

Brain Abscess in a Japanese Black Calf: Utility of Computed Tomography (CT)

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ABSTRACT. Computed tomography (CT) was used for diagnosis of brain abscess in a 6-month-old, Japanese black calf presented with neurological dysfunction, compulsive circling and vision disturbance. CT images showed asymmetric lateral ventricles, and presence of intra-cranial multiple low absorption lesions surrounded by capsule suggestive of abscess in the right cerebral hemisphere. Postmortem examination revealed marked swelling of right cerebral hemisphere and olfactory bulb. Multilocular large abscess containing creamy pus was found to occupy most area of periventricular and lateral ventricle. *Fusobacterium necrophorum* was isolated from the abscess contents as the causative agent. These results demonstrate that CT is useful tool for tentative diagnosis of bovine brain abscess.

KEY WORDS: bovine, brain abscess, CT.

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Space occupying intracranial mass is one of the most important causes of neurological signs in cattle. Abscess, tumor, hydrocephaly and/or intracranial cyst are the main differential diagnosis [3, 9, 17]. Physical examination, biochemical analysis, neurology, and imaging were the main methods of diagnosis [2, 3, 16, 18]. However, these methods are not definitive, and it is difficult to decide the final diagnosis and the prognosis. Computed Tomography (CT) was introduced for diagnosis of intracranial abscess and tumor in goats [6, 10]. In human medicine, CT has made an important impact on the diagnosis of brain abscess due to high sensitivity and accuracy [1]. The possibility of using CT to diagnose bovine brain diseases may become one of the most useful diagnostic tools which are so in human medicine, as CT shows good contrast and screens the intended organ at different planes. In the present case, adjunct to the conventional methods, CT was used to recognize its usefulness for tentative diagnosis of the brain abscess.

A 6-month-old female Japanese black calf with 190 kg body weight was presented at the Veterinary Teaching Hospital of Obihiro University of Agriculture and Veterinary Medicine for investigation of nervous manifestations, circling, abnormal gait and vision disturbance. The signs appeared one month before admission, and the calf was treated by Vitamin B1 at 500 mg intramuscularly for three days. On the first examination, the calf was dull, anorexic, and dehydrated. Rectal temperature, pulse rate and heart beats were within normal range. Circling to the left side, stiffness in gait and vision disturbance were the main clinical signs. Hematological examination showed poly-

cythemia, hemoconcentration (PCV 42%) and thrombocytosis (736,000/ μ l), but total leukocytes was within normal range (7,200/ μ l). Serum biochemical analysis showed low level of vitamin A (55.8 IU/dl) and vitamin E (0.06 mg/dl), however, there were elevation of AST (216 IU/l) and selenium (9.1 μ g/dl). Arterial blood gases analysis showed hypoxemia (PO₂=50 mmhg), hypernatremia (177 mmol/l), and mild hyperkalemia (3.8 mmol/l). The calf did not respond to any treatment, and tremors of the all legs became obvious. On the second examination, urinalysis showed only acidic pH (5.0), whereas hematology showed leukocytosis (11,400/ μ l). The calf condition became worse, and diarrhea appeared. CT examination was carried out under sedation using multi-detector row CT unit (Asteion super 4, Toshiba, Tokyo, Japan). Imaging technique was at 135 kvp, 150 mA, 2.0 mm slice thickness and 0.75 sec/rotation scan time, and then images were reconstructed by soft tissue algorithm. Scan time of the whole skull was 25 sec. Obtained CT data were reconstructed by image processing Workstation (Virtual Place, AZE, Tokyo, Japan), and observed transverse and dorsal plane images. It showed asymmetrical appearance of the lateral ventricle and presence of intra-cranial multiple low absorption lesions surrounded by capsule suggestive of brain abscess in the right cerebral hemisphere (Fig. 1). Because of poor prognosis, the calf was euthanatized. Gross postmortem examination revealed the marked swelling of right cerebral hemisphere and olfactory bulb due to presence of multilocular abscess containing creamy pus. On the cut section, the abscess completely involved the right lateral ventricle and extended to the adjacent periventricular white matter and basal ganglia (Fig. 2). Left hemisphere was markedly compressed with mild dilatation of lateral ventricle. The cranial cavity of the affected side was markedly dilated. There were no signifi-

