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REVIEW ARTICLE

What is the evidence? The issue of verifying correct needle position during epidural anaesthesia in dogs

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Abstract

Objectives To review the methods for verifying the needle position while performing epidural anaesthesia in dogs, and to discuss the advantages, disadvantages, usefulness and reliability of each technique in the experimental and clinical research setting.

Databases used PubMed, Scopus, Google Scholar and the Basel University Library online catalogues; the latter, which was provided by the University of Berne, were used as databases. The results were filtered manually based on the titles and abstracts in order to narrow the field.

Conclusions Besides some drawbacks, including the potential side effects of contrast medium injection, which may limit its routine use in clinical patients, epidurography should still be regarded as one of the most reliable techniques to verify needle position in dogs. Ultrasonography, electrical nerve stimulation, loss of resistance and the hanging drop technique are regarded as less invasive than epidurography and, for this reason, their use may be more applicable to clinical patients. However, these methods have been described in only a few published reports, all of which involved a limited number of dogs. Finally, the detection of epidural pressure waves has been investigated more extensively in dogs, and the findings of these studies suggest that this technique may be used to verify epidural needle placement for experimental and clinical research, on condition that all the negative subjects are excluded from the study.

Keywords correct needle position, dog, epidural anaesthesia.

Premise

Within the past decade there has been increasing interest in locoregional anaesthetic techniques for companion animals, and a considerable portion of current clinical and experimental veterinary anaesthesia research focuses on neuroaxial analgesia in dogs (Hendrix et al. 1996; Hoelzler et al. 2005; Campagnol et al. 2011).

To increase the chances of successful epidural analgesia, precise knowledge of the position of the needle tip before injection is essential. Whilst blind techniques are commonly regarded as acceptable in the clinical setting, confirmation of correct placement of the needle in the epidural space is of utmost importance when research studies are being carried out.

But how should needle location be confirmed in canine patients? Which methods have been described in dogs for this purpose and could be recommended when carrying out experimental and clinical research involving dogs? And is there any evidence of the usefulness and reliability of these techniques?

The aim of this review was to attempt to answer these questions, and also to discuss the advantages and disadvantages of the techniques, described in dogs, used to verify epidural needle position.

Epidurography

In human medicine, epidural needle position is traditionally identified with epidurography (Shetty et al. 2007; Kim et al. 2009). This technique has also been used in dogs, as a reference technique, when investigating the reliability of other methods (Iff et al. 2007; Garcia-Pereira et al. 2010; Liotta et al. 2014; Otero et al. 2014).

The history of epidurography dates back to 1921, when two medical doctors injected, by accident, a contrast agent into the epidural space of a human patient (Luyendijk & vanVoorthuisenae 1966). Since then, the technique has been extensively investigated in human medicine for confirmation of epidural needle position and, before the advent of magnetic resonance imaging (MRI), for various diagnostic purposes as well. Once the needle is believed to be correctly positioned, a contrast medium is injected. At this point, proper visualization of the epidural space — and of the needle within it — can be obtained with real-time fluoroscopic guidance, standard radiography or computed tomography (CT) scan. Many studies enrolling a large number of human patients have evaluated epidurography and found it useful for identification of the epidural space, to verify the exact position of needles and catheters in this space and to evaluate volume distribution and detect leakages of injectate through the dura mater (Robertson et al. 1979; Johnson et al. 1999; Botwin et al. 2004; Motamed et al. 2006; Shetty et al. 2007; Kim et al. 2009).

In veterinary medicine, epidurography also had its heyday before CT and, in particular, MRI became mainstream and is still regarded as safe (Feeney and Wise, 1981; Barthez et al. 1994) and reliable for a variety of purposes (Sande 1992; Roberts & Seken 1993; Zhang et al. 2013). Although several epidurography techniques, all of which have in common the fact that the tip of the needle lies on the floor of the vertebral canal, are described in dogs (Klide et al. 1967; Barthez et al. 1994), the sacrococcygeal approach is largely preferred for imaging of disease. In contrast, the dorsal lumbosacral approach is favoured for injection of analgesics (Jones 2001).

Surprisingly, to the authors' knowledge, an epidurography technique with a dorsal lumbar approach has never been described in dogs with the specific purpose of guiding needle insertion within the spinal canal, as is the case for humans (Robertson et al. 1979; Shetty et al. 2007; Kim et al. 2009). Attempting to reach the floor of the vertebral canal in a location where there might still be spinal cord is regarded by some as potentially dangerous (Abd & Depalma 2011). Another potential limitation of epidurography is the need for either a positive or a negative contrast, such as iodinated compounds and air, respectively, to identify the epidural space and its components. In contrast with iodinated compounds (Rodrigo-Mocholí et al., 2015; Scarabelli et al. 2016), the use of air as a negative contrast medium does not carry the risk of allergic reaction; however, it has been identified as a source of pain in people, which makes it a poor alternative to iodinated contrast (Overdiek et al. 2001). To address reported iodine allergies, use of gadolinium chelate has been proposed as an alternative in humans (Shetty et al. 2007). Additionally, all nonionic iodinated contrast media that could be employed for epidurography, namely iopamidol, iomeprol and iohexol, carry risks of seizures when they are accidentally or deliberately injected into the subarachnoid space (Barone et al. 2002; Lexmaulova et al., 2009; DaCosta et al. 2011).

Hanging drop technique

The pressure in the canine epidural space is consistently sub-atmospheric, so that a drop of fluid placed in the hub of the needle tends to move from the hub to the shaft when the distal tip of the needle enters the epidural space (Bengis & Guyton 1977). However, the steady-state epidural pressure may vary with changes in interstitial fluid pressure and also oscillates throughout the respiratory cycle, probably resulting from changes in pressures in the epidural veins (Bengis & Guyton 1977). Therefore, the presence of negative epidural pressure may or may not be observed, a drawback that limits the reliability of the hanging drop and all techniques relying on the detection of a sub-atmospheric pressure.

One study investigated the hanging drop technique in eight dogs positioned in sternal and lateral recumbency on two different occasions. The authors found that aspiration of fluid into the needle was observed in seven out of eight dogs positioned in sternal recumbency (Naganobu and Hagio, 2007). By contrast, a hanging drop sign was not observed in any dog in lateral recumbency, indicating that patient position greatly affects the accuracy of this technique. Additionally, the technique yielded one false negative in a subject positioned in sternal recumbency.

Loss of resistance technique

This practical, inexpensive technique can be carried out by injecting a small amount of either saline or air