

COMPARISON OF DURAL PUNCTURE EPIDURAL TECHNIQUE WITH CONVENTIONAL LUMBAR EPIDURAL ANALGESIA IN PROVIDING LABOUR ANALGESIA AND LABOUR OUTCOME

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ABSTRACT

Background: Labour pain requires effective, titratable analgesia, with conventional epidural remaining established. Dural puncture epidural may accelerate analgesia through improved spread. This study compared both techniques for analgesic efficacy, maternal and neonatal outcomes, and labour and delivery outcomes in patients undergoing active labour. **Materials and Methods:** This prospective randomised, single-blinded controlled study enrolled 100 patients at Govt Rajaji Hospital, Madurai Medical College. Patients were randomised to Dural puncture epidural (n=50) or conventional lumbar epidural (n=50). Both groups received 10 mL 0.125% levobupivacaine with dexmedetomidine 0.5 mcg/kg initially and 8 mL top-ups when required. Analgesia, sensory and motor block, haemodynamics, labour, fetal and maternal outcomes were assessed. **Results:** Mean age was 22.8 ± 2.321 versus 22.58 ± 2.251 years ($P=0.631$), gestational age ($P=0.278$), height ($P=0.096$), and weight ($P=0.255$). Mean onset of analgesia was significantly shorter with Dural puncture epidural ($P<0.001$). VAS scores were significantly lower at 5 minutes ($P<0.001$) and 10 minutes ($P<0.001$), but comparable thereafter. First- and second-stage labour durations were longer ($P<0.001$ and $P<0.001$), whereas third-stage duration was shorter ($P=0.025$). Mode of delivery was comparable ($P=0.537$). Birth weight ($P=0.055$), Apgar scores at 1 minute ($P=0.550$) and 5 minutes ($P=0.675$), fetal heart rate ($P=0.080$), blood loss ($P=0.337$), CTG findings ($P=0.842$), and complications ($P=0.501$) were comparable. **Conclusion:** Dural puncture epidural provided faster onset and superior early analgesia while maintaining comparable maternal, fetal, neonatal, and delivery outcomes to conventional epidural analgesia.

INTRODUCTION

Analgesia is an important aspect of obstetric care due to the painful nature of labour, and physiological stress. Neuraxial analgesia (especially lumbar epidural) is very effective, is adjustable, and allows the mother to stay awake and be able to co-operate during the labour and delivery process. Epidural analgesia has been proven to be effective, safe and flexible and is established in obstetric anaesthesia, with the conventional lumbar technique being where a catheter is inserted into the epidural space from which the local anaesthetic, commonly in combination with an opioid, is administered as the labour progresses.^[1-3] Effective, onset and spread

may vary. If the unilateral or patchy block, inadequate analgesia or inadequate sacral spread occurs, additional doses of the block, catheter adjustment or replacement may be necessary. These are especially significant at the end of labour when good sacral analgesia is required. The quality of the block can also be influenced by the quality of the block and may influence conversion to surgical anaesthesia during cesarean delivery.^[4-6]

Dural puncture epidural (DPE) is a variation of the traditional epidural. Once the epidural space is located, a small spinal needle is inserted through the dura (without intrathecal injection of medication). The epidural catheter is then put in place and medication administered via it. The dural puncture

can aid the diffusion of epidurally injected drugs, including towards the sacral area, and can facilitate change of bilateral sensory blockade and accelerate onset of analgesia. Some studies have found an initial intrathecal injection to be beneficial with combined spinal-epidural analgesia while others have not.^[7-10] By comparison, it is believed that there is an early benefit in DPE. A further study showed that adequate analgesia was achieved more quickly with DPE, and that labour duration and top-up rates were comparable, but that there was no additional improvement in analgesia after top-up.^[9,10] The primary advantage of DPE might be the rapidity of onset of adequate analgesia, rather than its effectiveness during labour.

