IMAGING DIAGNOSIS—TRANSCRANIAL COLOR-CODED DUPLEX SONOGRAPHY IN A DOG WITH HEPATIC ENCEPHALOPATHY

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We report the use of transcranial Doppler ultrasonography in a dog with hepatic encephalopathy secondary to a congenital portosystemic shunt. A severe increase in the pulsatility index was measured in the right middle cerebral artery, left middle cerebral artery, and basilar artery. These values returned to normal following medical stabilization of the patient and resolution of the neurologic signs. Transcranial Doppler ultrasonography appears to have value for monitoring the status of intracranial hypertension in patients with hepatic encephalopathy. © 2010 *Veterinary Radiology & Ultrasound, Vol. 52, No. 1, 2011, pp 111–113.*

Key words: congenital portosystemic shunt, hepatic encephalopathy, transcranial doppler.

Signalment, History, and Clinical Findings

A 1-YEAR-OLD DACHSHUND HAD intermittent anorexia, diarrhea, vomiting, exercise intolerance, lethargy, weight loss, and hypersalivation. The dog was thin, hypothermic (36°C), and had clinical signs consistent with acute hepatic encephalopathy, graded as IV (stupor) according to the accepted standards.[1]

There were mild elevations of alanine aminotransferase and alkaline phosphatase, moderate-to-severe hypoproteinemia and hypoalbuminemia, and marked elevation of preprandial bile acids. Large numbers of ammonium urate crystals were present in urine.

Imaging

Sonographically, the liver was small with reduced visibility of intrahepatic portal veins. An extrahepatic portocaval shunt was also identified. Transcranial Doppler ultrasonography was performed for indirect evaluation of intracranial pressure using a Philips Medical System HDI 5000 (Bothell, WA), equipped with a 2–4 MHz sectorial-phased array scan. The temporal and suboccipital windows were used for evaluation of the middle cerebral and basilar arteries, respectively. Compression of the ipsilateral carotid artery was applied when attempting to identify the middle cerebral artery.[2] The cursor was placed inside the vessel being studied followed by adaptation of the sample volume and corrections of the Doppler angle to obtain measurements as exact as possible. The pulsatility index (PI) was 2.24 in the right middle cerebral artery, 2.35 in the left middle cerebral artery, and 2.00 in the basilar artery (Fig. 1). These findings were compared with the normal values obtained in 30 healthy dogs[2] and indicated severe elevation of the PI.

After 12 h of treatment using metronidazol and lactulose enemas, for the hepatic encephalopathy and mannitol for the suspected cerebral edema, there was improvement in the clinical signs. Transcranial Doppler sonography was repeated and the following data obtained: PI = 2.00 in the right middle cerebral artery, PI = 1.96 in the left middle cerebral artery, and PI = 1.96 in the basilar artery (Fig. 2). Medical therapy was continued. After 24 h, the dog's condition had improved further and Doppler sonography was repeated again. The following values were obtained: PI = 1.37 in the right middle cerebral artery, PI = 1.45 in the left middle cerebral artery, and PI = 1.07 in BA (Fig. 3).

Discussion

Transcranial Doppler ultrasonography has been successfully used both in humans and animals for evaluation of intracranial pressure.[3,4] The correlation between elevated

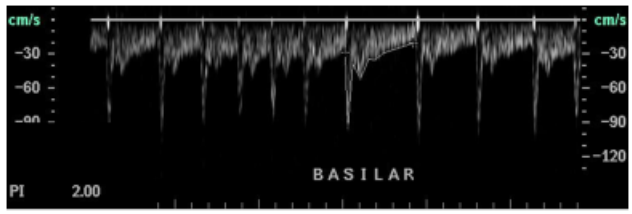

FIG. 1. Transcranial color-coded duplex images of cerebral flow velocity before treatment of the cerebral edema. Flow velocity was recorded from the basilar artery and the pulsatility index is elevated.

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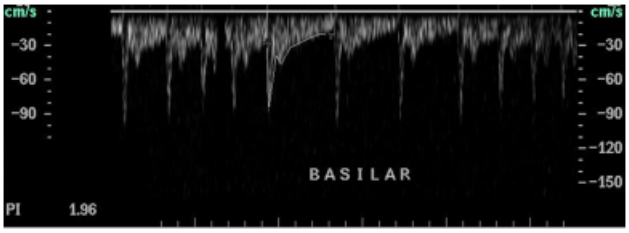

FIG. 2. Flow velocity was recorded from the basilar artery 12 h after treatment for cerebral edema and the pulsatility index is decreased.

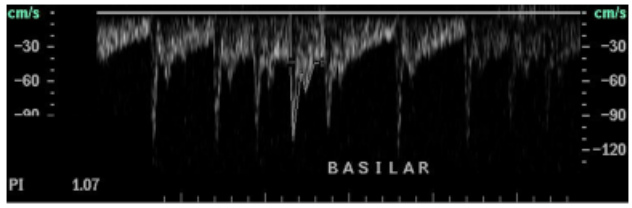

FIG. 3. Twenty-four hours posttreatment, the pulsatility index recorded from the basilar artery was normal.

intracranial pressure and an increase in the PI has been validated.[3–6]

A marked increase in the PI was observed in all intracranial arteries interrogated in this dog with hepatic encephalopathy, which was suggestive of increased intracranial pressure.[4,5] A decrease in the PI to normal values was observed following normalization of clinical signs. These results are similar to those observed in humans where an increased PI in the middle cerebral artery has been found in patients with hepatic failure.[7,8] In humans, the PI is the most frequently used parameter for assessing intracranial pressure in patients with hepatic failure. Advantages of this method include simplicity of calculation, it is not affected by minor changes in the angle of insonation and the fact that it reflects a combination of physiologic factors, such as resistance in the distal vessels, elasticity of the vessel wall, and size of the vessel.[8]

The development of brain edema and increased intracranial pressure has been studied extensively. Hyperammonemia induces accumulation of glutamine inside astrocytes, causing intracellular swelling and subsequent increase in brain water.[9–16] In rats receiving ammonia infusion after portocaval anastomosis, an increase in cortical blood flow was detected using Laser Doppler flowmetry. Furthermore, cerebral hyperemia is important in the development of brain edema, with movement of water into brain facilitated by diffusion forces as well as increased expression of water transporters such as Glut-1 and aquaporin-4.[13]

Transcranial Doppler sonography is an important tool to measure cerebral blood flow velocity in major intracranial arteries in critical care units in human hospitals due to it is noninvasive approach.[17] This technique has only been described occasionally in veterinary medicine.[2,4,18–21] An exponential increase in the PI has been found with intracranial hypertension in dogs and cats.[4,5] Also, the flow pattern and PI may be useful indices of cerebral blood flow under conditions of intracranial hypertension.[5]

In conclusion, we report the use of transcranial Doppler sonography for evaluation and monitoring of intracranial pressure in a dog with hepatic encephalopathy. Furthermore, the normalization of the PI was associated with clinical improvement.

Transcranial Doppler sonography appears to have use in the evaluation of intracranial hypertension in dogs with hepatic encephalopathy.

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