Laparoscopy-assisted ventriculo-peritoneal shunt implantation in a dog: a case report

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ABSTRACT: This article describes the procedure of ventriculo-peritoneal shunt implantation in an English bulldog with laparoscopy-assisted placement of the peritoneal catheter in the abdominal cavity. Prior to surgery, the patient was subjected to physical and neurological examinations involving a complete blood count (CBC), biochemistry profiling, EEG and MRI. This case report also describes the patient's pharmacological treatment before the procedure, the applied surgical technique and the benefits of the laparoscopy-assisted approach.

Keywords: laparoscopy; hydrocephalus; ventriculo-peritoneal shunt; dog

Hydrocephalus is a condition in which the ventricular system is enlarged, and is caused by an abnormal accumulation of cerebrospinal fluid. Hydrocephalus may be an acquired or a congenital condition. Canine pedigrees which are most predisposed to the congenital form of hydrocephalus include the Maltese, Yorkshire terrier, English bulldog, Cairn terrier, Pomeranian, Chihuahua, pug and the Pekinese. Puppies affected by hydrocephalus are usually smaller in size and lighter in weight than their siblings. Their cognitive functions are impaired, and they may be aggressive towards other puppies. The disease is not always clinically evident. If symptoms are present, they most often include tetraparesis and gait abnormalities such as ataxia and hypermetria. Changes in mental status may lead to aggression or depression (Thomas, 2010).

Acquired hydrocephalus may be induced by cerebrospinal fluid retention due to impaired fluid circulation. In most cases, it is a consequence of central nervous system infections. CSF production may be enhanced by neoplasms, mostly choroid plexus papillomas, ependymomas or pituitary gland tumours. The presence of neoplastic mass in the brain stem region may compress the third and fourth ventricle closing the mesencephalon aqueduct, leading to secondary hydrocephalus. In brachycephalic pedigrees, aqueductal agnesis or stenosis may be observed, and this condition may be exacerbated by temporal and occipital dysplasia (Harington et al., 1996; Thomas, 2010).

Hydrocephalus is diagnosed based on the patient's clinical history and neurological symptoms. X-ray examinations may be a helpful tool, although they do not provide for an accurate diagnosis. In congenital cases, increased convexity of the cranium is observed, and the frontal and parietal bones may be thin. Persistent fontanelle is frequently reported. Magnetic resonance imaging is considered to be the imaging modality of choice for diagnosing the disease (Thomas, 2010).

Patients displaying clinical symptoms have a guarded prognosis, and surgery is indicated. Patients who receive medical treatment and show no clinical signs are also given a guarded prognosis because their condition may deteriorate. Surgical procedures which may be undertaken in the treatment of hydrocephalus are the ventriculo-atrial shunt and the ventriculo-peritoneal shunt, both of which are considered to be modalities of choice (Kim et al., 2006; Woo et al., 2009).

Case description

A male English bulldog, aged seven years and weighing 17 kg, was admitted to the clinic with a history of epilepsy and aggression starting six months earlier. The owner was concerned about the dog's epileptic attacks which occurred three to four times a week. Epileptic episodes were classified as grand mal seizures with prodromal, ictus and postictal phases. During that time, the patient showed signs of aggression such as barking and growling, and it had even bitten one person.

Physical examination revealed no abnormalities. The patient's mental status and behaviour were also normal. Gait examination revealed slight ataxia of all four limbs and hypermetria. Minor spasticity of all four limbs was reported. Mild intention tremor of the head was observed when the dog was eating. The above clinical sings were not exacerbated when the dog walked up and down the stairs. The patient's posture was wide leg stance with occasional loss of balance. Postural reactions were slightly abnormal on all four limbs, mainly during the initiation phase. The proprioceptive positioning test was delayed on the hind limbs, whereas the spinal reflexes were normal on all four limbs. Cranial nerve examination showed mild deficits. The sensation on the head was diminished, whereas the menace response was normal, and the papillary light reflex was present. The remaining cranial nerves were normal. Based on the results of a neurological examination and the patient's history, the problem was localized to the brain.

Blood was sampled, and a complete blood count (CBC) and a biochemistry profiling were performed. The results were within the normal range. A cerebrospinal fluid examination (CSF) was also carried out, and no abnormalities were detected. All parameters were within the reference range. The electroencephalogram (EEG) recording was characterized by low-frequency and high voltage activity that was synchronized, generalized and symmetric – suggestive of canine hydrocephalus (Berendt et al., 1999).

