

World Journal of *Clinical Cases*

World J Clin Cases 2022 July 16; 10(20): 6759-7186



OPINION REVIEW

- 6759 Semaglutide might be a key for breaking the vicious cycle of metabolically associated fatty liver disease spectrum?
Cigrovski Berkovic M, Rezic T, Bilic-Curcic I, Mrzljak A

MINIREVIEWS

- 6769 Drainage of pancreatic fluid collections in acute pancreatitis: A comprehensive overview
Bansal A, Gupta P, Singh AK, Shah J, Samanta J, Mandavdhare HS, Sharma V, Sinha SK, Dutta U, Sandhu MS, Kochhar R
- 6784 Frontiers of COVID-19-related myocarditis as assessed by cardiovascular magnetic resonance
Luo Y, Liu BT, Yuan WF, Zhao CX

ORIGINAL ARTICLE**Case Control Study**

- 6794 Urinary and sexual function changes in benign prostatic hyperplasia patients before and after transurethral columnar balloon dilatation of the prostate
Zhang DP, Pan ZB, Zhang HT
- 6803 Effects of the information-knowledge-attitude-practice nursing model combined with predictability intervention on patients with cerebrovascular disease
Huo HL, Gui YY, Xu CM, Zhang Y, Li Q

Retrospective Cohort Study

- 6811 Effects of Kampo medicine hangebyakujutsutemmato on persistent postural-perceptual dizziness: A retrospective pilot study
Miwa T, Kanemaru SI

Retrospective Study

- 6825 Longitudinal changes in personalized platelet count metrics are good indicators of initial 3-year outcome in colorectal cancer
Herold Z, Herold M, Lohinszky J, Szasz AM, Dank M, Somogyi A
- 6845 Efficacy of Kegel exercises in preventing incontinence after partial division of internal anal sphincter during anal fistula surgery
Garg P, Yagnik VD, Kaur B, Menon GR, Dawka S

Observational Study

- 6855 Influence of the water jet system vs cavitron ultrasonic surgical aspirator for liver resection on the remnant liver
Hanaki T, Tsuda A, Sunaguchi T, Goto K, Morimoto M, Murakami Y, Kihara K, Matsunaga T, Yamamoto M, Tokuyasu N, Sakamoto T, Hasegawa T, Fujiwara Y

- 6865** Critical values of monitoring indexes for perioperative major adverse cardiac events in elderly patients with biliary diseases

Zhang ZM, Xie XY, Zhao Y, Zhang C, Liu Z, Liu LM, Zhu MW, Wan BJ, Deng H, Tian K, Guo ZT, Zhao XZ

- 6876** Comparative study of surface electromyography of masticatory muscles in patients with different types of bruxism

Lan KW, Jiang LL, Yan Y

Randomized Controlled Trial

- 6890** Dural puncture epidural technique provides better anesthesia quality in repeat cesarean delivery than epidural technique: Randomized controlled study

Wang SY, He Y, Zhu HJ, Han B

SYSTEMATIC REVIEWS

- 6900** Network pharmacology-based strategy for predicting therapy targets of Sanqi and Huangjing in diabetes mellitus

Cui XY, Wu X, Lu D, Wang D

META-ANALYSIS

- 6915** Endoscopic submucosal dissection for early signet ring cell gastric cancer: A systematic review and meta-analysis

Weng CY, Sun SP, Cai C, Xu JL, Lv B

- 6927** Prognostic value of computed tomography derived skeletal muscle mass index in lung cancer: A meta-analysis

Pan XL, Li HJ, Li Z, Li ZL

CASE REPORT

- 6936** Autosomal dominant osteopetrosis type II resulting from a *de novo* mutation in the *CLCN7* gene: A case report

Song XL, Peng LY, Wang DW, Wang H

- 6944** Clinical expression and mitochondrial deoxyribonucleic acid study in twins with 14484 Leber's hereditary optic neuropathy: A case report

Chuenkongkaew WL, Chinkulkitnivat B, Lertrit P, Chirapapaisan N, Kaewsutthi S, Suktitipat B, Mitrpant C

- 6954** Management of the enteroatmospheric fistula: A case report

Cho J, Sung K, Lee D

- 6960** Lower lip recurrent keratoacanthoma: A case report

Liu XG, Liu XG, Wang CJ, Wang HX, Wang XX

- 6966** Optic disc coloboma associated with macular retinoschisis: A case report

Zhang W, Peng XY

- 6974** A 7-year-old boy with recurrent cyanosis and tachypnea: A case report
Li S, Chen LN, Zhong L
- 6981** Schwannomatosis patient who was followed up for fifteen years: A case report
Li K, Liu SJ, Wang HB, Yin CY, Huang YS, Guo WT
- 6991** Intentional replantation combined root resection therapy for the treatment of type III radicular groove with two roots: A case report
Tan D, Li ST, Feng H, Wang ZC, Wen C, Nie MH
- 6999** Clinical features and genetic variations of severe neonatal hyperbilirubinemia: Five case reports
Lin F, Xu JX, Wu YH, Ma YB, Yang LY
- 7006** Percutaneous transhepatic access for catheter ablation of a patient with heterotaxy syndrome complicated with atrial fibrillation: A case report
Wang HX, Li N, An J, Han XB
- 7013** Secondary positioning of rotationally asymmetric refractive multifocal intraocular lens in a patient with glaucoma: A case report
Fan C, Zhou Y, Jiang J
- 7020** Laparoscopic repair of diaphragmatic hernia associating with radiofrequency ablation for hepatocellular carcinoma: A case report
Tsunoda J, Nishi T, Ito T, Inaguma G, Matsuzaki T, Seki H, Yasui N, Sakata M, Shimada A, Matsumoto H
- 7029** Hypopituitary syndrome with pituitary crisis in a patient with traumatic shock: A case report
Zhang XC, Sun Y
- 7037** Solitary plasmacytoma of the left rib misdiagnosed as angina pectoris: A case report
Yao J, He X, Wang CY, Hao L, Tan LL, Shen CJ, Hou MX
- 7045** Secondary coronary artery ostial lesions: Three case reports
Liu XP, Wang HJ, Gao JL, Ma GL, Xu XY, Ji LN, He RX, Qi BYE, Wang LC, Li CQ, Zhang YJ, Feng YB
- 7054** Bladder perforation injury after percutaneous peritoneal dialysis catheterization: A case report
Shi CX, Li ZX, Sun HT, Sun WQ, Ji Y, Jia SJ
- 7060** Myotonic dystrophy type 1 presenting with dyspnea: A case report
Jia YX, Dong CL, Xue JW, Duan XQ, Xu MY, Su XM, Li P
- 7068** Novel mutation in the *SALL1* gene in a four-generation Chinese family with uraemia: A case report
Fang JX, Zhang JS, Wang MM, Liu L
- 7076** Malignant transformation of primary mature teratoma of colon: A case report
Liu J

