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SHORT COMMUNICATION

Low-Field Magnetic Resonance Imaging of Canine Hydrocephalus

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ABSTRACT

The aim of presented study was to evaluate selected surface spine coil, and low-field magnetic resonance (MR) selected sequences in diagnosing hydrocephalus in dogs. This paper discusses 19 dogs (14 canine patients with hydrocephalus and 5 healthy dogs), of five breeds, subjected to low-field magnetic resonance imaging (MRI) of hydrocephalus. Area of the lateral ventricles and brain were examined in dogs with hydrocephalus using low-field MRI (at 0.25 Tesla). The MRI of FSE REL, SE, FLAIR, STIR, 3D HYCE, T3DT1, GE STIR 3D and 3D SHARC sequences with an indication of the most effective sequences are described. Additionally, coils for MR were compared, and models for infusion anesthesia were described. As a result of performed study all estimated sequences were diagnostically useful. However, spinal coil No. 2 (ESAOTE) was the most optimal for examining and positioning the cranium.

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INTRODUCTION

Hydrocephalus is an abnormal accumulation of cerebrospinal fluid in the ventricular system which results from an imbalance in fluid production, flow and absorption. Disruptions in cerebrospinal fluid hydrodynamics enlarge cranial cavities and increase intracranial pressure. Based on its underlying functional mechanisms, it can be classified into communicating and non-communicating hydrocephalus (Harrington *et al*., 1996, Hecht and Adams, 2010).

Symptoms of hydrocephalus are observed in 1-1.5% of the human population (Lamire, 1988). No such estimates are available for animals. In clinical practice, the most popular imaging techniques for diagnosing hydrocephalus in animals are computed tomography (CT) and magnetic resonance (MR). In young dogs with an open fontanelle and in adult dogs of certain breeds, the condition can also be diagnosed by ultrasonography (Thomas, 2010). Magnetic resonance has the highest diagnostic value of the three discussed techniques because it produces numerous images of the same brain fragment in different planes and sequences. Such numerous MR scans of brain give excellent opportunity for effective diagnosis of hydrocephalus and its causes.

The objective of this study was to evaluate selected surface-coil low-field MR sequences in diagnosing hydrocephalus in dogs.

MATERIALS AND METHODS

The MRI evaluations were performed in 19 dogs: Fourteen dogs belonged to five different breeds (6 Yorkshire Terriers, 3 English Bulldogs, 2 Chihuahuas, 2 Miniature Poodles and 1 American Staffordshire Terrier) with hydrocephalus while five healthy dogs, one in each breed, were treated as control. The evaluated dogs were aged from 2 months to 5 years. In all patients, the indications for an MRI scan were neurological symptoms of hydrocephalus, including ataxia, changes in behavior, aggression, vomiting and epilepsy. . The patients were examined by a low-field MRI scanner with magnetic field intensity of 0.25 Tesla (Vet Grande, Esaote, Italy) with surface-coils adapted to the patients' head size. The examinations were performed under infusion anesthesia, and the patients' condition was monitored in a Faraday cage. Two anesthetic protocols were applied. In the first protocol, anesthesia was induced with xylazine 1mg/kg i.v. (Sedazin, Biowet Pulawy, Pl), diazepam 0,1 mg/kg i.v. (Relanium, Polfa Warszawa, Pl), ketamine 5 mg/kg i.v. (Ketamina 10%, Biowet Pulawy, Pl), and in the second protocol, medetomidine 10µg/kg i.v. (Sedator, Novartis, Ch) and propofol 3 mg/kg i.v. (Disoprivan, Zeneca, GB) were used. Images were produced in the transverse (Fig. 1) sagittal (Fig. 2) and dorsal plane (Fig. 3). The T1-weighted and T2-weighted scans were

produced using FSE REL, SE, FLAIR, STIR, 3D HYCE, T3DT1, GE STIR 3D and 3D SHARC sequences. Every patient was carefully positioned in the scanner to eliminate artifacts.

