Abscess of Bovine Brain Stem Diagnosed by Contrast MRI Examinations

Takeshi TSUKA and Yasuho TAURA*

Department of Veterinary Hospital, Faculty of Agriculture, Yamaguchi University, 1677-1 Yoshida, Yamaguchi 753-8515, Japan

(Received 29 October 1998/Accepted 2 December 1998)

ABSTRACT. A 3-month-old, female Japanese Black calf that showed signs of neurological dysfunction soon after birth was twice examined by magnetic resonance imaging (MRI). Survey MR images showed changes in a hydrocephalus from mild to severe and the existence of a mass above the brain stem that could be distinguished from the surrounding cerebral parenchyma. Contrast MRI examinations using Gd-DO3A-butriol showed the mass to have a doughnut-like form. As the mass changed, the clinical signs aggravated. We diagnosed a brain stem abscess, which we confirmed pathologically. To our knowledge there are no other reports of the use of contrast MRI to examine cattle.—**KEY WORDS:** bovine, brain stem abscess, contrast MRI.

J. Vet. Med. Sci. 61(4): 425–427, 1999

The bovine cephalic diseases, including polioencephalomalacia, hereditary neurologic diseases, and hydranencephaly and/or a cerebellar dysplasia induced by virus infection, have been variously discussed [3–6, 12].

These diseases are diagnosed generally from the main signs, physical condition, and various kinds of analysis, for example neurology, biochemistry of blood and cerebrospinal fluid, and imaging [7, 8, 11, 13]. But it is difficult to decide the final diagnosis and the prognosis from these examinations.

The possibility of using MR imaging to diagnose bovine cephalic diseases may become one of the most useful diagnostic methods which is so in the medical field, as MRI shows good contrast. The case introduced in this study was diagnosed by both simple and contrast MRI examinations.

A 3-month-old, female Japanese Black calf with 72 kg body weight was presented to Yamaguchi University Veterinary Hospital with a history of neurological dysfunction soon after birth. The main signs were parosmia and depression. The calf was also circling to the left with her neck turned obliquely to the left. From these clinical signs, we suspected this case to be a cerebral disorder and used MRI to confirm brain lesions.

We used a 0.2-tesla permanent magnet (MRP-20, Hitachi Medico, Japan) and a human flexible body coil. The MRI conditions were T1-weighted (500/25 [repetition time/echo time]), T2-weighted (2,000/110), and proton-density weighted (2,000/25) spin echo sequences. Two MRI examinations were done. The calf was sedated with xylazine (0.3 mg/kg IM) and maintained with isoflurane 2.0 to 4.0% and oxygen at 5 to 8 l/min while anesthetic depth was monitored. Circular regions of interest (ROIs) were used to measure the areas.

T1-weighted images revealed that the mass existed on the upper parts of the left brain stem and projected slightly into the lateral ventricular cavity (Fig. 1a). T2-weighted images suggested that the mass was divided into at least 3

parts. Comparison between the mass and the surrounding cerebral parenchyma showed that the mass had relatively higher (T1-weighted image) and lower (T2-weighted image) signal intensities than the parenchyma; the distinction was clearer on the T2-weighted image. These results suggested the possibility that the mass might not have belonged to the structures that originate in the brain stem. We also found a mild hydrocephalus: the lateral ventricle was slightly dilated on dorsal-plane sections. We used contrast MRI examination for clinicopathological diagnosis of the mass. T1-weighted imaging was started soon after a slow injection of gadolinium tetraazacyclododecanetriacetic acid-butriol (Gd-DO3A-butriol, Nihon Schering, Japan), which has found good use in human and small animal fields [9, 14, 15], through the cervical vein (0.1 mmol/kg). We compared contrast changes and forms before and after injection, which revealed more than 3 masses concentrated on part of the left brain stem. Their margins had a doughnut-like form (Fig. 1b). The total mass had areas of 260 mm² (coronal section), 340 mm² (transverse), and 250 mm² (sagittal).

Characteristic findings of T1- and T2-weighted images are thought to indicate abundant proteinaceous contents in the mass. The doughnut-like appearance is similar to the appearance of human brain abscesses [1, 2, 10].

Because of aggravation of the neurological signs, we used a second MRI examination 25 days after the first to detect any change in the lesions.

T1-weighted images revealed that the mass had swelled (Fig. 2a). T2-weighted images showed a wider area of low signal intensity (Fig. 2b). The lateral ventricle was clearly more dilated, sufficient for a diagnosis of severe hydrocephalus. A second contrast MRI examination revealed that the mass had become wider, and the several doughnut-like forms seen in the first contrast images had combined to form one (Fig. 2c). The mass was confirmed as a flat sphere in a dorsal-ventral direction with areas of 490 mm² (same coronal section as the first), 440 mm² (transverse), and 310 mm² (sagittal).

In gross appearance, the mass, whose surface was covered with a hemal plexus, existed between the left corpus callosum and the ventricular ependyma, isolated from the surrounding tissues. The mass protruded toward the left

* CORRESPONDENCE TO: TAURA, Y., Department of Veterinary Hospital, Yamaguchi University, Yamaguchi 753-8515, Japan.