The effect can be different depending on the group of patients and the type of analgesics given. With no consistent differences in the number of times the catheter was adjusted, whether a top-up had been required, or whether conversion to regional anaesthesia had failed; however, a faster onset of anaesthesia was reported.^[11,12] Fetal and neonatal outcomes were similar overall with no consistent differences in fetal heart-rate abnormalities, Apgar scores or neonatal complications. Overall, there are some reports of DPE improving the onset and spread of labour analgesia in the sacral region, though the benefits of DPE over conventional epidural analgesia have not been consistent on the various measures of analgesia, labour, maternal or neonatal outcomes.^[11,13,14]

Aim

This study aimed to compare the effectiveness of the DPE technique with conventional lumbar epidural analgesia for pain relief during labour, and to evaluate their comparative effects on maternal and neonatal outcomes, as well as the progress and mode of labour and delivery.

MATERIALS AND METHODS

This prospective randomised, single-blind, controlled study was carried out in 100 pregnant women attending the department of obstetrics and gynaecology, Govt Rajaji Hospital, Madurai Medical College during one year. Ethical clearance was obtained before initiation of the study. Informed consent was obtained for participation in the study.

Inclusion and Exclusion criteria

Only women between 20 and 30 years of age, with a singleton pregnancy, vertex presentation, no cephalopelvic disproportion, gestational age ranging from 38 to 42 weeks, Active labour with cervical dilation 2 to 4 cm, and who gave valid informed consent were included in this study. Patients who did not meet the inclusion criteria, did not have written informed consent, or had contraindications for neuraxial analgesia, or had conditions associated with an increased risk of caesarean delivery were excluded from the study.

Materials

The materials used in the study included an 18-gauge Tuohy epidural needle, 27-gauge Quincke spinal needle, 18-gauge multiport epidural catheter, 0.125% levobupivacaine, dexmedetomidine, intravenous cannula, standard monitoring equipment, and all necessary emergency drugs.

Methods

The pregnant women were randomly allocated to the DPE group (n=50) and the conventional lumbar epidural group (n=50) (Figure 1). All patients were pre-medicated and IV cannula was inserted, standard monitoring was used and baseline vital parameters were recorded. The infusion of 1 litre of RL was done over 15min before the neuraxial procedure, which was done in a sitting position. The epidural space was located at L3-L4 via the midline route and by loss of resistance to air (<2 ml) in the DPE group. A 27-gauge Quincke needle was introduced, and free flow of CSF confirmed dural puncture and drug was injected intrathecally. For the conventional lumbar epidural group, no dural puncture was done. 18-gauge multiport epidural catheter was placed 5 cm into the epidural space. 10ml of 0.125% levobupivacaine and 0.5mcg/kg body weight of dexmedetomidine was administered in both groups and 8ml was subsequently administered as needed.

Patients were first dosed and then placed in supine position with lateral tilt and left lateral recumbency. Each uterine contraction was followed by an assessment of analgesia, using a 0–10 verbal numeric pain rating scale. Pinprick was performed from S2 caudad to S1 cephalad and sensory block was evaluated. Motor block was evaluated using the Modified Bromage score scoring: 0, full knee and ankle flexion; 1, partial knee and full ankle flexion; 2, inability to flex knees with partial flexion of the ankle; and 3, inability to flex knees and ankles. Onset of analgesia, pain score, sensory and motor block, maternal blood pressure and pulse, fetal heart rate, top-up, duration of labour, uterine contractions, use of oxytocin, maternal and fetal outcomes, total dose of bupivacaine, satisfaction and side effects were evaluated. Deliveries included normal, instrumental, and LSCS delivery.

Statistical analysis

Data were presented as mean, standard deviation, frequency and percentage. Continuous variables were compared using the independent sample t-test. Categorical variables were compared using the Pearson chi-square test and Fisher's exact test where appropriate. Significance was defined by P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

