Anaesthesia of a French bulldog for a T9-T10 spinal arachnoid diverticula

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Will graduated from the Royal Veterinary College in 2010 and then completed an internship in a busy referral hospital in Berkshire. He subsequently worked in both first opinion and referral practices before starting a residency in Veterinary Anaesthesia and Analgesia at the University of Bristol in 2014. During his residency he completed an RCVS Advanced Certificate in Veterinary Anaesthesia in 2016, before finishing his residency in 2017. Will passed his specialist diploma exams in 2019.

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ABSTRACT: A 2-year-old male French bulldog presented with a 3-month history of progressive pelvic limb ataxia and paraparesis, was admitted for magnetic resonance imaging, showing a T9-T10 subarachnoid diverticulum, followed by corrective surgery. Pre-anaesthetic medication consisted of intravenous methadone 0.2 mg/kg. General anaesthesia was induced with alfaxalone, total dose 1.1 mg/kg, and dexmedetomidine 2 mcg/kg, intravenously. General anaesthesia was maintained with isoflurane vaporised in 100% oxygen, delivered via a circle breathing system. Intraoperative analgesia was provided via a variable rate infusion of ketamine 10-20mcg/kg/min, dexmedetomidine 0.5-1mcg/kg/hr, and fentanyl 5-10mcg/kg/hr. The patient was mechanically ventilated throughout.The surgery was completed successfully, with no complications during recovery and the patient was discharged three days postoperatively

Keywords: anaesthesia; brachycephalic; spinal arachnoid diverticula; neurology

Introduction

Spinal arachnoid diverticula occur due to an accumulation of cerebral spinal fluid (CSF) within the subarachnoid space, which can cause progressive compression of the spinal cord (Lorenz, et al., 2011). With increased access to advanced imagining such as magnetic resonance imaging (MRI) and computed tomography (CT), cystic lesions of the vertebral column and spinal cord are becoming more recognised in veterinary patients (see Table 1). These lesions may cause clinical signs such as paresis, ataxia and pain, but may also be found as an incidental finding (da Costa & Cook, 2016). There are numerous proposed causes of a subarachnoid diverticulum, including congenital malformations, trauma, inflammation and neoplasia but the underlying aetiology is rarely found (Dewey & da Costa, 2016).

Medical management of these patients is limited and not always successful, however if opted for, includes anti-inflammatory medication, physiotherapy, and medications to reduce the CSF production (Mauler, et al., 2017). A study by Mauler, et al. (2017), showed that 30% of medically managed dogs had an improvement in clinical signs, compared to 82% of dogs treated surgically. This suggested that the best treatment option for these patients is surgery. Surgery can initially cause deterioration of clinical signs but with physiotherapy and careful management post operatively, improvements are readily noticed.

Case

Background

A 2-year-old French bulldog presented with a three month history of progressive hind limb ataxia and paraparesis. A CT scan at the referring veterinary practice demonstrated a spinal arachnoid diverticulua, with the owners electing to try medical management. Prednisolone had not fully resolved the clinical signs so the owners opted for referral for surgery. Neurological examination showed severe paraparesis and ataxia of the pelvic limbs, with decreased paw positioning on both. The localisation of the lesion was T3-L3 myelopathy. The

remainder of the physical examination was unremarkable.

To complete the diagnostic imaging, the patient underwent MRI scan prior to surgery being performed. Although the previous CT scan gave a diagnosis, MRI scanning shows soft tissue in more detail allowing the neurologist to see exactly what areas of the spinal cord were effected (see Figure 1).

