Veterinary Anaesthesia and Analgesia 2017, **xxx**, 1–8 http://dx.doi.org/10.1016/j.vaa.2016.03.002

RESEARCH PAPER

Comparison of the hanging-drop technique and running-drip method for identifying the epidural space in dogs

Fernando Martinez-Taboada[a] & **José I Redondo**[b]

[a] North Downs Specialist Referrals, Redhill, UK

[b] Departamento de Medicina y Cirugía Animal, Facultad de Veterinaria, Instituto de Ciencias Biomédicas, Universidad CEU Cardenal Herrera, Valencia, Spain

Correspondence: Fernando Martinez-Taboada, Anaesthesia Department, Veterinary Teaching Hospital (Sydney), Evelyn Williams Building, University of Sydney, Sydney, NSW 2006, Australia. Email: fer_m_taboada@hotmail.com

Abstract

Objective To compare the running-drip and hanging-drop techniques for locating the epidural space in dogs.

Study design Prospective, randomized, clinical trial.

Animals Forty-five healthy dogs requiring epidural anaesthesia.

Methods Dogs were randomized into four groups and administered epidural anaesthesia in sternal (S) or lateral (L) recumbency. All blocks were performed by the same person using Tuohy needles with either a fluid-prefilled hub (HDo) or connected to a drip set attached to a fluid bag elevated 60 cm (RDi). The number of attempts, 'pop' sensation, clear drop aspiration or fluid dripping, time to locate the epidural space (TTLES) and presence of cerebrospinal fluid (CSF) were recorded. A morphine–bupivacaine combination was injected after positive identification. The success of the block was assessed by experienced observers based on perioperative usage of rescue analgesia. Data were checked for normality. Binomial variables were analysed with the chi-squared or Fisher's exact test as appropriate. Non-parametric data were analysed using Kruskal–Wallis and Mann–Whitney tests. Normal data were studied with an ANOVA followed by a Tukey's means comparison for groups of the same size. A *p*-value of < 0.05 was considered to indicate statistical significance.

Results Lateral recumbency HDo required more attempts (six of 11 dogs required more than one attempt) than SRDi (none of 11 dogs) ($p = 0.0062$). Drop aspiration was observed more often in SHDo (nine of 11 dogs) than in LHDo (two of 11 dogs) ($p = 0.045$). Mean (range) TTLES was longer in LHDo [47 (18–82) seconds] than in SHDo [20 (14–79) seconds] ($p = 0.006$) and SRDi [(34 (17–53) seconds] ($p = 0.038$). There were no differences in 'pop' sensation, presence of CSF, rescue analgesia or pain scores between the groups.

Conclusion and clinical relevance The running-drip method is a useful and fast alternative technique for identifying the epidural space in dogs. The hanging-drop technique in lateral recumbency was more difficult to perform than the other methods, requiring more time and attempts.

Keywords dog, epidural, hanging drop, local anaesthesia, running drip.

Introduction

The epidural administration of drugs is common practice in veterinary anaesthesia, in both small and large animals. The success of this technique relies largely on the correct identification of the epidural space and, as a result, many methods of verifying the correct positioning of the needle in the epidural space have been described.

The most common methods used in veterinary medicine to identify the epidural space are the 'pop' sensation (POP), the 'lack of resistance to injection' and the 'hanging drop' technique (Jones 2001; Valverde 2008). In human subjects, the most popular technique is that involving loss of resistance with either air or fluid (Ames et al. 2005; Figueredo et al.

2005), but there are no published data on the method preferred among veterinary anaesthetists.

All of the commonly used methods in clinical veterinary practice have limitations. A recent study in dogs found that when the epidural space was identified using loss of resistance with air, radiological confirmation identified a failure rate of almost one-third (Sarotti et al. 2015). An earlier study by Naganobu & Hagio (2007) found the hanging-drop technique in dogs to be less successful in animals in lateral recumbency than in those in sternal recumbency. The authors speculated that this might be explained by the fact that extradural pressure is lower in sternal recumbency than in lateral recumbency, as was previously demonstrated in human subjects (Shah 1984).