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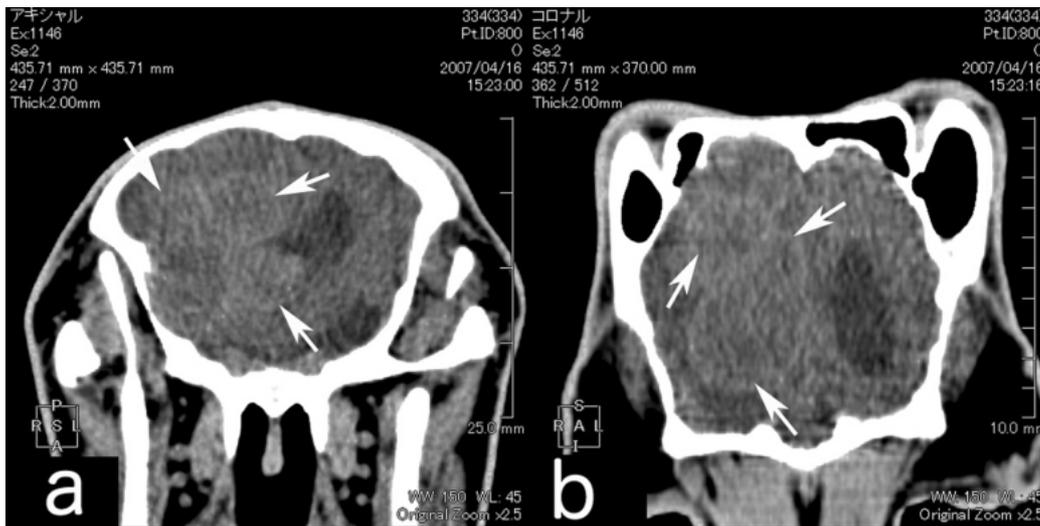


Fig. 1. Transverse (a) and dorsal-plane (b) of CT examination of brain abscess in the right cerebrum showing asymmetric lateral ventricles, and presence of intra-cranial multiple low absorption masses (arrows heads) surrounded by a capsule. The CT values in the lesion were 20–30 H. U.

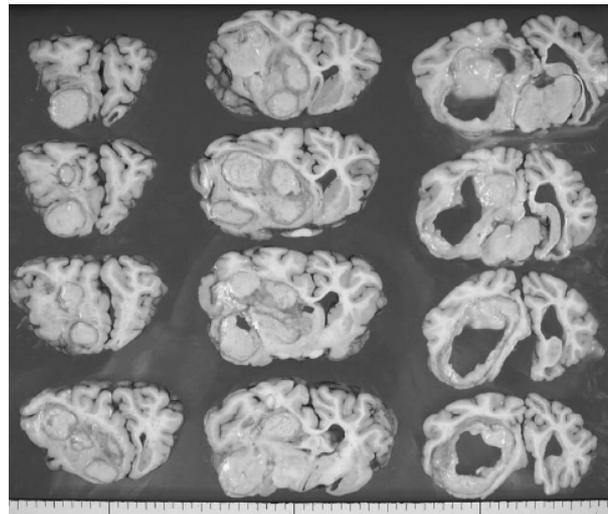


Fig. 2. Transverse sections at different levels of brain show the multilocular abscess in the right cerebral hemisphere.

cant macroscopic lesions in the extracranial organs and tissues, including upper digestive tract. Routine histopathological examination confirmed the brain abscess, which contained amount of necrotic and inflammatory debris surrounded by inflammatory cells and glio-mesenchymal tissues (Fig. 3). In the necrotic tissues, there were also some basophilic filamentous materials, which were stained positive with Warthin-Starry stain (Fig. 3). Macrophages, plasma cells and lymphocytes were the main infiltrates. Most areas of the remaining and adjacent cerebral white matter of the affected side were edematous with severe axonal degeneration and astrogliosis. Axonal degeneration was also noticed in the optic tract and corpus callo-

sum of the opposite site. In addition, mild leptomeningitis was also noticed in both cerebral hemispheres. Bacteriological culture recovered gram negative anaerobic rods, *Fusobacterium necrofrum*. On the basis of these findings, a diagnosis of cerebral abscess was made.

Brain abscesses were recorded to occur in both young and mature cattle [3, 16, 18], and their development may be due to either through hematogenous metastasis or direct extension from local lesion [11]. Metastatic infection is usually manifested by multiple septic foci in other organs [12]. Abscess of the brain can present in a variety of ways, largely dependent on the anatomical location of the mass. Symptoms may result from the effects of infection, neurological