- 7082** Treatment of pyogenic liver abscess by surgical incision and drainage combined with platelet-rich plasma: A case report
Wang JH, Gao ZH, Qian HL, Li JS, Ji HM, Da MX
- 7090** Left bundle branch pacing in a ventricular pacing dependent patient with heart failure: A case report
Song BX, Wang XX, An Y, Zhang YY
- 7097** Solitary fibrous tumor of the liver: A case report and review of the literature
Xie GY, Zhu HB, Jin Y, Li BZ, Yu YQ, Li JT
- 7105** MutL homolog 1 germline mutation c.(453+1_454-1)_(545+1_546-1)del identified in lynch syndrome: A case report and review of literature
Zhang XW, Jia ZH, Zhao LP, Wu YS, Cui MH, Jia Y, Xu TM
- 7116** Malignant histiocytosis associated with mediastinal germ cell tumor: A case report
Yang PY, Ma XL, Zhao W, Fu LB, Zhang R, Zeng Q, Qin H, Yu T, Su Y
- 7124** Immunoglobulin G4 associated autoimmune cholangitis and pancreatitis following the administration of nivolumab: A case report
Agrawal R, Guzman G, Karimi S, Giulianotti PC, Lora AJM, Jain S, Khan M, Boulay BR, Chen Y
- 7130** Portal vein thrombosis in a noncirrhotic patient after hemihepatectomy: A case report and review of literature
Zhang SB, Hu ZX, Xing ZQ, Li A, Zhou XB, Liu JH
- 7138** Microvascular decompression for a patient with oculomotor palsy caused by posterior cerebral artery compression: A case report and literature review
Zhang J, Wei ZJ, Wang H, Yu YB, Sun HT
- 7147** Topical halometasone cream combined with fire needle pre-treatment for treatment of primary cutaneous amyloidosis: Two case reports
Su YQ, Liu ZY, Wei G, Zhang CM
- 7153** Simultaneous robot-assisted approach in a super-elderly patient with urothelial carcinoma and synchronous contralateral renal cell carcinoma: A case report
Yun JK, Kim SH, Kim WB, Kim HK, Lee SW
- 7163** Nursing a patient with latent autoimmune diabetes in adults with insulin-related lipodystrophy, allergy, and exogenous insulin autoimmune syndrome: A case report
He F, Xu LL, Li YX, Dong YX
- 7171** Incidental diagnosis of medullary thyroid carcinoma due to persistently elevated procalcitonin in a patient with COVID-19 pneumonia: A case report
Saha A, Mukhopadhyay M, Paul S, Bera A, Bandyopadhyay T
- 7178** Macular hole following phakic intraocular lens implantation: A case report
Li XJ, Duan JL, Ma JX, Shang QL

LETTER TO THE EDITOR

7184 Is every microorganism detected in the intensive care unit a nosocomial infection? Isn't prevention more important than detection?

Yildirim F, Karaman I, Yildirim M

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Jie-Feng Huang, PhD, Associate Chief Physician, Associate Professor, Department of Orthopaedics and Traumatology, The First Affiliated Hospital of Zhejiang Chinese Medical University, Hangzhou 310006, Zhejiang Province, China. 40983285@qq.com

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The *WJCC* is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2021 Edition of Journal Citation Reports® cites the 2020 impact factor (IF) for *WJCC* as 1.337; IF without journal self cites: 1.301; 5-year IF: 1.742; Journal Citation Indicator: 0.33; Ranking: 119 among 169 journals in medicine, general and internal; and Quartile category: Q3. The *WJCC*'s CiteScore for 2020 is 0.8 and Scopus CiteScore rank 2020: General Medicine is 493/793.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Hua-Ge Yan*; Production Department Director: *Xu Guo*; Editorial Office Director: *Jin-Lei Wang*.

NAME OF JOURNAL

World Journal of Clinical Cases

ISSN

ISSN 2307-8960 (online)

LAUNCH DATE

April 16, 2013

FREQUENCY

Thrice Monthly

EDITORS-IN-CHIEF

Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/2307-8960/editorialboard.htm>

PUBLICATION DATE

July 16, 2022

COPYRIGHT

© 2022 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/gerinfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/gerinfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/gerinfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>

Randomized Controlled Trial

Dural puncture epidural technique provides better anesthesia quality in repeat cesarean delivery than epidural technique: Randomized controlled study

Sheng-You Wang, Yan He, Hai-Juan Zhu, Bo Han

Specialty type: Anesthesiology**Provenance and peer review:**

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind**Peer-review report's scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): 0

Grade C (Good): C

Grade D (Fair): D

Grade E (Poor): 0

P-Reviewer: Sabouri AS, United States; Simionescu AA, Romania**Received:** November 23, 2021**Peer-review started:** November 23, 2021**First decision:** January 22, 2022**Revised:** February 3, 2022**Accepted:** May 16, 2022**Article in press:** May 16, 2022**Published online:** July 16, 2022**Sheng-You Wang, Hai-Juan Zhu, Bo Han**, Department of Anesthesiology, Hefei Maternal and Child Health Care Hospital, Hefei 230001, Anhui Province, China**Sheng-You Wang, Hai-Juan Zhu, Bo Han**, Department of Anesthesiology, Maternal and Child Health Care Hospital of Anhui Medical University, Hefei 230001, Anhui Province, China**Yan He**, Department of Anesthesiology, Wannan Medical College, Wuhu 241002, Anhui Province, China**Corresponding author:** Bo Han, MD, Chief Doctor, Department of Anaesthesiology, Anhui Maternal and Child Health Care Hospital, No. 15 Yimin Street, Hefei 230001, Anhui Province, China. 454379626@qq.com

Abstract

BACKGROUND

Repeat cesarean deliveries involve a longer surgery and more severe visceral traction than primary cesarean deliveries. The dural puncture epidural (DPE) technique provides faster and more effective analgesia for labor, but there is no sufficient evidence to indicate whether it is suitable for parturients undergoing repeat cesarean delivery.

AIM

To determine the efficacy and safety of the DPE anesthesia technique in patients undergoing repeat cesarean delivery.

METHODS

Patients undergoing repeat cesarean delivery were randomly divided into the DPE and epidural anesthesia (EA) groups. A 25-G spinal needle was used for dural puncture *via* a 19-G epidural needle. The patients in the two groups were injected with 5 mL of 2% lidocaine followed by 15 mL of a mixture of 1% lidocaine + 0.5% ropivacaine as the epidural dosage. The primary outcome was the onset time of sensory block to the T6 dermatome level and the sensory and motor block degree.