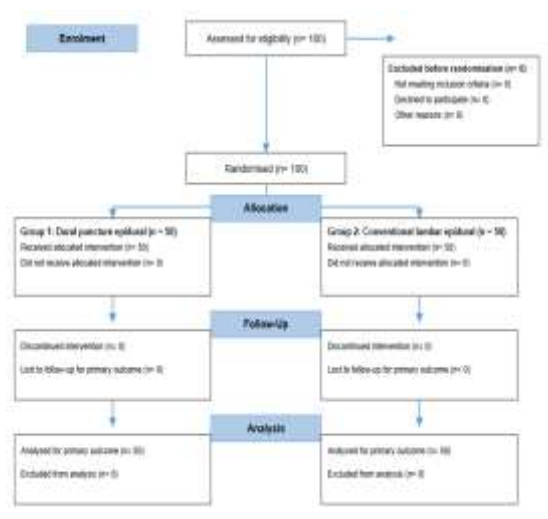


Figure 1: CONSORT flow diagram

RESULTS

The groups were comparable in age, gestational age, height, weight, blood loss, birth weight, and cervical dilatation. Most participants were aged ≤ 25 years, with similar distributions of gestational age, height, and weight between groups. Blood loss ≤ 400 mL occurred in 72% vs. 74%, and birth weight ≤ 3 kg in 88% of both groups. Cervical dilatation of 4 cm was more common in the DPE group (80% vs. 72%), whereas 5 cm was more common in the conventional epidural group (28% vs. 20%). The DPE group had a significantly faster onset of analgesia ($P < 0.001$). [Table 1]

Table 1: Distribution of demographic, obstetric, analgesic, and clinical characteristics between the groups

		N (%)	
		DPE	Conventional lumbar epidural
Age (in years)	≤ 25	43 (86%)	46 (92%)
	> 25	7 (14%)	4 (8%)
Gestational age (In weeks)	38	17 (34%)	20 (40%)
	39	33 (66%)	30 (60%)
Height (in cms)	≤ 155	22 (44%)	24 (48%)
	> 155	28 (56%)	26 (52%)
Weight (in Kgs)	≤ 60	29 (58%)	26 (52%)
	> 60	21 (42%)	24 (48%)
Time to onset of analgesia (in minutes)	10-12	39 (78%)	15 (30%)
	13-15	11 (22%)	35 (70%)
Blood loss (ml)	≤ 400	36 (72%)	37 (74%)
	> 400	14 (28%)	13 (26%)
Birth weight (kg)	≤ 3	44 (88%)	44 (88%)
	> 3	6 (12%)	6 (12%)
Cervical dilatation, cm	4	40 (80%)	36 (72%)
	5	10 (20%)	14 (28%)

There was no difference in mean age between the lumbar puncture and conventional lumbar epidural groups (22.8 ± 2.321 years vs. 22.58 ± 2.251 years, $P = 0.631$). Mean gestational age was 38.67 ± 0.468 vs. 38.56 ± 0.466 weeks ($P = 0.278$), and mean height was 155.92 ± 3.63 vs. 154.60 ± 4.209 cm ($P = 0.096$). Mean weight was 60.44 ± 3.221 vs. 61.30 ± 4.229 kg ($P = 0.255$). Mean pulse rate was 79.10 ± 4.151 vs.

77.88 ± 3.249 beats/min ($P = 0.105$). Systolic blood pressure was 113.20 ± 5.869 vs. 113.80 ± 5.303 mmHg ($P = 0.593$), while diastolic blood pressure was 72.40 ± 4.314 vs. 72.60 ± 4.431 mmHg ($P = 0.820$). Mean cervical dilatation was 4.20 ± 0.404 vs. 4.30 ± 0.454 cm ($P = 0.354$). It appears there were no significant differences. [Table 2]

Table 2: Comparison of demographic, obstetric, baseline haemodynamic, and cervical characteristics between the groups

	Mean $\pm$ SD		P value
	DPE	Conventional lumbar epidural	
Mean Age (in years)	22.8 ± 2.321	22.58 ± 2.251	0.631
Mean gestational age (in weeks)	38.67 ± 0.468	38.56 ± 0.466	0.278
Mean Height (Cm)	155.92 ± 3.63	154.60 ± 4.209	0.096
Mean Weight (Kg)	60.44 ± 3.221	61.30 ± 4.229	0.255
Pulse rate (beats/min)	79.10 ± 4.151	77.88 ± 3.249	0.105
Systolic BP (mmHg)	113.20 ± 5.869	113.80 ± 5.303	0.593
Diastolic BP (mmHg)	72.40 ± 4.314	72.60 ± 4.431	0.82
Mean Cervical dilation (in cm)	4.20 ± 0.404	4.30 ± 0.454	0.354

Birth weight was slightly higher in the DPE group (2.827 ± 0.218 vs. 2.739 ± 0.234 kg; $P = 0.055$), while Apgar scores at 1 and 5 min and fetal heart rate were comparable between groups. The first and second stages of labour were significantly longer with DPE