The disadvantages of the methods commonly used to locate the epidural space have encouraged researchers to find other alternatives. The majority of these are still not broadly applied in general practice as a result of their complexity or the costs involved. Some examples include the use of electrical stimulation (Garcia-Pereira et al. 2010), ultrasonography (Gregori et al. 2014), fluoroscopy (Gautam et al. 2010), acoustic devices (Iff et al. 2010), and extradural pressure waves (Iff & Moens 2010).

The running-drip method was first described in human subjects in the early 1970s (Baraka 1972). Baraka (1972) stressed that this technique did not depend on the presence of negative pressure in the epidural space or the subjective feeling of loss of resistance. The author also described how hydrostatic pressure allowed the drip to run clearly and reliably as soon as the needle tip pierced the ligamentum flavum and entered the epidural space.

The ready availability of the materials needed, the minimal associated cost and the ease with which this technique can be mastered makes it very accessible to clinical practice. Additionally, it does not depend on pressure in the epidural space, which potentially makes it applicable in both sternal and lateral recumbency. The aim of this study was therefore to compare the hanging-drop and running-drip methods in sternal and lateral recumbency in healthy dogs.

Materials and methods

This study was approved by the research ethics committee of the CEU University (no. 2014-03). Informed owner consent was obtained prior to the enrolment of dogs in the study.

Forty-five dogs scheduled for elective surgery of the pelvic limbs or the caudal abdomen were recruited for this study. All animals were considered healthy [American Society of Anesthesiologists (ASA) class I status] based on the history and a thorough physical examination performed by the main investigator (FMT). Exclusion criteria denied the enrolment of any dog with a physical status of ASA classes II−V, coagulopathy, neurological disease or pyoderma at the site of injection. Body condition score (BCS) was assessed using a 9-point scale (Laflamme 1997). Data for dogs that developed major anaesthetic complications during the study were excluded from the analysis.

The dogs were fasted for 8 hours prior to the induction of anaesthesia. Water was available until preanaesthetic medication was administered. This medication consisted of 0.02 mg kg^{-1} acepromazine [ACP injection, 2 mg mL^{-1}; Novartis Animal Health (UK) Ltd, UK], medetomidine 5 μg kg^{-1} (Sedator 1 mg mL^{-1}; Dechra Veterinary Products Ltd, UK) and 0.2 mg kg^{-1} methadone (Physeptone 1% injection; Martindale Pharmaceuticals Ltd, UK) administered intravenously (IV) via a cannula previously inserted into one of the cephalic veins.

Approximately 10 minutes after sedation, anaesthesia was induced with IV propofol (Vetofol 1% w/v; Norbrook Laboratories Ltd, UK) to effect until direct laryngoscopy and subsequently tracheal intubation were possible. General anaesthesia was maintained with isoflurane (Isocare; Animalcare Ltd, UK) in oxygen via a circle breathing system (Datex Aestiva/5; Datex-Ohmeda Instrumentarium Corp., Finland). Heart rate (HR), non-invasive arterial blood pressure (ABP), respiratory rate (f_R), haemoglobin oxygen saturation (SpO_2), end-tidal carbon dioxide ($P_{E'}CO_2$), end-tidal isoflurane ($F_{E'}Iso$) and oesophageal temperature (T) were monitored continuously during anaesthesia (AS3 Monitor; Datex Ohmeda Instrumentarium Corp.). Hartmann's solution (Vetivex 11; Dechra Veterinary Products Ltd, UK) was also infused IV at a rate of 10 mL kg^{-1} hour^{-1} throughout the procedure.

The dogs were allocated to four groups using computer-generated block randomization. In two groups, epidural anaesthesia was administered using the hanging-drop technique (HDo) in sternal (S) or lateral (L) recumbency (groups SHDo and LHDo). In the other two groups, epidural anaesthesia was administered using the running-drip method (RDi) in sternal or lateral recumbency (groups SRDi and LRDi). Each dog was then placed in either lateral or

Please cite this article in press as: Martinez-Taboada F, Redondo JI. Comparison of the hanging-drop technique and running-drip method for identifying the epidural space in dogs, Veterinary Anaesthesia and Analgesia (2017), http://dx.doi.org/10.1016/j.vaa.2016.03.002