RESULTS

A total of 115 women were included (EA: 57, DPE: 58). The mean time to sensory

block to the T6 Level was significantly shorter in the DPE group than in the EA group (14.7 min *vs* 16.6 min; 95% confidence interval, 13.9 to 15.4 *vs* 15.8 to 17.4; $P = 0.001$). The cranial sensory block level was significantly higher at 5, 10, and 15 min after the initial dose in the DPE group than in the EA group ($P < 0.05$). The sacral sensory block level was significantly higher and the modified bromage score was significantly lower in the DPE group at each time point ($P < 0.05$). Adverse effects and neonatal outcomes were comparable between the two groups ($P > 0.05$).

CONCLUSION

The DPE technique provided higher-quality anesthesia than the EA technique, with a rapid onset of surgical anesthesia, better cranial and sacral sensory block spread and a higher motor block degree, without increasing the incidence of maternal or fetal side effects in patients undergoing repeat cesarean delivery.

Key Words: Parturients; Repeat cesarean delivery; Epidural; Dural puncture epidural; Anesthesia; Onset time

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: This study aimed to explore a comparatively superior anesthesia technique for repeat cesarean delivery. The dural puncture epidural (DPE) anesthesia technique with 1% lidocaine combined with 0.5% ropivacaine provided higher-quality anesthesia than the epidural anesthesia (EA) technique, with a faster onset of surgical anesthesia, better cranial and sacral sensory block spread and a higher motor block degree, without increasing the incidence of maternal or fetal side effects, in patients undergoing repeat cesarean delivery. The DPE anesthesia technique might be a preferable anesthesia scheme over the EA technique.

Citation: Wang SY, He Y, Zhu HJ, Han B. Dural puncture epidural technique provides better anesthesia quality in repeat cesarean delivery than epidural technique: Randomized controlled study. *World J Clin Cases* 2022; 10(20): 6890-6899

URL: <https://www.wjgnet.com/2307-8960/full/v10/i20/6890.htm>

DOI: <https://dx.doi.org/10.12998/wjcc.v10.i20.6890>

INTRODUCTION

As one of the most common surgeries worldwide, the rate of cesarean delivery (CD) increases year by year[1]. According to the data, the rate of CD is 32%-33% in the United States and 55% to 85% in other highly populated countries[2]. The vast majority of women with a history of CD prefer repeat CD (RCD) when they give birth again[3]. RCD is known to be associated with greater operative difficulties, a longer surgery and more severe visceral traction due to severe intra-abdominal adhesion[4,5] or invasive placentation[6]. The incidence of intra-abdominal adhesion development after primary CD ranges from 46%-65% and increases to 43% to 75% at the third CD and to 83% at the fourth CD[7,8]. The rate of placenta accreta spectrum disorders have been reported to reach up to 2.1% along with the increase in elective RCD[6].

Spinal anesthesia is the most commonly used anesthesia technique for cesarean delivery due to its rapid onset and excellent sensory and motor blockade[9]. However, in some cases of severe adhesions and placental implantation, the action time of spinal anesthesia is not sufficient to meet the requirements of longer surgeries, and combined spinal-epidural (CSE) or epidural anesthesia (EA) should be performed[2]. Although CSE technology can meet the needs of prolonged surgery, it is associated with a high incidence of hypotension, similar to spinal anesthesia, which might lead to adverse maternal and fetal outcomes[9-11]. The EA technique has fewer adverse effects but is associated with a slow onset and a certain degree of failure, such as inadequate sacral spread or unilateral or patchy sensory blockade [12].

The dural puncture epidural (DPE) technique is a modification of the CSE technique that was first described for use in nonobstetric surgical patients in 1996 by Suzuki *et al*[13] and was subsequently applied by other investigators in obstetric patients[14]. It is performed by creating a perforation in the dura mater using a spinal needle (25-27 G) through the shaft of an epidural needle[15]. After the dural perforation is created and the free flow of cerebrospinal fluid (CSF) is confirmed, the spinal needle is withdrawn without local anesthetic injection into the subarachnoid space. The epidural catheter is normally placed in the epidural space, and local anesthetic is injected into the epidural space *via* the epidural catheter. The dural puncture creates a conduit for translocation of the local anesthetic from the epidural to the subarachnoid space, which is a unique characteristic of the DPE technique[13]. Studies

have shown that compared with standard EA, DPE can provide higher-quality analgesia and lower pain scores in the first 10 min, with a lower rate of unilateral block for labor analgesia, with lower dosages of analgesic drugs, and without adverse maternal or fetal effects[14,16-18]. DPE has also been shown to result in improved anesthetic spread and better sacral blockade than EA in lower abdominal surgery[13] and in morbidly obese parturients undergoing CD[19]. However, limited evidence is available regarding the efficacy and safety of the DPE technique in RCD.

Therefore, we designed this double-blind, prospective, randomized trial to compare the DPE and EA techniques in elective RCD and aimed to explore whether DPE is suitable for anesthesia in RCD. The primary outcome was the onset time of anesthesia and the sensory and motor block levels.

MATERIALS AND METHODS

Study design

This study was approved by the Ethics Committee of Hefei Maternal and Child Health Care Hospital of Anhui Province (No. YYLL2020-15-01) in accordance with the Declaration of Helsinki (1964), and all the patients signed the informed consent form. The study was registered prior to subject enrollment with the Chinese Clinical Trial Registry (Available from: www.chictr.org.cn; identification number is ChiCTR2100050266) with minor revision of the title and collected indicators. This manuscript adheres to the applicable CONSORT 2010 guidelines.

From January 2020 to September 2021, a total of 120 parturients at Hefei Maternal and Child Health Care Hospital of Anhui Province who were scheduled to undergo RCD with a lower uterine segment transverse incision were recruited for this study. Healthy pregnant women with an American Society of Anesthesiologists (ASA) physical status of I or II, age of 23-34 years, weight of 57-83 kg, height of 155-168 cm and a singleton fetus with cephalic presentation at 38-42 wk of gestational age were eligible. We excluded subjects with complications during pregnancy (*e.g.*, gestational hypertension, preeclampsia, or diabetes), neurological diseases, contraindications to neuraxial anesthesia, or known fetal anomalies.

The study was designed as a double-blind, prospective, randomized controlled trial. Patients were allocated to one of two groups using a computer-generated random-number sheet (EA and DPE, $n = 60$ in each group). The random-number sheet was placed into a sealed envelope and was opened after the initiation of patient enrollment. Two anesthesiologists were involved in the anesthesia procedure to maintain blinding. One anesthesiologist performed the neuraxial anesthesia procedure, while the other anesthesiologist was responsible for anesthesia management and data collection; the latter anesthesiologist remained outside the operating room until the neuraxial anesthesia procedure was completed. The parturients were also blinded to the type of neuraxial procedure.