Anaesthesia

The patient was admitted on the morning of surgery, having had food withheld for eight hours overnight. On admission, a 20 gauge intravenous catheter was placed into the left cephalic vein following aseptic technique. The patient was pre oxygenated with 2 L/min of oxygen delivered via a mask. Maropitant 1 mg/mg (Prevomax, Dechra), omeprazole 1 mg/kg (Omeprazole; Bowmed Ibisqus) and methadone 0.2 mg/kg (Synthadon, Animal Care) were administered intravenously (IV) as the pre anaesthetic medication. General anaesthesia was induced using a co-induction technique with alfaxalone (Alfaxan, Jurox) administration to effect, total dose 1.1 mg/kg, and dexmedetomidine 2 mcg/kg (Dexdomitor, Orion Pharma) given IV. Dexmedetomidine was used during induction to reduce the time the patient's airway was at risk of obstructing. Endotracheal intubation was performed with the aid of a laryngoscope, using a 7.0 mm polyvinyl chloride (PVC) cuffed tube. The cuff was not inflated with any air as when a manual breath leak test was performed no leak was audible. General anaesthesia was maintained with isoflurane (IsoFlo Vet, Merial) vaporised in 100% oxygen, delivered via a circle breathing system. The initial fresh gas flow was set at 2 L/min and was reduced to 0.5 L/min after 30 minutes. Hartmanns (B. Braun Vet Care Hartmanns Lactated Ringers, Braun) fluid therapy was administered IV at 4 ml/kg/hr throughout anaesthesia. A variable rate infusion (VRI) was set up to provide additional IV analgesia during the surgery. The VRI was a combination of fentanyl 5-10mcg/kg/hr (Fentadon, Dechra), dexmedetomidine 0.5-1mcg/kg/hr (Dexdomitor, Orian Pharma) and ketamine 10-20mcg/kg/min (Anaestamine, Dechra) made up into a 100 ml bag of sodium chloride (Aqupharm 1, Animal Care). Cefuroxime 20 mg/kg (Zinacef, GSK) was administered IV every 90 minutes throughout surgery.

During the anaesthetic, a multi parameter monitor (Cardiocap/5, Datex Ohemda) was used monitoring oscillometric non-invasive blood pressure, lead two electrocardiogram (ECG), core body temperature (via oesophageal stethoscope), sidestream capnography, and pulse oximetry (via lingual probe). This machine also allowed the volatile agent to be monitored. Alongside this assessment of eye position and palpation of peripheral pulse was conducted throughout the anaesthetic to ensure adequate depth of anaesthesia

Once suitably anaesthetised, and with all the monitoring attached, the patient was clipped and aseptically prepared, with chlorhexidine, ready for theatre.

Once in theatre, the patient's lungs were mechanically ventilated using a bag in the bottle ventilator (Datex Ohmeda). The ventilator was set to deliver 10 ml/kg tidal volume with a respiratory rate of 20 breaths per minute and an inspiratory/expiratory ratio of 1:3. These settings prevented the patient from spontaneously ventilating meaning that there was no movement to disrupt the surgical site. The patient was positioned in sternal recumbancy with active warming via a forced air warmer (Bair Hugger).

Monitored physiological parameters were well maintained throughout surgery with only one episode of the patient reacting to nociceptive stimulus. This was treated by an additional dose of methadone 0.1 mg/kg (Synthadon, Animal Care) being administered IV. There was a period of hypotension (mean BP 50-59mmhg). The concentration of volatile agent was decreased, having no effect on the BP, a 10 ml/kg IV fluid bolus given over ten minutes which rectified the hypotension.

Recovery and post-operative care

When the surgery was complete, the patient was weaned from the ventilator, and once spontaneously ventilating adequately, isoflurane anaesthesia was discontinued. The patient was allowed to breathe 100% oxygen until swallowing. The endotracheal tube was

Table 1. Table highlighting the difference between computed tomography and magnetic resonance imaging for accusation of diagnostic imaging.

	CT	MRI
Time	• 3D volume acquisition is quick	Time consuming when scanning large areas
Tissue	• Good detail of bone structures. Poor differentiation of spinal cord and soft tissue structures without myelography	• Shows good detail of the spinal cord but limited detail of bone structures
Availability	• Widely available	• Usually only at referral centres
Chemical restraint	• Can be carried out under sedation (unless myelography)	• Needs general anaesthesia
Radiation	Radiation	Magnetic field