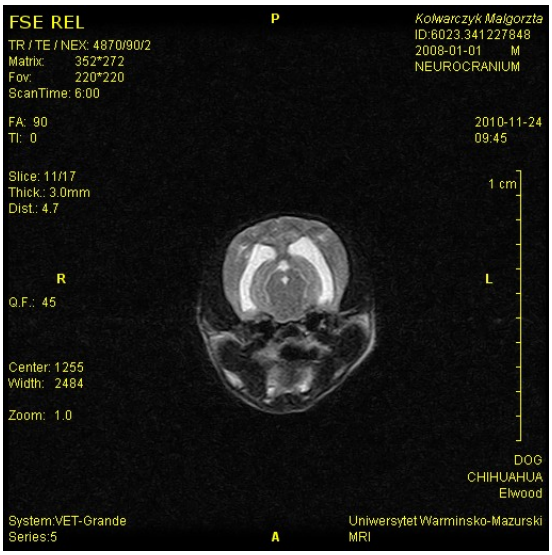

Fig 1: MR image of the Chihuahua in transvers plane of MRI in FSE REL sequence.

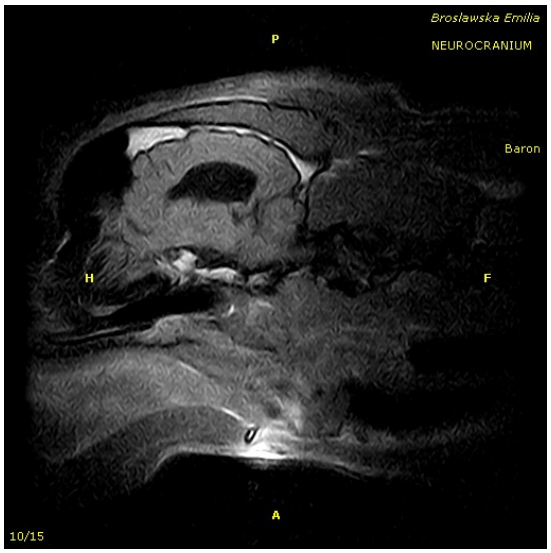

Fig. 2: Sagital view of brain English bulldog in SE sequence.

RESULTS AND DISCUSSION

The results of the examination revealed dysfunctions in the neurocranium of all patients. The ventricular system was enlarged in all MR images. Images of the highest diagnostic value were produced at the level of lateral ventricles. Changes in the third and fourth ventricle and the mesencephalic duct were also observed in all dogs. Because of wide variation in breeds of dogs and scarce amount of patients our diagnostic analysis was based on the work of Woo *et al.* (2010). Coil No. 2 (ESAOTE system) was the most optimal for examining and positioning the cranium. Each of the analyzed sequences produced satisfactory images of changes in the ventricular system. The MRI scanning times ranged from 40 to 70 minutes, subject to the applied sequence and the examined region of the brain. The resultant images were without distortions or artifacts caused by insufficient anesthesia. This is a vital observation since faster respiratory rates resulting from insufficient anesthesia contribute results in poor quality MRI.

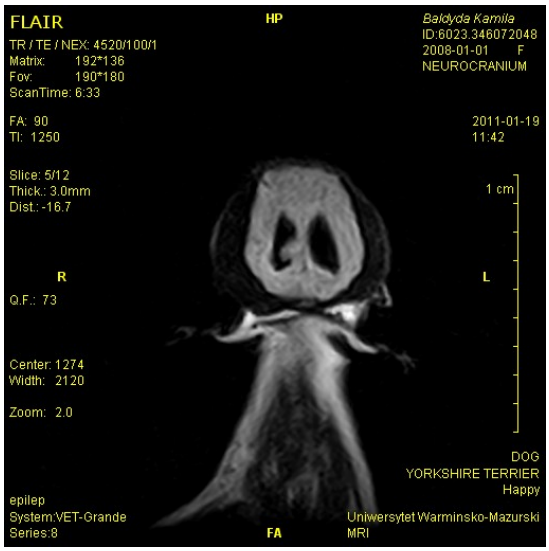

Fig 3: Flair sequence of lateral ventricles in Yorkshire terrier in dorsal view.

The majority of evaluated breeds are characterized by increased risk of hydrocephalus (Kii *et al*., 1997; Targett *et al*., 1999; Esteve-Ratsch *et al*., 2001, Matijatko *et al*., 2007). All of the analyzed sequences were of high diagnostic value. The above observation implies that two or three sequences can be effectively used to shorten the time of the MRI test. The size and positioning of the surface coil also determines the quality of the resulting images. The results of our study showed that coil No. 2 provides the best imaging of the cranium, and both intravenous anesthetic models were sufficient to perform optimum MRI examination.

The results of the study indicated that MRI is a highly useful technique for diagnosing hydrocephalus in dogs.

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