Anesthetic procedure

After the participant entered the room, peripheral venous access was secured using an 18-G intravenous (IV) cannula, standard monitoring including electrocardiography, noninvasive arterial blood pressure, oxygen saturation (SPO₂) and heart rate (HR) monitoring was applied, and 500 mL of lactated Ringer's solution was infused within 30 min before surgery. The obstetricians monitored the fetal HR before and after the neuraxial procedure to ensure that the fetal HR was in the normal range.

All neuraxial procedures were performed by a senior anesthesiologist at the L2-3 interspace with the patient in the left lateral decubitus position. The epidural space was accessed with a 19-G epidural needle and confirmed by the loss of resistance to saline. After confirming the epidural space, a stainless steel multiorifice epidural catheter was inserted 4 cm into the epidural space toward the cranial side in the EA group. In the DPE group, a 25-G Whitacre needle was used for dural puncture through the epidural needle with confirmation of free CSF flow. Then, the spinal needle was removed, and a stainless steel multiorifice epidural catheter was placed 4 cm into the epidural space toward the cranial side, as in the EA group. Then, patients in both groups were placed in the supine position and received oxygen at 5 L/min. After negative aspiration of CSF and blood, 5 mL of 2% lidocaine hydrochloride (excluding adrenaline) was injected as the test dose. If abnormal signs were not observed five min later, 15 mL of the mixture of 1% lidocaine + 0.5% ropivacaine (the mixture consisted of 10 mL of 2% lidocaine and 10 mL of 1% ropivacaine) was injected at a rate of 0.5 mL/s. The sensory block level was measured by acupuncture every 5 min. Surgery was allowed after the sensory block level reached the T6 dermatome. To prevent hypotension due to the supine position, the right side of the lower back was elevated with a lumbar cushion to incline 20 degrees to the left. If systolic blood pressure < 90 mmHg or mean arterial pressure < 60 mmHg, 8 µg of phenylephrine was given intravenously. If HR < 60 beats/min, 0.25 mg of atropine was given intravenously. In the case of a chill reaction, 10 mg of nalbuphine was given after the fetus was delivered. In the case of dyspnea, the assessment plan was applied, followed by mask oxygen inhalation or tracheal intubation as appropriate to improve respiratory function. If the patient complained of discomfort during the procedure, supplemental analgesics were administered by the anesthesiologist.

Data collection

The primary outcome was the onset time of surgical anesthesia, which was defined as the time from the end of the initial dose to when the sensory block level reached the T6 dermatome[20]. Additional outcomes included the cranial and sacral sensory block levels, as well as the motor block degree. The sensory block levels were determined by acupuncture at 5 min, 10 min, 15 min, and 20 min after drug injection and 5 min after surgery. The motor block degree was assessed at the same timepoints using the modified bromage classification (grade 0: No motor nerve block; 1: Cannot lift leg; 2: Cannot bend knee; 3: Cannot bend the ankle)[20].

The secondary outcomes were the number of patients with cranial sensory block to the T6 Level, the number of patients with a modified bromage score reaching 3 at 15 min, intraoperative IV analgesic supplementation, the local anesthetic volume, the incidence of vasopressor administration and general intraoperative data. We also recorded the incidence of side effects, such as chills, hypotension, and postoperative headache, as well as neonatal outcomes, including the appearance, pulse, grimace, activity, and respiration (Apgar) score.

Statistical analysis

Sample size calculation: Based on the preliminary data, the mean onset time was 17.5 min in the EA group and 15.42 min in the DPE group, with standard deviations (SD) of 2.61 and 3.34, respectively. For a power of 90% and two-sided statistical significance set at 0.05, the minimum sample size calculated by G*Power (Version 3.1) was 47 patients in each group[21]. To compensate for a dropout rate of 20%, 60 patients were recruited for each group.

Data validation and analysis were carried out by SPSS for version 23.0 (IBM Corp., Armonk, NY, United States). The primary outcome, *i.e.*, onset time of T6 sensory block, is presented as the 95% confidence interval (CI) around the difference in group means and was compared *via* the Mann-Whitney U test. Measurement data with a normal distribution are expressed as the mean \pm SD and were analyzed by the Student's t test. Nonnormally distributed data are expressed as the median (interquartile range) and were compared using the Mann-Whitney U test. The Chi-square test or Fisher's exact test was used to compare categorical data. Repeated measurement data, including sensory block levels and motor block scores, were assessed longitudinally between groups with linear mixed modeling using the restricted maximum likelihood method and accounting for patient-level clustering (random intercept) under an unstructured model. Adjusted Bonferroni correction was used for multiple comparisons between groups at each timepoint. $P < 0.05$ was considered to indicate a statistically significant difference.

RESULTS

From January 2020 to September 2021, 120 subjects were recruited and randomized into the groups. Five participants were excluded due to unilateral block or accidental dural rupture with an epidural needle and were converted to general anesthesia or spinal anesthesia. Thus, data were collected from 115 subjects (Figure 1). The demographic data, including age, height, weight, body mass index, gestational weeks, hematocrit, operation time, and ASA class, were comparable between the two groups ($P > 0.05$, Table 1).

Primary outcome

The mean time to achieve a bilateral sensory block to the T6 dermatome level was 14.7 min in the DPE group (95%CI, 13.9-15.4) and 16.6 min (95%CI, 15.8-17.4) in the EA group (Table 2). The mean difference in the onset time of sensory blockade between the two groups was 1.9 min (95%CI for the difference: -5.0 to 0.0, $P = 0.001$, Table 2).

Table 3 presents the sensory block levels and modified bromage motor block scores at different time points after the initial dosage. The sensory block level on the cranial side was significantly higher at 5 min, 10 min and 15 min after the initial dose in the DPE group than in the EA group ($P < 0.05$). The sensory block level on the sacral side was significantly lower in the DPE group than in the EA group at each time point ($P < 0.05$). The modified bromage motor block score was significantly higher in the DPE group than in the EA group at each time point ($P < 0.05$).

Secondary outcomes

The maximum sensory block level in both groups was T5 ($P = 0.303$). The number of patients with cranial sensory block to the T6 Level at 15 min was 30 in the EA group and 54 in the DPE group (52.6% *vs* 93.1%, $P < 0.001$). The number of patients with a modified bromage score reaching 3 at 15 min was 21 in the EA group and 45 in the DPE group (36.8% *vs* 77.6%, $P < 0.001$).

