



Commonly-used versus less commonly-used methods in the loss of resistance technique for identification of the epidural space: A systematic review and meta-analysis of randomized controlled trials



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ABSTRACT

Study objective: To summarize the efficacy of less-commonly used modern methods (e.g. epidrum, lidocaine, acoustic device, Macintosh balloon) compared to more commonly-used methods (i.e. air, saline, both) in the loss of resistance technique for identification of the epidural space.
Design: A systematic review.
Setting: A hospital-affiliated university.
Measurements: The following databases were searched: PubMed, CENTRAL, EMBASE, and LILACS. We used the GRADE approach to rate overall certainty of the evidence.
Results: Eight randomized trials including 1583 participants proved eligible. Results suggested a statistically significant reduction in inability to locate the epidural space (RR 0.29, 95% CI 0.11, 0.77; $P = 0.01$; $I^2 = 60\%$, risk difference (RD) 104/1000, moderate quality evidence), accidental intravascular catheter placement and accidental subarachnoid catheter placement (RR 0.35, 95% CI 0.21, 0.59; $P < 0.0001$; $I^2 = 0\%$, risk difference (RD) 108/1000, moderate quality evidence), and unblocked segments (RR 0.37, 95% CI 0.18, 0.77; $P = 0.008$; $I^2 = 0\%$, risk difference (RD) 56/1000, moderate quality evidence) with the use of epidrum, lidocaine, acoustic device, or modified Macintosh epidural balloon methods in comparison to air. Compared to saline, lidocaine presented higher rates of reduction in the inability to locate the epidural space (RR 0.31, 95% CI 0.12, 0.82; $P = 0.02$; $I^2 = \text{not applicable}$).
Conclusions: Moderate-quality evidence shows that less commonly-used modern methods such as epidrum, lidocaine and acoustic devices, are more efficacious compared to more commonly-used methods (i.e. air, saline, both) in terms of the loss of resistance technique for identification of the epidural space. These findings should be explored further in the context of the clinical practice among anaesthesiologists.

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1. Introduction

The establishment of epidural anesthesia depends on accurate identification of the epidural space. The loss of resistance (LOR) technique for identification of the epidural space seems to be the most commonly used method for the identification of the epidural space [1,2].

The selection between air and saline in the LOR technique for identification of the epidural space has been headed by know-how and individual preference of anesthesiologists [2,3]. In 1998, a study showed that 53% of the anesthesiologists interviewed used saline, 37% used air, 6% used both, and only 3% used alternative methods in conducting the LOR technique [2–4].

However, both methods also present disadvantages [3,5,6]. Epidural injection of air implies some hazards [7–11], and air bubbles in the epidural space can result in only partial analgesia [12]. Also, complications may increase with the use of large volumes of air when validation of the correct placement of the epidural needle is needed [13,14]. Furthermore, the use of saline is reported to slow the onset and reduce the quality of epidural analgesia [15,16]. Thus, there is no consensus as to whether an air or a liquid medium should be used for identifying the epidural space when using a loss of resistance technique. It is also possible that the techniques not widely used today such as epidrum, Macintosh balloon, advancing needle by indirect means such as hanging drop, or even other liquids such as lidocaine can improve quality of analgesia, and reduce complications associated with loss of resistance technique.

With a variety of methods introduced over the last three decades [2, 17–22] to improve the success of the puncture procedure [23,24], the literature remains conflicted in terms of the most appropriate strategy for epidural catheter placement in patients undergoing surgical procedures, women in obstetrical labor and patients with analgesia in the postoperative period.

Over the years, many devices have been designed to improve the success of the puncture procedure [25,26]; however, none of them is widely used today. Among them, there are the epidrum, which is a single-use device that is placed between a luer syringe and epidural needle, and it provides the user with a visual signal when the epidural needle enters the epidural space; the acoustic devices [27]; and the use of lidocaine [28].

In a recent Cochrane systematic review [2], authors concluded that there was no difference between air and saline in the LOR technique

for identification of the epidural space; however, the generalizability of these findings might be compromised, given that the majority of the synthesized data was obtained from pregnant women.

The methods used in identification of the epidural space are extremely important for effective anesthesia and to avoid potential complications, such as perforation of the dura mater, epidural hematomas (due to lesions of vessels from the needle and catheter), patchy blocks, low back pain and air venous embolisms [2,29–34].

To the best of our knowledge, a systematic synthesis of randomized controlled trial (RCT) data comparing more commonly-used versus less commonly-used methods in the LOR technique in terms of their efficacy and associated complications has not been conducted. As such, the purpose of this systematic review was to evaluate the efficacy and safety of more commonly-used methods (i.e. air or saline, or both) versus less commonly-used methods (e.g. epidrum, lidocaine, acoustic device, Macintosh balloon) in the LOR technique for identification of the epidural space.

2. Materials and methods

The Cochrane Handbook for Intervention Reviews [35] guided our choice of methods. This systematic review of the literature on interventional studies was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) statement [36].

2.1. Eligibility criteria

We considered all RCTs and quasi-RCTs evaluating one or more commonly-used methods (i.e. air or saline, or both) versus one or more less commonly-used methods, such as epidrum, lidocaine, acoustic device, Macintosh balloon, or the combination of a commonest methods with a not widely used today device (e.g. air and lidocaine), in the LOR technique for identification of the epidural space.

Eligible studies reported one or more of the following: a) inability to locate the epidural space, defined as inability to identify the epidural space and/or unintentional dural puncture by epidural needle; b) accidental intravascular catheter placement and/or accidental subarachnoid catheter placement; c) unblocked segments; d) inadvertent dural puncture; e) adverse events, such as headache or migraine, neck pain, subcutaneous emphysema, difficulty in advancing the catheter, hypotension,

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