A Case of a Dog with Thickened Calvaria with Neurologic Symptoms: Magnetic Resonance Imaging (MRI) Findings

Kazutaka YAMADA, Kazuro MIYAHARA, Mitsuyoshi NAKAGAWA¹⁾, Yoshiyasu KOBAYASHI²⁾,
Hidefumi FURUOKA²⁾, Takane MATSUI²⁾, Satoshi SHIGENO³⁾, Tsuneo HIROSE⁴⁾ and Motoyoshi SATO

Department of Veterinary Clinical Radiology, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, 080–8555,

¹⁾Nakagawa Small Animal Hospital, Obihiro, 080–0804, ²⁾Department of Pathology, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, 080–8555, ³⁾Obihiro Neuro-Surgery Hospital, Obihiro, 080–0023 and ⁴⁾Research Institute of Information Science Development on Animal Medicine, Obihiro 080–0028, Japan

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ABSTRACT. A 6-year-old female mongrel dog weighing 9.0 kg was presented anastatic, with clouding of consciousness, bilateral loss of hearing and depressed reactivity of the eyes to light. Magnetic resonance imaging (MRI) examination showed that the calvaria was markedly thickened with compression to the cerebrum and cerebellum. The case of a dog with thickened calvaria with compression of the cerebrum and cerebellum which could not be diagnosed by conventional measures was amenable to diagnosis by MRI. With increased application of MRI examination, such canine cases might increase in number.—**KEY WORDS:** canine distemper virus (CDV), magnetic resonance imaging (MRI), Paget's disease.

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A 6-year-old female mongrel dog weighing 9.0 kg was referred to this Veterinary Teaching Hospital for evaluation of neurologic symptoms. On admission, the dog was anastatic and had clouding of consciousness. A physical examination revealed bilateral loss of hearing and depressed reactivity of the eyes to light. A hematologic examination showed slight anemia. The animal had been vaccinated yearly, had a history of heart failure at the age of four years, and had received an electrocardiogram examination because of frequent episodes of sudden falling four months before the admission. A radiograph of the lateral view of the dog disclosed that the calvaria was markedly thickened (Fig. 1). The middle diploic region between the outer and inner tables was relatively radiolucent. There were no abnormalities in other structures of the skeleton. As the animal showed no symptomatic improvement thereafter, a cerebral abnormality was suspected and magnetic resonance imaging (MRI) examination was performed on the 5th hospital day. The MRI examination was performed on a 1.5 tesla whole-body imager (VISARTTM, Toshiba, Tokyo, Japan). The sagittal magnetic resonance (MR) image showed an expanded calvaria, cerebral atrophy, indistinct cerebral sulci and thickened tentorium cerebelli. High signal regions were present in the calvaria in a T₁ weighted image (Fig. 2); such was also evident in a T₂ weighted image, which is suggestive of fatty marrow. There was basilar invagination with a resulting small posterior fossa and deformation of the cerebellum. On the MR image the calvaria measured 11 mm in thickness. The animal died on the 8th hospital day. With owner's permission for sampling of only a small part of the calvaria, a pathological specimen was obtained and processed for histopathology. The calvaria was expanded with diploic bone marrow; the outer table was noticeably thick while the inner table was thin. The thickness (11 mm) of the median calvaria was exactly the same as that noted on MRI. Thick coarse-fibered trabeculae and areas of bone substance rarefaction were observed, and

neither new osteoblastic bone formation nor osteoclastic resorption was demonstrable (Fig. 3).

The cause in this case is unclear, but is reminiscent of a disease with similar manifestations and imaging features in humans called Paget's disease, a metabolic hypertrophic bone disease characterized by excessive remodeling of bone, first described by Paget as osteitis deformans in 1877 [11]. Epidemiologically, this disease is common in Great Britain, France, Germany, Australia and New Zealand, and is rare in Asia and Africa. It is rare among African blacks but is seen among blacks in North America [1]. Only 120 cases have been reported in Japan. The incidence of this disease increases with advancing age. The disease is often asymptomatic but, in clinically overt cases, headache and neurological signs due to compression by the thickened calvaria, and loss of hearing because of lesions in the auris media or compression of the acoustic nerve appear. From his countenance and deafness, it has been suggested that Beethoven suffered from Paget's disease [7]. The etiology was thought to be inherited for many years because of a notable familial incidence. However, it is difficult to support the involvement of any hereditary factors because of the results of an investigation of monozygotic twins [6]. An alternative explanation could be that Paget's disease was caused by viral infection because nuclear inclusions have been found in osteoclasts in pagetic bone of a human patient in 1976 [12]. There is an interesting report that patients with Paget's disease were significantly more common among dog owners [4, 8, 9]. In fact, the canine distemper virus (CDV) ribonucleic acid was demonstrated by the *in situ* hybridization technique in osteoclasts, osteoblasts and osteocytes biopsied from patients with Paget's disease [2, 3]. This would suggest that CDV might be the responsible infective agent. Similar diseases in veterinary medicine exist, such as metaphyseal osteopathy in puppies of large breeds and craniomandibular osteopathy which also occurs in puppies. Mee and Sharpe, Padgett and Mostosky reported

Fig. 1. A radiograph of lateral view of the dog. It disclosed the calvaria was markedly thickened.

Fig. 2. Sagittal magnetic resonance image of the dog (Spin echo pulse sequence, time of repetition/time of echo=600/15 msec). It showed an expanded calvaria, cerebral atrophy, indistinct cerebral sulci and thickened tentorium cerebelli.

metaphyseal osteopathy and craniomandibular osteopathy respectively as conditions resembling Paget's disease [5, 10]. Although there are unclear points, from the clinical manifestations and images noted in the case reported herein, if Paget's disease exists in dogs, then it would be intriguing to speculate that dogs may play an important role in human Paget's disease. If so, the facts of geographical variations, familial incidence and late onset of the disease in humans would be explicable.

The case of a dog with thickened calvaria with compression of the cerebrum and cerebellum which could

not be diagnosed by conventional measures was amenable to diagnosis by MRI. With increased application of MRI examination, such canine cases might increase in number.

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Fig. 3. Microscopic view of patient calvaria. Thick coarse-fibered trabeculae and areas of bone substance rarefaction were observed, and neither new osteoblastic bone formation nor osteoclastic resorption was demonstrable.

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