Sixteen subjects in the EA group and seven in the DPE group complained of pain during surgery and required intraoperative IV analgesic supplementation (28.1% *vs* 12.1%, $P = 0.032$, Table 2). There were no significant differences in terms of vasopressor administration, local anesthetic volume, fluid administration, estimated blood loss, duration of surgery, urine output, neonatal outcomes or adverse effects (P

Table 1 Demographic data in the two groups

	EA (n = 57)	DPE (n = 58)	Z/t/ χ^2	95%CI of difference	P value
Age (yr)	28.0 (26.0-30.0)	28.0 (25.0-30.0)	0.766	-1.0, 1.0	0.443 ²
Height (cm)	159.7 ± 3.8	160.6 ± 4.2	1.159	-2.4, 0.6	0.249 ¹
Weight (kg)	73.0 (69.5-75.0)	73.5 (71.8-76.0)	1.622	-3.3, 0.2	0.105 ²
BMI (kg/m ²)	28.2 ± 1.9	28.5 ± 1.7	0.981	-1.0, 0.3	0.329 ²
Gestational age (w)	39.8 ± 1.1	39.5 ± 1.1	1.450	-0.1, 0.7	0.150 ¹
Hb (g/l)	116.7 ± 8.5	117.0 ± 8.3	0.223	-3.5, 2.8	0.824 ¹
HCT (%)	35.4 ± 2.3	35.0 ± 2.2	0.782	-0.5, 1.2	0.436 ¹
ASA physical status					
Class 1	6 (10.5)	10 (17.2)	1.082	0.1, 1.7	0.298 ³
Class 2	51 (89.5)	48 (82.8)			

¹Student's t test.

²Mann-Whitney U test.

³Chi-square test.

Values are expressed as n (%), mean ± SD, or median (interquartile range). P < 0.05 is present to be significant. ASA: American Society of Anesthesiologists; BMI: Body mass index; Hb: Hemoglobin; HCT: Hematocrit; CI: Confidence interval; DPE: Dural puncture epidural; EA: Epidural analgesia.

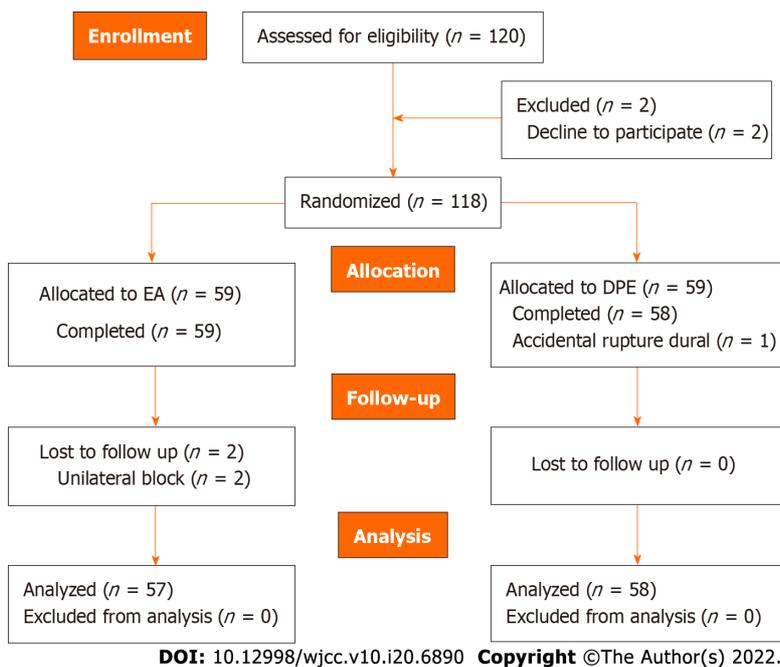


Figure 1 CONSORT flow diagram. All 120 parturients undergoing repeat cesarean delivery were recruited and assigned to one of two groups. DPE: Dural puncture epidural; EA: Epidural analgesia.

> 0.05, Table 2).

DISCUSSION

The main finding of this study was that the onset of surgical anesthesia was faster with the DPE technique than the standard EA technique. The DPE technique provided higher-quality anesthesia than the EA technique, with superior cranial and sacral coverage and a higher motor block degree, without increasing the incidence of side effects.

EA is a popular and safe technique and has a sufficient duration of action for RCD. However, it has the drawback of a long onset time and limited anesthesia plane spread, and IV rescue analgesia is often

Table 2 Details of anesthesia, adverse effects, and neonatal outcomes

	EA (n = 57)	DPE (n = 58)	Z/t/ χ^2	95%CI of difference	P value
The onset time to T6 level (min)	16.6 (15.8-17.4)	14.7 (13.9-15.4)	4.039	-5.0, 0.0	0.001 ²
Maximum sensory level (T)	5 (4-6)	5 (4-5)	1.120	0.0, 1.0	0.263 ³
Modified bromage score to 3, n (%)	21 (36.8)	45 (77.6)	19.516	2.6, 13.5	< 0.001
Cranial sensory block to T6, n (%)	30 (52.6)	54 (93.1)	23.915	3.8, 38.0	< 0.001
Vasopressor administration, n (%)	6 (10.5)	9 (15.5)	0.631	0.5, 4.7	0.427 ³
Intraoperative IV analgesic supplementation, n (%)	16 (28.1)	7 (12.1)	4.600	0.1, 0.9	0.032 ³
Local anesthetic volume (ml)	20.0 (17.5-20.0)	20.0 (15.0-20.0)	0.429	0.0, 0.0	0.668 ²
Fluid administration (ml)	800.0 (750.0-800.0)	800.0 (700.0-800.0)	0.806	0.0, 0.0	0.424 ²
Estimated blood loss (ml)	400.0 (400.0-400.0)	400.0 (300.0-400.0)	1.548	0.0, 0.0	0.122 ²
Duration of surgery (min)	37.4 ± 8.3	36.3 ± 6.3	0.746	-3.7, 1.7	0.457 ¹
Urine output (ml)	100.0 (100.0-150.0)	100.0 (100.0-150.0)	0.248	0.0, 0.0	0.804 ²
Adverse effects, n (%)					
Hypotension	5 (8.8)	2 (3.5)	1.425	0.1, 2.0	0.422 ³
Respiratory depression	0 (0.0)	0 (0.0)	0.000	0.0, 0.0	1.000 ³
Postdural headache	0 (0.0)	0 (0.0)	0.000	0.0, 0.0	1.000 ³
Nausea and vomiting	7 (12.3)	5 (8.6)	0.412	0.2, 2.3	0.521 ³
Chest distress	5 (8.8)	7 (12.1)	0.334	0.4, 4.8	0.563 ³
Dizzy	6 (10.5)	4 (6.9)	0.477	0.2, 2.4	0.719 ³
Nasal obstruction	5 (8.8)	6 (10.3)	0.082	0.3, 4.2	0.774 ³
Chills	19 (33.3)	14 (24.1)	1.188	0.3, 1.4	0.276 ³
Neonatal outcomes					
Apgar score < 8 at 1 min, n (%)	3 (5.3)	2 (3.4)	0.000	0.1, 4.0	0.984 ³
Apgar score < 8 at 5 min, n (%)	0 (0.0)	0 (0.0)	0.000	0.0, 0.0	1.000

¹Student's t test.²Mann-Whitney U test.³Chi-square test.