($P < 0.001$), whereas the third stage was shorter ($P = 0.025$). Blood loss was comparable (251.20 ± 85.443 vs. 268.60 ± 94.675 mL; $P = 0.337$). Baseline VAS was similar, but scores were significantly lower with DPE at 5 and 10 min (both $P < 0.001$). Onset of

analgesia was significantly faster with DPE (11.46 ± 1.568 vs. 13.54 ± 1.619 min; $P<0.001$). [Table 3]

Table 3: Comparison of analgesic efficacy, labour duration, neonatal outcomes, and blood loss between the groups

		Mean $\pm$ SD		P value
		DPE	Conventional lumbar epidural	
Mean Birth weight (kg)		2.827 ± 0.218	2.739 ± 0.234	0.055
Apgar score at	1 min	7.68 ± 0.551	7.74 ± 0.443	0.55
	5 min	8.70 ± 0.505	8.74 ± 0.443	0.675
Mean fetal heart rate, (beats/min)		135.98 ± 5.176	137.82 ± 5.209	0.08
VAS score	0 min	8.348 ± 0.674	8.277 ± 0.713	0.622
	5 min	3.891 ± 0.315	4.600 ± 0.889	<0.001
	10 min	2.891 ± 0.315	3.400 ± 0.580	<0.001
	15 min	1.152 ± 0.363	1.156 ± 0.367	0.965
	30 min	1.065 ± 0.250	1.044 ± 0.208	0.668
	60 min	1.152 ± 0.363	1.133 ± 0.344	0.8
	120 min	1.109 ± 0.315	1.156 ± 0.367	0.514
	180 min	1.196 ± 0.401	1.178 ± 0.387	0.829
Mean Time to Onset of Analgesia (in min)		11.46 ± 1.568	13.54 ± 1.619	<0.001
Duration of Labor (in minutes)	I Stage	222.61 ± 20.703	208.29 ± 17.361	<0.001
	II Stage	52.065 ± 8.204	46.702 ± 6.859	<0.001
	III Stage	6.174 ± 0.825	6.553 ± 0.775	0.025
Mean Blood Loss (in ml)		251.20 ± 85.443	268.60 ± 94.675	0.337

There were no significant differences between the groups of primigravidas or multigravidas ($P=1.000$). The use of natural labour was higher with conventional epidural [46 (92%) vs. 43 (86%)] and LSCS [4 (8%) vs. 3 (6%)] and outlet delivery [3 (6%) vs. 1 (2%)] were higher with DPE, but these were not significant ($P=0.537$). CTG was normal in 48 (96%)

vs. 47 (94%), while late deceleration occurred in 1 (2%) vs. 2 (4%) and variable deceleration in 1 (2%) in each group ($P=0.842$). DPE had a higher rate of vomiting (5 (10%) vs. 2 (4%)), but a similar rate of postpartum haemorrhage (2 (4%) vs. 2 (4%)) ($P=0.501$). [Table 4]

Table 4: Comparison of parity, mode of delivery, cardiotocography findings, and maternal complications between the groups

		N (%)		P value
		DPE	Conventional lumbar epidural	
Parity	Primigravida	47 (94%)	46 (92%)	1
	Multigravida	3 (6%)	4 (8%)	
Mode of delivery	Labour natural	43 (86%)	46 (92%)	0.537
	LSCS	4 (8%)	3 (6%)	
	Outlet delivery	3 (6%)	1 (2%)	
CTG findings	No abnormality	47 (94%)	48 (96%)	0.842
	Late deceleration	2 (4%)	1 (2%)	
	Variable deceleration	1 (2%)	1 (2%)	
Complications	Vomiting	5 (10%)	2 (4%)	0.501
	Postpartum haemorrhage	2 (4%)	2 (4%)	

DISCUSSION

In our study, DPE and conventional epidural groups were comparable at baseline, with no significant differences in demographic, obstetric, haemodynamic, or cervical findings. This was similar to Narang et al., who studied 60 term primigravidas randomized equally between DPE and conventional epidural.^[15] In contrast, Tan et al. included 132 obese parturients with BMI ≥ 35 kg/m² and cervical dilatation of 2-7 cm, with 66 patients in each group.^[11] These differences in patient characteristics may influence epidural performance and analgesic response.