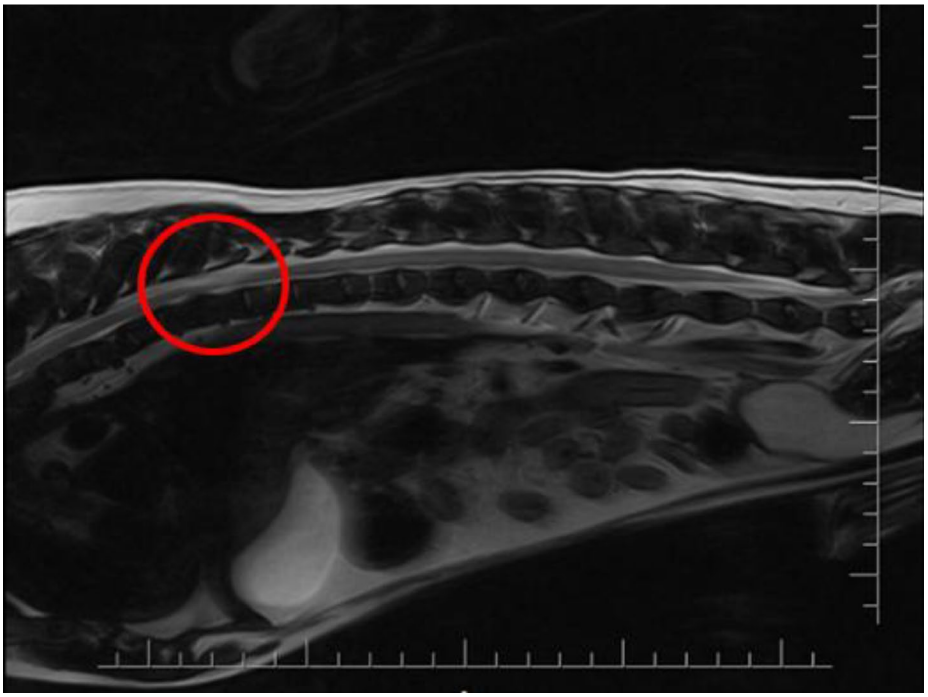

Figure 1. A magnetic resonance imaging scan showing a T2 sagittal view of a spinal arachnoid diverticula at T9-T10 in a 2 year old ataxic French bull dog.

removed as late as possible to ensure adequate return of laryngeal function. His rectal temperature was 33.3 °C on recovery, so active warming with a forced air warmer was continued until rectal temperature reached 37 °C. A nurse was present with the patient until normothermic and able to stand.

The patient was recovered from anaesthesia in a kennel that was set up with an orthopaedic mattress, veterinary bedding (VetBed, Petlife) and a non-slip mat. The recovery was uneventful. Paracetamol 10 mg/kg (Paracetamol, Braun) was administered IV as additional analgesia once the VRI was stopped, being continued every eight hours overnight. Methadone 0.25 mg/kg, was continued every 4 hours until the following day. Antibiotics were stopped at the end of surgery. Hartmanns solution was continued at 2 ml/kg/hr until the patient was eating well. Bladder size was evaluated every six hours, via manual palpation, for the first 24 hours post surgery, to ensure adequate bladder function. Ultrasound scanning is more accurate when checking the bladder to measure the exact size, but the neurologist was not concerned about the patient's ability to urinate so deemed manual palpation to be adequate. Physiotherapy was started the following day, with the patient showing a good response to therapy. The patient was eating well, comfortable and ambulatory, and was discharged from the hospital three days post surgery.

Discussion

Gaining access to the airway was a concern with this patient being a brachycephalic breed. In brachycephalics, the length of the skeletal muzzle is reduced but the soft tissue contained within the skull does not decrease to compensate for this. This has the effect to constrict of the nasal cavity, pharynx and larynx, meaning more respiratory effort is needed from the patient for effective ventilation (Cambridge, 2019). These breeds can present challenges to endotracheal intubation, therefore it is important to ensure a wide range of endotracheal tube sizes are available. Pre-oxygenation will help in this situation as it increases the oxygen reserve in the functional residual capacity and therefore gives a longer time to desaturation. Dogs pre-oxygenated with 100 ml/kg oxygen via facemask take five times longer to desaturate after induction of general anaesthesia compared to those that are not pre-oxygenated (McNally et al., 2009). A laryngoscope is also helpful as it allowed visualisation of the larynx. Maintaining a patent airway post surgery is another concern, therefore these patients can be extubated late to allow the airway to be maintained for as long as possible. There is a risk on recovery that once extubated, the patients' airway could become obstructed and endotracheal re-intubation would be required. This patient had an uneventful recovery but a difficult airway kit was available in case any complications were encountered.