Values are expressed as n (%), mean ± SD, or median (interquartile range). P < 0.05 is present to be significant. CI: Confidence interval; DPE: Dural puncture epidural; EA: Epidural anesthesia.

needed[22]. The DPE technique is a modified anesthesia method based on CSE; the dura is punctured using a spinal needle, and local anesthetics are introduced into the epidural space *via* an epidural catheter instead of directly into the subarachnoid space[14]. The theoretical basis is that perforation of the spinal dura facilitates the infiltration of local anesthetics into the subarachnoid space[15]. As early as 1998, Leach *et al*[23] observed the translocation of epidural dye into the subarachnoid space through an accidental dural puncture *via* a tuohy needle (gauge not documented), which verified the theory. Previous studies have shown that the DPE technique using a 25-G or 26-G Whitacre needle resulted in earlier and greater sacral spread than the EA technique[12,13,24]. In addition, an *in vitro* study demonstrated notable lidocaine flux into the subarachnoid space *via* an 18-G or 24-G needle puncture but no flux *via* a 27-G needle puncture[25]. Thomas *et al*[26] also found that the DPE technique with a 27-G needle did not provide improved labor analgesia quality compared with the EA technique. Therefore, a larger spinal needle aperture may play a critical role in transmeningeal flux; however, the aperture of the spinal needle should be limited to no larger than 25 G to control the risk of postdural puncture headache and abnormally extensive blockade.

Aside from the spinal needle, as mentioned above, Layera *et al*[27] found that the transmeningeal flux of anesthetic may depend on many other variables, including the pressure gradient between the epidural space and the subarachnoid space, the distance between the puncture location and site of epidural drug administration, the pressure of epidural bolus injection, and the patient's posture and epidural compliance, which may vary by age and height[18,23]. The local anesthetic volume might affect

Table 3 Sensory nerve and motor block levels in the two groups at each time point after drug injection

	Group	5 min	10 min	15 min	20 min	5 min after operation
Sensory block levels of cranial side	EA (<i>n</i> = 57)	T11 (T10-11)	T9 (T7-T9)	T6 (T5-T7)	T5 (T4-T6)	T5 (T5-T6)
	DPE (<i>n</i> = 58)	T10 (T10-11)	T8 (T7-T8)	T6 (T5-T6)	T5 (T4-T6)	T5 (T4-T6)
	95%CI	0.349-1.020	0.064-0.905	0.381-1.141	0.262-0.436	0.078-0.705
	<i>P</i> value	< 0.001	0.024	< 0.001	0.623	0.115
	$P_{\text{time}} < 0.001, P_{\text{group}} = 0.008, P_{\text{interaction}} < 0.001$					
Sensory block levels of sacral side	EA (<i>n</i> = 57)	L1 (L1-L3)	L3 (L2.5-L4)	L5 (L4-S1)	S1 (S1-S1)	S1 (S1-S1)
	DPE (<i>n</i> = 58)	L2 (L2-L2.3)	L4 (L3-L4)	S1 (L5-S1)	S1 (S1-S2)	S1 (S1-S2)
	95%CI	0.471-0.966	0.245-0.992	0.319-0.925	0.078-0.710	0.269-0.734
	<i>P</i> value	< 0.001	0.001	< 0.001	0.015	< 0.001
	$P_{\text{time}} < 0.001, P_{\text{group}} < 0.001, P_{\text{interaction}} = 0.425$					
Motor block score	EA (<i>n</i> = 57)	0.0 (0.0-0.0)	1.0 (0.0-1.0)	1.0 (1.0-2.0)	2.0 (1.0-3.0)	3.0 (2.0-3.0)
	DPE (<i>n</i> = 58)	1.0 (1.0-1.0)	1.0 (1.0-2.0)	2.5 (2.0-3.0)	3.0 (3.0-3.0)	3.0 (3.0-3.0)
	95%CI	0.443-0.757	0.631-1.153	0.773-1.354	0.507-1.008	0.210-0.636
	<i>P</i> value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	$P_{\text{time}} < 0.001, P_{\text{group}} < 0.001, P_{\text{interaction}} < 0.0011$					

Values are expressed as median (interquartile range). The data were analyzed with linear mixed model. P_{time} : The time effect within group, the differences between the two groups at each timepoint were tested with adjusted bonferroni correction for multiple comparisons, $P < 0.05$ was considered statistically significant; P_{group} : The main effect between the epidural anesthesia and dural puncture epidural group over time; $P_{\text{interaction}}$: The interaction effect of group-by-time; CI: Confidence interval; DPE: Dural puncture epidural; EA: Epidural anesthesia.

the transmeningeal flux of anesthetics by altering the pressure gradient between the epidural space and the subarachnoid space. Chau *et al*[28] used an identical DPE technique *via* a 25-G Whitacre needle with different epidural dosing regimens (20 mL of 0.125% bupivacaine and 12 mL of 0.25% bupivacaine) in different studies and suggested that a more dilute, higher-volume initial bolus was associated with a more rapid onset of thoracic sensory blockade and greater median cranial spread[15]. The concentration of the local anesthetic solution and transferability of local anesthetics may also affect the translocation of the medications from the epidural space to the subarachnoid space[18]. A low concentration of ropivacaine was used by Wang *et al*[24] and Song *et al*[18] in the DPE technique for labor analgesia and resulted in a faster onset and better sacral block than the EA technique. In our study, a 15-ml mixture of 1% lidocaine and 0.5% ropivacaine as the epidural loading dose was used for the first time to induce anesthesia and resulted in a faster onset of surgical anesthesia and better spread than the EA technique. Clement *et al*[29] found that bupivacaine exhibited a slower transmeningeal flux than lidocaine in rabbit models. Further studies are warranted to determine the difference in transmeningeal flow between bupivacaine and ropivacaine.

Although the motor block degree reported by previous studies was comparable between the DPE and EA techniques for labor analgesia [15,18,24], the DPE technique resulted in significantly higher motor block scores at each time point than the EA technique in our study. One possible reason is that the concentration of local anesthetics was significantly higher than that in other studies applied for labor analgesia, in which a low concentration of ropivacaine produced motor-sensory separation. We did not record the hemodynamic data since a previous study reported that the hemodynamic stability produced by the DPE technique was better than that of the CSE technique and comparable to that of the EA technique[15]. The rate of vasopressor administration in our study was observed to be comparable between the two groups, which indirectly supports this result.

Neither postdural puncture headache nor respiratory depression was observed in either group. The incidence of other side effects, including chest distress, nausea and vomiting, nasal obstruction, maternal hypotension and chills, was comparable between the two groups[14]. While the symptom of nasal obstruction was rarely reported in other studies, we observed 5 cases (8.8%) in the EA group and 6 cases (10.3%) in the DPE group, which was related to the high thoracic sensory blockade and was not followed by decreasing SPO₂ or chest distress. Neonatal outcomes also did not differ between the DPE and EA groups, indicating that the DPE technique used in anesthesia for repeat cesarean delivery was as safe for the mother and the fetus as the EA technique.