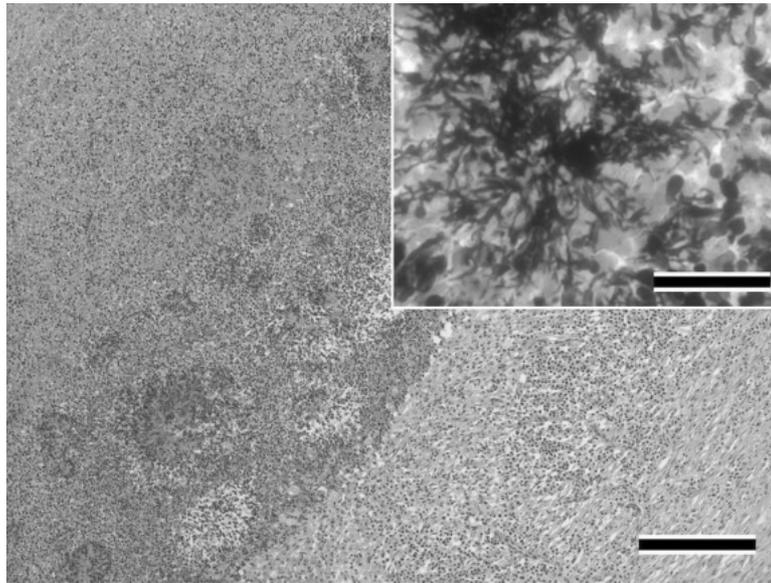


Fig. 3. Photomicrograph of the brain abscess containing necrotic and inflammatory debris. Hematoxylin & eosin stain. Bar = 500 μ m. Necrotic area containing numerous long filamentous materials, which stained positive with Warthin-Starry method. Bar=50 μ m.

disturbance, or raised intracranial pressure, and the antemortem diagnosis is often presumptive [3, 7, 16]. In the present case, compulsive circling, vision disturbance and abnormal gait could reflect cerebral disease. The clinical condition of the calf suggested involvement of most areas of the brain. It was found that, the exact site of abscess could reflect the clinical signs [6]. Low level of vitamin A was recorded in the present case, however, circling, stiff gait and metabolic derangement are not characteristic [12]. Hypoxemia, acidosis, hyperkalemia, hyponatremia and hemconcentration, indicated severe metabolic derangement. It is suggested that combined effect of central nervous system involvement, toxemia, and electrolytes imbalance were the main cause of metabolic abnormalities.

CT could recognize the site and nature of the lesion at various planes of examination. Lateral ventricles asymmetry indicated abnormal lesion including edema, abscess or tumor. Ventriculomegaly as abscess complication and edematous frontal lobe were also found to give similar findings in human patient [8, 14]. Moreover, the abscess appeared as a smooth, thin walled lesion. The center was of low density, and a mass effect may be appreciable. In contrast, small ischemic infarcts or partial territory ischemic infarcts do not exert a large degree of mass effect [13]. These findings came in accordance with that obtained by survey CT images of brain abscess in human [5, 15]. Contrast enhanced CT showed the brain abscess as large complex lesion with thin smooth to thick irregular ring enhancement [7]. In human, simple *Echinococcus granulosus* cysts were welldefined, smooth thin-walled, spherical, homogeneous cystic lesions with no contrast enhancement,

however, complicated one showed cystic lesions with surrounding hyperintensity of perifocal edema with complete or incomplete rim enhancement [4]. Moreover, in a dog with intracranial epidermoid cyst, CT scan showed large, hypoattenuating mass with a slight peripheral ring enhancement pattern ventral to the cerebellum [9]. The present results reflected a relationship between the CT images and physical signs. CT suggested primarily that the pressure on the right cerebral hemisphere and lateral ventricular dilatation were the main causes of the clinical signs.

Gross and histopathological findings supported the CT findings and confirmed the characters of multilocular abscess. These findings support the role of postmortem examination to confirm the brain abscess [3]. *Fusobacterium necrophorum*, though stated to be a cause of brain abscess in cattle [12], has been infrequently reported. Numerous species of *Fusobacterium* were isolated from cerebellar abscess in a heifer [3]. However, many other bacteria were recorded to cause such problem [11]. It is suggested that *Fusobacterium necrophorum* gained access to the brain blood flow through an oral lesion, because postmortem lesions didn't reveal any abnormalities in other organs. Moreover, vitamin A and vitamin E deficiency were found to be related to immunity [12], and consequently could play a role to increase susceptibility to infection.

CT was thus greatly useful to this case, because it showed not only morphological characters such as brain deformations and lateral ventricular dilatation, but also constitutional ones, such as low x ray absorption lesions. This should become an important diagnostic method for abscess, which is an important disease condition in cattle, and could be used

in veterinary clinics. Rapid and accurate establishment of the reference images for the CT features of bovine brain will support greatly rapid and proper diagnosis of brain diseases in such species.

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