The dog was administrated mannitol in bolus at 1 g/kg of body weight for three consecutive days. Furosemide was administered twice a day intravenously at 4 mg/kg of body weight after mannitol, and the above dose was subsequently reduced to 2 mg/kg *per os* once a day (Thomas et al., 2010). Gabapentin was introduced at 10 mg/kg of body weight twice a day (Cashmore et al., 2009).

The patient was examined by a low-field MRI scanner with magnetic field intensity of 0.2 Tesla (Vet Grande, Esaote) under general anaesthesia. Images of the brain were produced in the sagittal, transverse and dorsal plane using T1-weighted and T2-weighed sequences as well as FSE T2 (T2-weighed fast spin echo), SE T1 (T1-weighed spin echo), and FLAIR (Fluid attenuated inversion recovery) sequences. Gadolinium (Omniscan®, Nycomed, Irleand) contrast was also administered at 0.1 mmol/kg *i.v.* The resulting images showed enlarged lateral ventricles (Figures 1 and 2). Hydrocephalus was diagnosed.

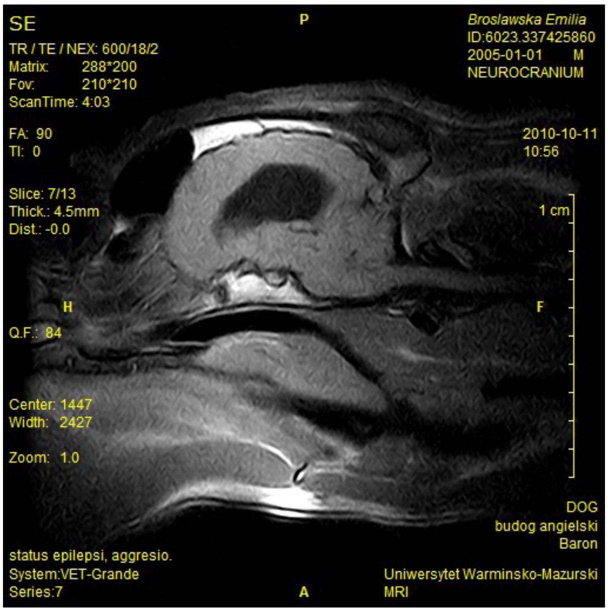

Figure 1. The sagittal T1-weighted MRI image with hydrocephalus, prior to shunting

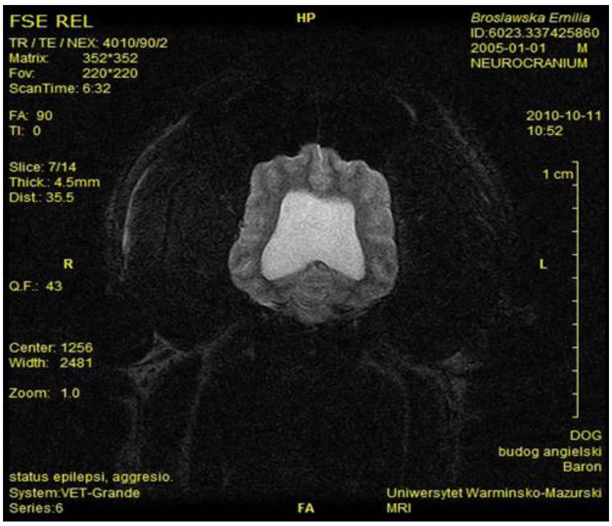

Figure 2. The dorsal T2-weighted MRI image with hydrocephalus, prior to shunting

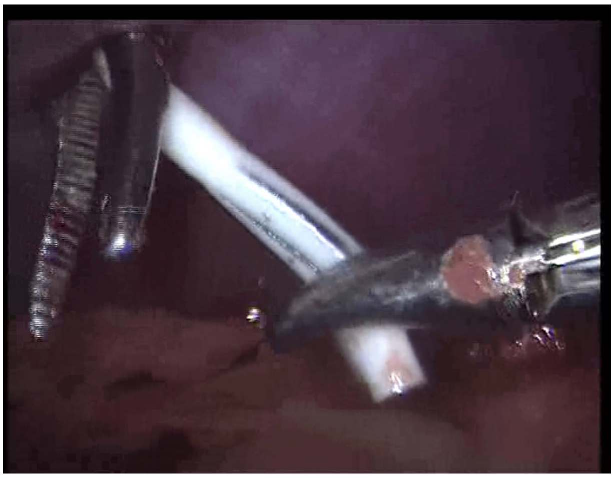

Figure 3. Catheter introduction into the abdominal cavity under laparoscopic control