This study has several limitations. First, although our results suggest that DPE yielded a superior bilateral block, we did not record the rate of asymmetrical neuraxial block but excluded such patients from the study in the follow-up stage because patients with asymmetrical neuraxial block had to undergo conversion to general anesthesia to complete the surgery. Second, in patients undergoing RCD, adhesions in the epidural space may also affect the spread of the local anesthetic solution in the epidural space as well as its translocation into the subarachnoid space, which might increase the bias of the data.

CONCLUSION

In summary, the DPE technique provided rapid-onset surgical anesthesia and higher-quality anesthesia compared with the EA technique, with superior cranial and sacral sensory block spread and a higher motor blockage degree, without increasing the incidence of maternal or fetal side effects in patients undergoing RCD.

ARTICLE HIGHLIGHTS

Research background

Repeat cesarean delivery (RCD) involves a longer surgery and more severe visceral traction than primary cesarean deliveries, and the rate of RCD is increasing year by year. As an improvement upon the combined spinal-epidural (CSE) technique, the dural puncture epidural (DPE) technique has been reported to provide faster and more effective labor analgesia; however, insufficient data from among parturients undergoing RCD were available. This study aimed to determine whether the DPE technique is superior to the epidural anesthesia (EA) technique in parturients undergoing repeat cesarean delivery.

Research motivation

The aim of this study was to overcome the drawbacks of the slow onset and limited blockade spread of the EA technique. The DPE technique might provide a faster onset and better spread than the EA technique while providing more stable hemodynamics than the CSE technique; hence, this technique might be superior to the EA and CSE techniques.

Research objectives

The objective of this study was to find a better anesthesia method for repeat cesarean delivery.

Research methods

This was a double-blind, prospective, randomized controlled trial.

Research results

The DPE technique provided a faster onset of surgical anesthesia, better cranial and sacral sensory spread and higher motor block degree without increasing the incidence of maternal or fetal side effects when compared with the EA technique in patients undergoing RCD.

Research conclusions

The DPE technique provided higher-quality anesthesia than the EA technique when used in patients undergoing repeat cesarean delivery.

Research perspectives

Future research will explore the short-term and long-term potential complications of the DPE technique.

FOOTNOTES

Author contributions: Wang SY was responsible for the study design, data collection, and manuscript drafting; He Y and Zhu HJ were responsible for data collection and analysis; Han B reviewed and revised the article; all the authors reviewed and approved the final version to be published.

Supported by the Applied Medical Research Project of Hefei Health and Family Planning Commission, No. Hwk2020yb0016.

Institutional review board statement: The study was reviewed and approved by the Institutional Ethics Committee of the Anhui Women and Child Health Care Hospital, No. YYLL2020-15-01.

Clinical trial registration statement: This study is registered prior to subject enrollment at www.chictr.org.cn. The registration identification number is ChiCTR2100050266.

Informed consent statement: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Conflict-of-interest statement: The authors declare that they have no conflict of interest.

Data sharing statement: The data that support the findings of this study are available from the corresponding author upon request.

CONSORT 2010 statement: The authors have read the CONSORT 2010 Statement, and the manuscript was prepared and revised according to the CONSORT 2010 Statement.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: China

ORCID number: Sheng-You Wang 0000-0002-8687-7166; Yan He 0000-0002-0756-7910; Hai-Juan Zhu 0000-0002-0407-3771; Bo Han 0000-0002-1521-9326.

S-Editor: Guo XR

L-Editor: A

P-Editor: Chen YX

REFERENCES

- 1 **Abbas AM**, Khalaf M, Abdel-Reheem F, El-Nashar I. Prediction of pelvic adhesions at repeat cesarean delivery through assessment of striae gravidarum score: A cross-sectional study. *J Gynecol Obstet Hum Reprod* 2020; **49**: 101619 [PMID: 31430563 DOI: 10.1016/j.jogoh.2019.08.002]
- 2 **Ioscovich A**, Gozal Y, Shatalin D. Anesthetic considerations for repeat cesarean section. *Curr Opin Anaesthesiol* 2020; **33**: 299-304 [PMID: 32324661 DOI: 10.1097/ACO.0000000000000851]
- 3 **Ming Y**, Li M, Dai F, Huang R, Zhang J, Zhang L, Qin M, Zhu L, Yu H. Dissecting the current caesarean section rate in Shanghai, China. *Sci Rep* 2019; **9**: 2080 [PMID: 30765758 DOI: 10.1038/s41598-019-38606-7]
- 4 **Moosij R**, Mwampagatwa IH, van Dillen J, Stekelenburg J. Association between surgical technique, adhesions and morbidity in women with repeat caesarean section: a retrospective study in a rural hospital in Western Tanzania. *BMC Pregnancy Childbirth* 2020; **20**: 582 [PMID: 33012289 DOI: 10.1186/s12884-020-03229-8]
- 5 **Cai Q**, Gong H, Fan M, Chen W, Cai L. The analgesic effect of tramadol combined with butorphanol on uterine cramping pain after repeat caesarean section: a randomized, controlled, double-blind study. *J Anesth* 2020; **34**: 825-833 [PMID: 32627064 DOI: 10.1007/s00540-020-02820-9]
- 6 **Zeng C**, Yang M, Ding Y, Duan S, Zhou Y. Placenta accreta spectrum disorder trends in the context of the universal two-child policy in China and the risk of hysterectomy. *Int J Gynaecol Obstet* 2018; **140**: 312-318 [PMID: 29214633 DOI: 10.1002/ijgo.12418]
- 7 **Lyell DJ**. Adhesions and perioperative complications of repeat cesarean delivery. *Am J Obstet Gynecol* 2011; **205**: S11-S18 [PMID: 22114993 DOI: 10.1016/j.ajog.2011.09.029]
- 8 **Awonuga AO**, Fletcher NM, Saed GM, Diamond MP. Postoperative adhesion development following cesarean and open intra-abdominal gynecological operations: a review. *Reprod Sci* 2011; **18**: 1166-1185 [PMID: 21775773 DOI: 10.1177/1933719111414206]
- 9 **Zhou Y**, Yu Y, Chu M, Zhang Y, Yu X, Chen G. Comparison of Metaraminol, Phenylephrine, and Norepinephrine Infusion for Prevention of Hypotension During Combined Spinal-Epidural Anaesthesia for Elective Caesarean Section: A Three-Arm, Randomized, Double-Blind, Non-Inferiority Trial. *Drug Des Devel Ther* 2022; **16**: 117-127 [PMID: 35027821 DOI: 10.2147/DDDT.S331177]
- 10 **Xu W**, Drzymalski DM, Ai L, Yao H, Liu L, Xiao F. The ED₅₀ and ED₉₅ of Prophylactic Norepinephrine for Preventing Post-Spinal Hypotension During Cesarean Delivery Under Combined Spinal-Epidural Anesthesia: A Prospective Dose-Finding Study. *Front Pharmacol* 2021; **12**: 691809 [PMID: 34322021 DOI: 10.3389/fphar.2021.691809]
- 11 **Van de Velde M**. Low-dose spinal anesthesia for cesarean section to prevent spinal-induced hypotension. *Curr Opin Anaesthesiol* 2019; **32**: 268-270 [PMID: 30747727 DOI: 10.1097/ACO.0000000000000712]
- 12 **Bakhet WZ**. A randomized comparison of epidural, dural puncture epidural, and combined spinal-epidural without intrathecal opioids for labor analgesia. *J Anaesthesiol Clin Pharmacol* 2021; **37**: 231-236 [PMID: 34349372 DOI: 10.4103/joacp.JOACP_347_19]
- 13 **Suzuki N**, Koganemaru M, Onizuka S, Takasaki M. Dural puncture with a 26-gauge spinal needle affects spread of

