). Structures present and apparently fully developed were: the cerebellum, choroid plexus, hypophysis, cranial nerves, optic chiasma and the olfactory lobes. Though it was possible to identify the pyramids, medulla oblongata and cerebellar peduncles, no midbrain structures, thalamus, basal ganglia or any other parts of the cerebellar cortex could be found.

The calf which was born alive could not suckle and, owing to incoordination, it walked only with difficulty. The changes in its brain represented a porencephaly. The greater part of both cerebral hemispheres was replaced by large cyst-like cavities filled with a straw-coloured fluid and covered by a paper-thin cortex (Fig. 5 & 6). A fully-developed cerebellum, medulla oblongata, hippocampus, basal ganglia, thalamus, midbrain, optic chiasma, olfactory lobes, cranial nerves, choroid plexus and hypophysis were present. No changes were seen in the spinal cord.

The only virus that could be isolated with the techniques applied was Type 10 bluetongue virus. This was obtained from the lungs of the calf, which also had a complement-fixing antibody titre of 1:16 against bluetongue virus. It was not possible to demonstrate specific antibodies in the foetus.

DISCUSSION

No teratological abnormalities were mentioned in the detailed description of bluetongue in cattle in South Africa given by Bekker, De Kock & Quinlan (1934), but, in a recent discussion of hydranencephaly in the USA, bow-leggedness and jaw malformations were described (McKercher *et al.*, 1970).

The question arises whether similar conditions do indeed occur in South Africa or whether they have hitherto been overlooked. The abnormal "dome-shaped" head which was found in the aborted foetus of the first experimentally-produced case could possibly be overlooked in extensive husbandry since

aborted foetuses are rarely found. The calf had a normal appearance but could hardly walk owing to severe incoordination and weakness. Under field conditions such calves are often killed off without the aetiology being determined. A large percentage of the natural cases of hydranencephaly brought to our notice occurred in a herd in which prenatal losses had received special attention. The majority of these calves and foetuses appeared normal outwardly, and so it is quite possible that hydranencephaly, resulting from bluetongue virus, occurs more generally than is realised. The fact that hydranencephaly can be induced experimentally with attenuated virus and that similar cases were observed under normal husbandry conditions are positive indications that bluetongue virus must be incriminated as a possible cause of abortion and neo-natal deaths in cattle.

The immunological competence of a foetus is dependent on the age of the foetus and the nature of the relevant antigen (Silverstein, Uhr, Kraner & Lukes, 1963). In the case of bluetongue virus, the foetal calf is reported to become immunologically competent at approximately 150 days' pregnancy and that infections before that time apparently result in tolerance (Jochim, Luedke & Chow, 1974). In this investigation, however, the calf that was infected on Day 138 did develop antibodies. Since the calf remained infected until after birth, it is clear that antibodies could have developed at any stage after infection, but the development of such antibodies, in spite of the early infection, is an indication that more factors than just the antigen and the period of infection play a role in the development of tolerance.

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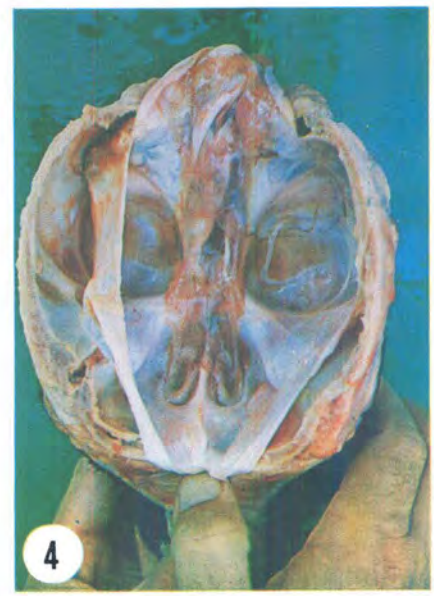

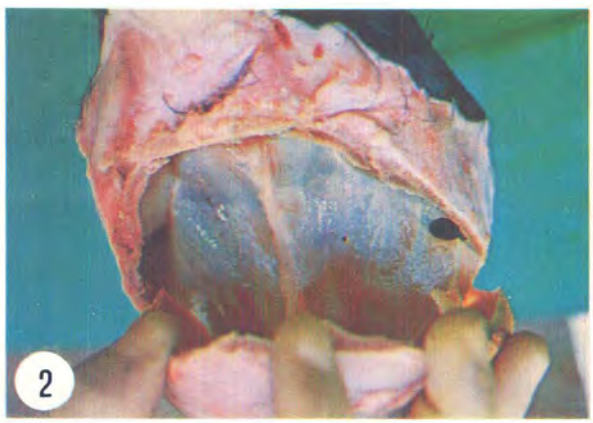

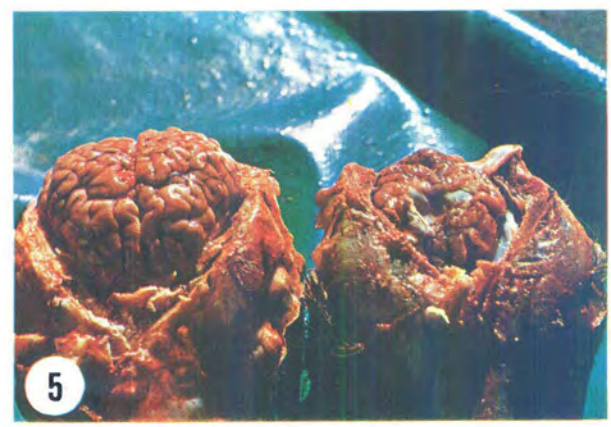

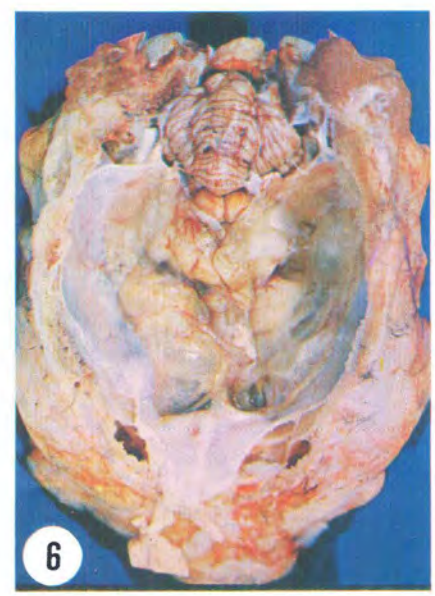

FIG. 1 The foetus shows a marked enlargement of the cranium
FIG. 2 Appearance of the foetal brain after removal of the dorsal wall of the cranium
FIG. 3 The cerebral hemispheres are completely replaced by a straw-coloured fluid
FIG. 4 The foetal brain after removal of the straw-coloured fluid
FIG. 5 The calf's brain on the left compared with a normal brain
FIG. 6 The greater part of both cerebral hemispheres of the calf's brain is replaced by large cyst-like cavities filled with a straw-coloured fluid