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A systematic review of DURAL puncture epidural analgesia for labor☆

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ABSTRACT

Study objective: This systematic review aimed to summarize the evidence derived from randomized controlled trials (RCTs) comparing dural puncture epidural analgesia (DPEA) and conventional lumbar epidural analgesia (LEA) for women undergoing labor.
Interventions: The MEDLINE and EMBASE databases were searched from inception to July 2018 in order to find RCTs published in the English language, which investigated DPEA in laboring women.
Main results: Six RCTs were included in the final analysis. Their collective results remain ambiguous. Dural puncture with small (i.e., 26- or 27-gauge) spinal needles seems to confer either minimal benefits or improved analgesic quality and lower pain scores in the first 10 min. Dural puncture with 25-gauge spinal needles has been reported to provide higher success rate than conventional LEA in one trial; however two other studies could only agree on the fact that DPEA results in improved sacral blockade and fewer unilateral blocks compared to LEA.
Conclusions: The current evidence regarding DPEA for labor analgesia remains ambiguous. Future research should investigate the optimal (spinal) needle size for dural puncture as well as factors governing transmeningeal flux of local anesthetics and opioids in the presence of a dural hole.

1. Introduction

Labor constitutes one of the most painful events experienced by women during their lifetime [1]. Although lumbar epidural analgesia (LEA) is commonly used [2], various strategies have been proposed to improve its efficacy. The most popular one remains combined spinal-epidural analgesia (CSEA), which involves the administration of intrathecal local anesthetic (LA) through a spinal needle prior to the placement of an epidural catheter [3]. The benefits of CSEA include shorter onset time, decreased motor blockade, and more reliable analgesia [3]. Unfortunately, CSEA is afflicted with many potential side effects. For instance, the expedetious pain relief and its attendant decrease in maternal catecholamine levels can lead to uterine hypertonus and nonreassuring fetal heart rate tracings [4]. Furthermore, the intrathecal LA injection may obscure the response of the test dose used to exclude inadvertent subarachnoid placement of the epidural catheter [5,6].

In 1996, Suzuki et al. [5] proposed dural puncture epidural analgesia (DPEA) as a means to retain the benefits of CSEA while avoiding its drawbacks. With DPEA, the operador inserts a spinal needle through the epidural needle in order to puncture the dura. However no LA is injected into the subarachnoid space. Instead, the spinal needle is withdrawn after the "dry" dural puncture and a catheter is placed inside the epidural space. Purported advantages conferred by DPEA stem from more efficient flux of LA and opioid from the epidural to the intrathecal space [5]. In recent years, DPEA has been increasingly used to provide labor analgesia [7]. However, in light of contradictory findings [6,8], its benefits remain unproven. Thus, in this systematic review article, we set out to summarize the level 1 evidence (derived from randomized trials) comparing DPEA and LEA for women undergoing labor.

2. Methods

The final literature search for this review article was conducted by two co-authors (SL and DQT) during the last week of July 2018, using the MEDLINE (January 1966 to July 2018) and EMBASE (January 1980 to July 2018) databases. Since "dural puncture epidural" does not exist as a MESH term, it was queried as keywords. Only randomized controlled trials (RCTs) pertaining to obstetrical patients and published in the English language were retained for analysis. No RCTs were excluded based on factors such as definition of intervention allocation or primary and secondary outcomes. However, non-randomized trials and

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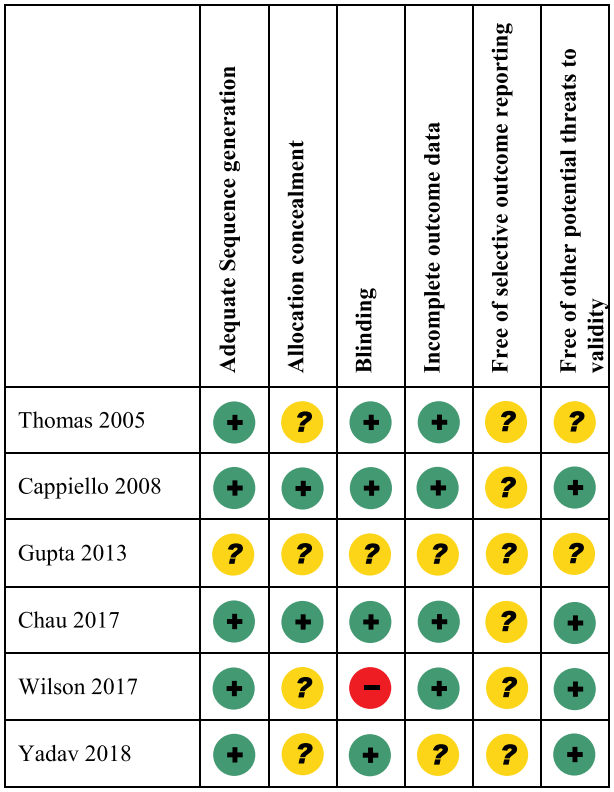

Fig. 1. Risk of bias summary of randomized controlled trials pertaining to dural puncture epidural analgesia for labor.

observational studies were discarded to avoid potential biases introduced by institutional practices. After selecting the initial articles, we perused their respective reference lists for additional material.