- epidural anesthesia. *Anesth Analg* 1996; **82**: 1040-1042 [PMID: 8610864 DOI: 10.1097/00000539-199605000-00028]
- 14 **Gunaydin B**, Erel S. How neuraxial labor analgesia differs by approach: dural puncture epidural as a novel option. *J Anesth* 2019; **33**: 125-130 [PMID: 30293143 DOI: 10.1007/s00540-018-2564-y]
 - 15 **Contreras F**, Morales J, Bravo D, Layera S, Jara A, Riaño C, Pizarro R, De La Fuente N, Aliste J, Finlayson RJ, Tran DQ. Dural puncture epidural analgesia for labor: a randomized comparison between 25-gauge and 27-gauge pencil point spinal needles. *Reg Anesth Pain Med* 2019 [PMID: 31118278 DOI: 10.1136/rapm-2019-100608]
 - 16 **Lu YY**, Cai JJ, Jin SW, Wang CH, Zhou YF, Hu MP, Li J. [Application of dural puncture epidural technique for labor analgesia]. *Zhonghua Yi Xue Za Zhi* 2020; **100**: 363-366 [PMID: 32074780 DOI: 10.3760/cma.j.issn.0376-2491.2020.05.009]
 - 17 **Heesen M**, Rijs K, Rossaint R, Klimek M. Dural puncture epidural versus conventional epidural block for labor analgesia: a systematic review of randomized controlled trials. *Int J Obstet Anesth* 2019; **40**: 24-31 [PMID: 31281033 DOI: 10.1016/j.ijoa.2019.05.007]
 - 18 **Song Y**, Du W, Zhou S, Zhou Y, Yu Y, Xu Z, Liu Z. Effect of Dural Puncture Epidural Technique Combined With Programmed Intermittent Epidural Bolus on Labor Analgesia Onset and Maintenance: A Randomized Controlled Trial. *Anesth Analg* 2021; **132**: 971-978 [PMID: 32282386 DOI: 10.1213/ANE.0000000000004768]
 - 19 **Mychaskiw G 2nd**, Panigrahi T, Ray T, Shah S. Intentional puncture of the dural space as an aid to epidural placement in a morbidly obese parturient. *J Miss State Med Assoc* 2001; **42**: 303-305 [PMID: 11688407]
 - 20 **Bromage PR**. A comparison of the hydrochloride and carbon dioxide salts of lidocaine and prilocaine in epidural analgesia. *Acta Anaesthesiol Scand Suppl* 1965; **16**: 55-69 [PMID: 5322004 DOI: 10.1111/j.1399-6576.1965.tb00523.x]
 - 21 **Faul F**, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007; **39**: 175-191 [PMID: 17695343 DOI: 10.3758/bf03193146]
 - 22 **Yan W**, Xiong Y, Yao Y, Zhang FJ, Yu LN, Yan M. Continuous intravenous infusion of remifentanyl improves the experience of parturient undergoing repeated cesarean section under epidural anesthesia, a prospective, randomized study. *BMC Anesthesiol* 2019; **19**: 243 [PMID: 31888504 DOI: 10.1186/s12871-019-0900-x]
 - 23 **Leach A**, Smith GB. Subarachnoid spread of epidural local anaesthetic following dural puncture. *Anaesthesia* 1988; **43**: 671-674 [PMID: 3421460 DOI: 10.1111/j.1365-2044.1988.tb04155.x]
 - 24 **Wang J**, Zhang L, Zheng L, Xiao P, Wang Y, Zhou M. A randomized trial of the dural puncture epidural technique combined with programmed intermittent epidural boluses for labor analgesia. *Ann Palliat Med* 2021; **10**: 404-414 [PMID: 33545772 DOI: 10.21037/apm-20-2281]
 - 25 **Bernards CM**, Kopacz DJ, Michel MZ. Effect of needle puncture on morphine and lidocaine flux through the spinal meninges of the monkey in vitro. Implications for combined spinal-epidural anesthesia. *Anesthesiology* 1994; **80**: 853-858 [PMID: 8024140 DOI: 10.1097/00000542-199404000-00019]
 - 26 **Thomas JA**, Pan PH, Harris LC, Owen MD, D'Angelo R. Dural puncture with a 27-gauge Whitacre needle as part of a combined spinal-epidural technique does not improve labor epidural catheter function. *Anesthesiology* 2005; **103**: 1046-1051 [PMID: 16249679 DOI: 10.1097/00000542-200511000-00019]
 - 27 **Layera S**, Bravo D, Aliste J, Tran DQ. A systematic review of DURAL puncture epidural analgesia for labor. *J Clin Anesth* 2019; **53**: 5-10 [PMID: 30273698 DOI: 10.1016/j.jclinane.2018.09.030]
 - 28 **Chau A**, Bibbo C, Huang CC, Elterman KG, Cappiello EC, Robinson JN, Tsen LC. Dural Puncture Epidural Technique Improves Labor Analgesia Quality With Fewer Side Effects Compared With Epidural and Combined Spinal Epidural Techniques: A Randomized Clinical Trial. *Anesth Analg* 2017; **124**: 560-569 [PMID: 28067707 DOI: 10.1213/ANE.0000000000001798]
 - 29 **Clement R**, Malinovsky JM, Le Corre P, Dollo G, Chevanne F, Le Verge R. Cerebrospinal fluid bioavailability and pharmacokinetics of bupivacaine and lidocaine after intrathecal and epidural administrations in rabbits using microdialysis. *J Pharmacol Exp Ther* 1999; **289**: 1015-1021 [PMID: 10215682]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: <https://www.f6publishing.com/helpdesk>
<https://www.wjgnet.com>