Regurgitation is also a concern in brachycephalic breeds. This is the passive discharge of gastric or oesophageal fluid from the mouth or nose. If this occurs, it can cause complications such as aspiration pneumonia, oesophagitis and oesophageal strictures (Lamata, et al., 2012). The increased effort required to ventilate leads to increased negative pressure, which draws the stomach content into the chest, causing gastro-esophageal reflux (Cambridge, 2019), and making these breeds susceptible to hiatal hernias. The period of time for which food is withheld prior to anaesthesia can impact upon the incidence of regurgitation, with prolonged periods of greater than 10 hours increasing the acidity of the stomach contents and increasing risk of complications should regurgitation occur (Savvas et al., 2009). Current recommendations are that withholding food for between six and eight hours is sufficient (Duke-Novakovski et al., 2016), we chose to opt for the higher end of this time period as brachycephalic breeds of dog can have delayed gastric emptying compared to other breeds (Lecoindre & Richard, 2004). Maropitant and omeprazole were administered prior to induction to try and limit the effects caused by regurgitation if it were to occur. Maropitant is a NK-1 receptor antagonists given to reduce nausea. Omeprazole is a proton pump inhibitor which interacts with the hydrogen potassium ATPase ion channel on the secretory membrane of the gastric mucosa to reduce the amount of gastric acid produced (Panti, et al., 2009). Giving omeprazole prior to anaesthesia will reduce the pH of the stomach acid making it less damaging to the oesophagus if an episode of regurgitation did occur. Post operatively, the patients head was elevated to reduce the chance of gastric reflux. If regurgitation did occur, the patients head would be lowered to allow the fluid to drain away from the larynx. Suction was available if an episode of regurgitation did occur.

When setting up the kennel for this patient it was important to make sure he had a non-slip mat, with an orthopaedic bed and plenty of padded bedding. This reduces the risk of pressure sores in non-ambulatory patients. These patients can suffer from urine scalds if they are unable to move themselves when they need to urinate. VetBeds are ideal postoperatively as any urine would have been drawn away from the patient and been absorbed by the incontinence sheet underneath.

This patient had an opioid only pre anaesthetic medication, but an alpha-2-adrenoreceptor agonist was included as part of a co-induction technique. Dexmedetomidine is a useful analgesic adjunct during surgery and is volatile anaesthetic sparing (Murrel & Hellebrekers, 2005). Once dexmedetomidine has been given it relaxes the pharyngeal and laryngeal muscles, increasing the risk of airway obstruction. Giving it as part of a co-induction reduced the amount of time the patient was at risk. Dexmedetomidine was also chosen as it has minimal effects on the respiratory system, reducing respiratory rate but maintaining minute volume (Murrel & Hellebrekers, 2005). This leads to a reduced airway pressure due to improved flow characteristics.

Steroid medication had been given to this patient prior to surgery, giving non-steroidal anti-inflammatory drugs alongside steroids is contraindicated due to increased risk of side effects when giving both, so paracetamol was used instead. Paracetamol has been shown to provide comparable postoperative analgesia to meloxicam in dogs (Pacheco, 2020).

Clinical signs had been present in this patient for 6-8 weeks before surgery was performed. He had been painful for this time so a full Mu opioid receptor agonist was used. Methadone reduces the minimum alveolar concentration (MAC) of isoflurane needed in a dose dependant manner, and giving higher doses and repeating them regularly prolongs the volatile agent sparing effect (Credie, et al., 2010). The VRI was chosen to give throughout surgery as it provided additional analgesia whilst also being anaesthetic sparing. A study by Williamson et al. (2017) suggested that continuous rate infusions of fentanyl given IV decreases the MAC of inhalant anaesthetic agents. Depending on the dose of fentanyl given, the study found a MAC reduction of 42-72%. Reducing the concentration of inspired inhalational agent reduces the cardiovascular effects, such as hypotension, but also reduces the environmental impact of these agents (Jones & West, 2019).

Conclusion

This case had a good outcome, surgery was successful and the patient had no post-operative neurological deterioration. The patient responded well to physiotherapy and was walking before being discharged from the hospital three days post surgery. It shows that anaesthesia in brachycephalic breeds can be safe with careful considerations.

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