Fig. 1. First MRI examination showed the masses located in a left brain stem on the transverse T1-weighted (a). The masses were demonstrated as a doughnut-like form by the contrast medium on the transverse MR image (b).

Fig. 2. Second MRI examination showed the progression of the masses on the same transverse T1-weighted (a), T2-weighted (b) and contrast MR image (c) as first one.

lateral ventricle from the lower parts of the ventricular ependyma (Fig. 3a). There was a lot of pus inside the capsule-like mass; it was cream, odorless, highly adhesive, and nonturbid. These findings supported the MRI. Histologically, a Masson Trichrome stain of the mass and the surrounding tissues showed collagenous fibers around the structure which contained inside proliferated microglia and neutrophil cells (Fig. 3b). The pathological diagnosis was brain stem abscess, though the pus was not cultured for bacterial analysis.

Simple and contrast MRI suggested that the mass was rich in vascularization and had a relatively poor fluid content. This suggested an abscess, which correlated with

the pathological findings. MRI 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 bleeding, inflammation, and fluid inclusions. The same contrast MRI as used for human and small animal examination [9, 14, 15] gave results corresponding closely with human case reports [1, 2, 10]. This should become an important diagnostic method for abscess, which is a major bovine disease, and could be used in veterinary clinics.

This study showed a relationship between the MR images and physical signs, such as the left circling in correspondence with the left brain stem mass and a decline in the

Fig. 3. An anatomical finding in a ventral section dissected along a coronal line to cross a lateral ventricle showed the mass on left brain stem (a, arrow head). Histologically, the mass was characterized by aggregations of microglia and neutrophilic cells and an fibrogenesis using Masson Trichrome stain. $\times 400$ (b).

vital signs such as astasia and depression of body temperature as the extension of the mass aggravated the neurological signs.

Bovine encephalic diseases are difficult to detect clinically [7, 8, 11, 13]; most are pathologically confirmed [3–6, 12]. MRI was useful to this study because it suggested primarily that the pressure on the brain stem and secondarily that the lateral ventricular dilatation caused the clinical signs.

In future, correlations between MRI findings and neurological signs will be helped by the production of a diagnostic base of MR images for bovine cephalic diseases and a bovine brain map in MR images.

ACKNOWLEDGEMENT. The authors wish to thank Nihon Schering Ltd., Osaka, for supplying Gd-DO3A-butriol.

REFERENCES

1. Haimes, A. B., Zimmerman, R. D., Morgello, S., Jennis, R., Becker, R. D. and Weingarten, K. 1989. *Am. J. Roentgenol.* 152: 1073–1085.
2. Irie, H., Hasuo, K., Yasumori, K., Mizushima, A., Masuda, K., Fukui, M., Kuroiwa, T. and Shirouzu, K. 1991. *Nippon Acta Radiol.* 51: 115–120.
3. Madarama, H., Azuma, K., Nozaki, H., Numata, K. and Konno, S. 1990. *Vet. Pathol.* 27: 296–298.
4. Miura, Y., Kubo, M., Goto, Y. and Kono, Y. 1990. *Jpn. J. Vet. Sci.* 52: 689–694.
5. Mori, K., Shimada, J., Kurisaka, M., Sato, K. and Watanabe, K. 1995. *Brain & Dev.* 17: 338–348.
6. Raimondi, A. J. 1994. *Child Nerv. Syst.* 10: 2–12.
7. Shiga, A., Ishida, M., Horii, N., Sugawara, H., Numakunai, S. and Okada, K. 1987. *Jpn. J. Vet. Sci.* 49: 1127–1128.
8. Spaulding, A. K. and Nicholas, J. H., 1990. *Vet. Radiol.* 31: 59–64.
9. Stack, J. P., Antoun, N. M., Jenkins, J. P. R., Metcalf, R. and Isherwood, I. 1988. *Neuroradiology* 30: 145–154.
10. Strain, G. M., Claxton, M. S., Turnquist, S. E. and Kreeger, J. M. 1987. *Cornell Vet.* 77: 374–382.
11. Taura, Y., Iwaizako, M. and Hamana, K. 1986. *J. Jpn. Vet. Med. Assoc.* 39: 687–692 (in Japanese).
12. Ubelaker, D. H., Berryman, H. E., Sutton, T. P. and Ray, C. E. 1991. *J. Forensic Sci.* 36: 801–812.
13. Welles, E. G., Tyler, J. W., Sorjonen, D. C. and Whatley, E. M. 1992. *Am. J. Vet. Res.* 53: 2050–2057.
14. Yuh, W. T. C., Fisher, D. J., Engelken, J. D., Greene, G. M., Sato, Y., Ryals, T. J., Crain, M. R. and Ehrhardt, J. C. 1991. *Radiology* 180: 485–491.
15. Zoarski, G. H., Lufkin, R. B., Bradley, R. B. Jr. and Flanders, A. E. 1993. *Am. J. Neuroradiol.* 14: 955–961.