The finding in our study was faster early analgesia with DPE. Puthenveetil et al. reported onset at 4.40 ± 1.32 vs. 6.37 ± 2.04 min ($P<0.001$) and five-minute VAS of 2.43 ± 1.25 vs. 3.97 ± 1.84 ($P=0.002$).^[16] Narang et al. reported five-minute VAS of $4.33 \pm$

0.922 vs. 4.97 ± 0.85 ($P<0.05$), with adequate analgesia by five minutes in 6 DPE patients versus none in the conventional group.^[15] Reddy reported adequate-analgesia times of 10.04 vs. 11.60 min, with adequate relief at ten minutes in 60% vs. 52%.^[17] Wilson et al. found adequate analgesia at ten minutes in 55.3% vs. 44.7% ($P=0.256$), but median onset was 8 min (95% CI 6-10) vs. 10 min (95% CI 8-14), with a 67% higher relative probability ($P=0.042$) with DPE.¹⁸ Pažur et al. (2023) found that 97.4% of DPE patients achieved pain score ≤ 3 at ten minutes ($P=0.028$).^[9] Lin et al., reviewing 7 RCTs involving 761 parturients, also found faster achievement of pain score $\leq 3/10$ at ten and twenty minutes with 25-gauge DPE.^[10]

The early analgesic advantage observed with DPE at 5 and 10 minutes was not sustained beyond 10 minutes. Puthenveetil et al. reported analgesia duration of 109.00 ± 26.63 vs. 104.17 ± 30.62 min

($P=0.517$) and top-ups of 2.47 ± 0.50 vs. 2.50 ± 0.50 ($P=0.80$).^[16] Narang et al. found 98.77 ± 24.955 vs. 99.37 ± 23.175 min ($P>0.05$).^[15] Yao et al., involving 400 enrolled and 339 analysed patients, found no difference in pain scores, programmed or manual boluses, or time to first programmed bolus; ropivacaine consumption differed by -0.724 mg (95% CI -1.450 to 0.001 ; $P=0.051$).^[19] Tan et al. similarly found no significant differences in local anaesthetic consumption, pain scores, obstetric, or neonatal outcomes.^[11] Hence, DPE appears to improve onset more than maintenance analgesia.

In our study, the first and second stages of labour were longer with DPE, whereas the third stage was shorter. This was not supported by Pažur et al., who found no significant difference in time to delivery.^[9] Tan et al. found no significant difference in second-stage duration, mode of delivery, fetal-heart-rate changes, Apgar scores, adverse events, or satisfaction.^[11] Yao et al., who found no difference in obstetric outcomes.^[19] Heesen et al. also highlighted heterogeneity between DPE studies.^[20] Therefore, labour-stage differences may reflect population or management factors rather than DPE itself. Mode of delivery in our study was comparable between groups. This agrees with Pažur et al., Tan et al., and Yao et al., who found no significant difference in delivery or obstetric outcomes.^[9,11,19] Maternal haemodynamic findings and blood loss were also comparable in our study, consistent with Puthenveetil et al., who reported no adverse maternal or fetal effect, and Tan et al., who found no difference in maternal adverse events in 132 obese parturients.^[16,11]

Fetal heart rate, CTG, birth weight, and Apgar scores were comparable in our study. This agrees with Tan et al., who found no significant fetal-heart-rate or Apgar differences, Pažur et al., who reported no adverse maternal or neonatal effect, and Yao et al., who found no difference in neonatal outcomes.^[9,11,19] Maternal complications were likewise comparable. Lin et al. found no significant difference in side effects or satisfaction, while Tan et al. (2022) reported no difference in maternal adverse events.^[10,11] Overall, our findings support DPE mainly for faster early analgesia, without clear evidence of superior maintenance, labour, delivery, fetal, neonatal, or maternal outcomes.

CONCLUSION

Both DPE and conventional lumbar epidural provided effective labour analgesia. DPE gave a significantly faster onset with lower pain scores at 5 and 10 minutes. The first and second stages of labour were significantly longer with DPE, while the third stage was significantly shorter. Mode of delivery, including natural labour, LSCS, and outlet delivery, was comparable. Fetal heart rate, CTG findings, birth weight, Apgar scores, blood loss, and maternal complications also showed no significant differences.

Overall, DPE was safe and effective, with the main benefit being faster onset and better early pain relief, without an increased rate of operative or caesarean delivery.

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