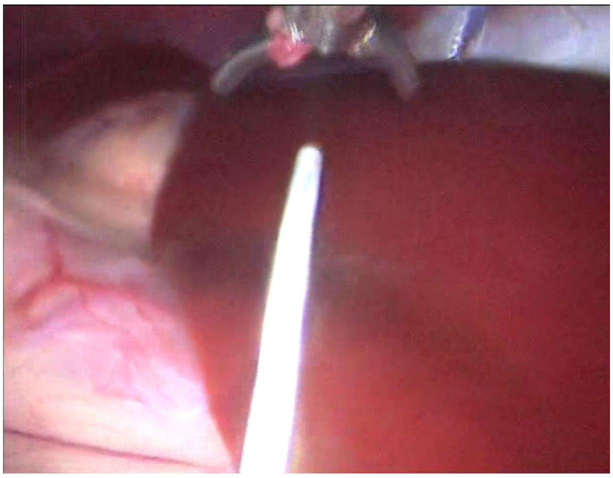

Figure 4. Laparoscopic placement of the catheter into the liver area

Prior to surgery, cephalexim (Ceporex®, Schering plough, Poland) was administered *i.v.* at 30 mg/kg of body weight. The dog was premedicated with atropine at 0.005 mg/kg and medetomidine (Domitor®, Pfizer Animal Health, Australia) at 0.02 mg/kg. Anaesthesia was maintained with propofol (Plofed®, Polfa S.A., Poland) in bolus at 5 mg/kg of body weight. General inhalatory anaesthesia was induced with 1% isoflurane (Floran®, Baxter, U.S.A). In the first phase of surgery (placement of a catheter in the left lateral ventricle), the patient was placed in the sternal position. 'CSF-Flow Control Valve-Ultra Small Low Pressure and Ventricular Catheter, Barium Impregnated 23cm' (Metronic, USA), was inserted into the lateral ventricle via an opening in the caudal part of the parietal bone, approximately 2 cm laterally to sagittal crest, and was subcutaneously connected to the 'Peritoneal Catheter, Barium Impregnated 90cm' (Metronic, USA). In the second phase, the patient was placed in dorsal recumbency, and the catheter was laparoscopically inserted into the liver area. Two laparoscopic ports were created, including an optical port and a working port. Carbon dioxide was insufflated into the peritoneum, and a 10mm optical trocar, 30°, and a working trocar were inserted. The peritoneal catheter was introduced into the abdominal cavity under visual control (Figure 2). Using laparoscopic graspers, the catheter was advanced into the liver area (Figure 3). Laparoscopic incisions were closed with a single suture.

After surgery, the patient was administered tramadol hydrochloride at 5 mg/kg of body weight in 150 ml of slow fluid infusion for three consecutive days. The therapy was continued with tramadol hydrochloride administered intramuscularly over the successive five days. Antibiotic treatment was continued four days after the surgery with a cephalexin (Ceporex®, Schering plough, Poland) dose of 18 mg/kg *i.m.*

Mild hypermetria and slight ataxia of the front limbs were observed when the dog was taken out for a walk. The above neurological sings were exacerbated during movement going up and down stairs. No signs of aggression or mental status deficits were noted. Thirty days after the surgery, the owner reported that the dog was eager to play and showed no recurring signs of the disease.

DISCUSSION AND CONCLUSIONS

Pharmacological treatment of canine hydrocephalus involves the use of drugs that temporarily inhibit the production of cerebrospinal fluid and reduce intracranial pressure. In the absence of pharmacological treatment that increases CSF absorption, surgery is the only life-saving modality. Ventriculo-peritoneal shunting is the standard procedure in dogs (Woo et al., 2009; Thomas, 2010; De Stefani et al., 2011). According to the author's knowledge, a ventriculo-peritoneal shunting procedure with laparoscopically controlled insertion of the catheter into the abdominal cavity has not been described to date in dogs. The advantages of laparoscopy-assisted ventriculo-peritoneal shunting include full control over catheter placement in the abdominal cavity which minimizes the risk of damage to the intestines and other abdominal organs (Sekula et al., 2009). Laparoscopically-assisted placement of the catheter tip into the liver area also minimizes the likelihood of catheter obstruction which may be caused by omental or intestinal wrapping around the walls and the openings of the catheter (Argo et al., 2009; Sekula et al., 2009). One major disadvantage of laparoscopic procedures is the equipment cost and the requirement for some experience with laparoscopic techniques.

Laparoscopy-assisted ventriculo-peritoneal shunting in dogs poses an alternative to conventional catheter placement techniques. The described procedure is particularly useful in dogs which, in addition to hydrocephalus, are also affected by diseases of abdominal organs, including peritoneal and intestinal adhesions, splenomegaly and neoplasms, whose damage during blind catheter insertion could have catastrophic consequences.

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