Data extraction was carried out by coauthors SL, JA and DQT. Information recorded included the year of publication, the method of randomization, the study's sample size, the presence of blinded assessment, the definition of the primary outcome, sample size justification, and trial registration. All data entry was then confirmed and verified by the four coauthors.

For each trial, validity was further explored by using the Cochrane Database Tool for assessing risk of bias (Figs. 1 and 2). Relevant information was collected by two coauthors (DB and SL). Six domains were evaluated including: adequacy of sequence generation; allocation concealment; blinding; how incomplete outcome data was addressed; selective outcome reporting; and other sources of bias (e.g., study design issues, early trial termination, baseline imbalance in study groups). Subsequently, each domain result was categorized as "yes" (green i.e., low risk of bias) "no" (red i.e., high risk of bias) and "unclear" (yellow i.e., unknown risk of bias).

3. Results

Our search criteria yielded six RCTs [6,8–12] (Table 1). Their Jadad scores ranged from 3 to 5 points (median score = 4 points). The average [range] patient enrollment in each trial was 107 [60–230] subjects. Trial registration, sample size justification and blinded assessment were implemented in 2 (33%), 6 (100%) and 4 (67%) RCTs, respectively. To date, trials investigating DPEA for labor have used three needle sizes for dural puncture: 27-, 26-, and 25-gauge.

3.1. Dural puncture epidural analgesia with a 27-gauge spinal needle

Two RCTs (combined $n = 290$) have compared LEA to DPEA using 27-gauge Whitacre spinal needles [6,8]. In the first trial (2005), Thomas et al. [6] randomized 230 parturients to DPEA versus LEA. In both groups, the epidural catheter was first bolused with a combined total of 10 mL of lidocaine 2% and then infused with 10 mL/h of bupivacaine 0.11%-fentanyl 2 μg/mL (with an additional 5 mL each 10 min PRN). These authors observed similar rates of catheter manipulation (28–37%) during labor. Furthermore, there were no intergroup differences in terms of sacral root sparing, unilateral block, peak block level, number of top-up doses, LA consumption, quality of analgesia, duration of labor, and mode of delivery [6]. In the second trial (2018), Yadav et al. [8] elected to bolus their 60 subjects with repeated top-ups of 10 mL of ropivacaine 0.2%-fentanyl 2 μg/mL. They reported lower visual analog scale (VAS) scores at 5 and 10 min with DPEA (both $P \leq 0.008$). Furthermore, the onset time (i.e. time to reach a VAS score < 3) and quality of analgesia were also improved with DPEA (both $P < 0.05$). However no intergroup differences were found in terms of the duration of the initial LA bolus, time to first top-up request, LA consumption, duration of labor, and incidence of Cesarean delivery [8].

3.2. Dural puncture epidural analgesia with a 26-gauge spinal needle

To date, only one RCT ($n = 80$) has compared LEA and DPEA using 26-gauge Whitacre needles. In 2017, Wilson et al. [9] randomized 80 patients with labor pain equal or exceeding a VAS score of 50 mm (on a

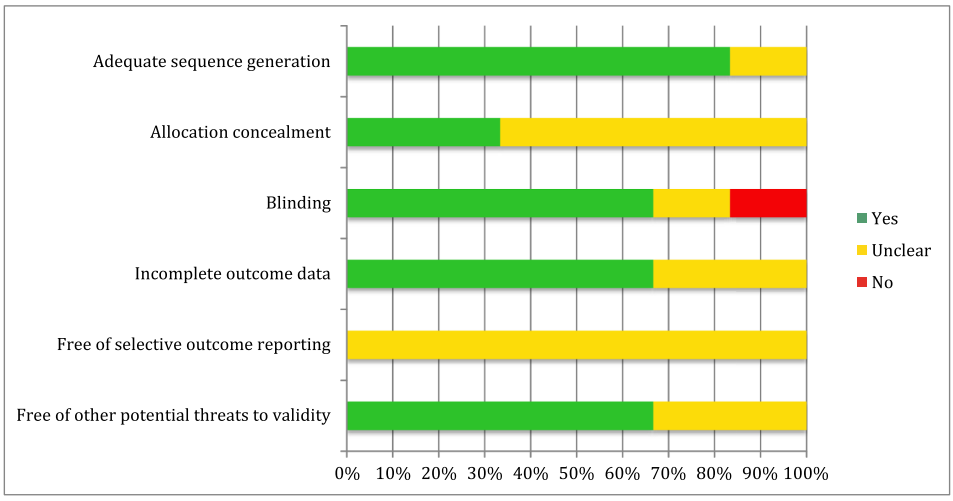

Fig. 2. Risk of bias graph of randomized controlled trials pertaining to dural puncture epidural analgesia for labor.