

## Comparative Analysis of Dura Puncture Technique and Conventional Epidural Technique in Labor Analgesia

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Conflict of interest: Nil

**Abstract:**

**Introduction:** Many medical guidelines emphasize that if there are no medical contraindications; pain relief during labor can be provided solely based on the mother's request. This reflects a patient-centered approach to obstetric care, where the mother's comfort and well-being are prioritized. The primary objectives of providing pain relief during labor are to ensure the safety and well-being of both the mother and the baby and to create a positive and manageable birthing experience. Managing pain effectively can reduce maternal stress and anxiety, improve maternal satisfaction, and promote better obstetric outcomes.

**Aim and Objective:** To compare the efficacy of labour analgesia with Dural puncture epidural versus standard epidural technique.

**Material and Methods:** This is a prospective, randomized; study was conducted in Department of Anaesthesia, AIIMS New Delhi, during Feb 2019 to Jan 2020. Randomization is done to give equal chance to participants of any group. In this study patients were randomly allocated using computer generated random number 50 number of patients were randomly divided in to 25 each group. The primary and secondary researchers measure the outcome and record the data. 50 parturients will be randomly selected and divided in to 2 groups. Randomization done by computer program and sealed envelope.

**Result:** The mean to achieve adequate analgesia in group B (Dural puncture epidural technique) was lesser than group A (traditional epidural technique). ( $11.60 \pm 2.36$  vs  $10.04 \pm 1.90$  min) P value  $< 0.05$  and is statistically significant. The systolic BP at 0 min was 125.8 mm hg in grp A, and 123.2 in grp B, AT 10 MIN THE SYS BP was 116.3 mm hg in grp A and 112.7 in Grp B, and at 20 min the systolic BP was 112.0 and 110.7 mm hg in grp A and B respectively.

**Conclusions:** When comparing the Traditional Epidural technique with the Dural Puncture Epidural technique for labor analgesia, it was found that the Dural Puncture Epidural technique provides faster attainment of adequate analgesia compared to the Traditional Epidural technique. Additionally, the Dural Puncture Epidural technique has shown to enhance the spread of analgesia in the sacral region, leading to quicker onset and better bilateral pain relief in laboring women.

**Keywords:** Dura Puncture, Combined Spinal-Epidural, CSE, Conventional Epidural, Labor Analgesia, Pain Relief.

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**Introduction**

Labor is the process of delivering the products of conception from the womb through the vagina, involving intense pain characterized as an unpleasant sensory and emotional experience related to potential tissue damage.

During the initial stage of labor, contractions and cervical dilatation cause visceral pain transmitted through specific nerve roots. In the second stage, pain is attributed to vaginal, perineal, and pelvic floor distention, transmitted through different nerve roots. Labor induces various physiological responses such as increased breathing and oxygen consumption due to hyperventilation during

contractions. Stress-related hormonal changes can affect uteroplacental blood flow, potentially leading to metabolic acidosis, which may impact the fetus. Pain relief measures can help reduce stress hormones, metabolic acidosis risk, and maternal oxygen consumption by approximately 14%. [1]

As per the guidelines of the American Society of Anesthesiology (ASA), if there are no medical reasons to avoid it, providing pain relief during labor based solely on the mother's request is considered a valid medical indication. The main objective of pain relief during labor is to ensure a secure and positive experience for both the mother

and the baby. An ideal pain relief technique should meet several criteria, including safety, efficient pain relief, without causing any depression in the mother or the baby, not hindering the progress of labor, minimal side effects, and a high success rate in its technical implementation. [2]

Several authors have advocated the conventional epidural technique for labor pain relief due to its rapid onset, strong analgesic effect, high patient satisfaction, and reliable verification of proper epidural needle placement through the return of cerebrospinal fluid (CSF) via the spinal needle, reducing the risk of epidural catheter failures. The conventional epidural technique is a widely used method for providing labor analgesia. It involves the insertion of a fine, flexible catheter into the epidural space, which is the area surrounding the spinal cord in the lower back. A small amount of local anesthetic is injected into the skin and deeper tissues to numb the area before the epidural needle is inserted. This helps minimize discomfort during the procedure. Once the catheter is secured, continuous or intermittent doses of local anaesthetics and/or opioids can be administered through the catheter to provide on-going pain relief during labor. [3]

To address these concerns and maintain the benefits, some authors propose a novel approach called the dural puncture epidural (DPE) method. The dural puncture epidural (DPE) technique involves making a single hole in the protective covering of the spinal cord using a spinal needle placed through an epidural needle. Then, a catheter is inserted into the epidural space to deliver medications for pain relief or anesthesia. Unlike the CSE technique, where drugs are given directly into the subarachnoid space, all medications in the DPE technique are introduced through the epidural catheter. [4] The dural puncture allows medications to move from the epidural to the subarachnoid spaces, resulting in unique characteristics observed with the DPE technique. Compared to the EPL technique, the DPE technique has been shown to provide faster and more widespread pain relief and anesthesia, particularly beneficial in obstetric patients. Additionally, the confirmation of proper epidural needle placement is done by observing cerebrospinal fluid return, making it a reliable indicator. By avoiding direct administration of medication into the subarachnoid space, the DPE technique may have fewer side effects compared to the CSE technique. [5] With the above background we had conducted this study to compare the efficacy of labour analgesia with dural puncture epidural versus standard epidural technique.

### Material and Methods

This is a prospective, randomized; study was conducted in Department of Anaesthesia, AIIMS

New Delhi, during Feb 2019 to Jan 2020. Randomization is done to give equal chance to participants of any group.

In this study patients were randomly allocated using computer generated random number 50 number of patients were randomly divided in to 25 each group. The primary and secondary researchers measure the outcome and record the data. 50 parturients will be randomly selected and divided in to 2 groups. Randomization done by computer program and sealed envelope. Study population is divided in to 2 groups and the groups are Group A – Patients receiving Traditional epidural analgesia Group B– Patients receiving Dural Puncture epidural analgesia.

### Inclusion Criteria

- Primigravida and gravida 2 patients at term in labour
- ASA I and ASA II
- Maternal request for epidural analgesia
- Women in active labour with cervical dilatation more than 2-3cm

### Exclusion Criteria

- Patients with contraindication to neuraxial anesthesia
- VAS score < 50 mm during an active contraction
- Parturients with Cephalopelvic disproportion
- Previous LSCS

### Study Intervention:

Group A received traditional epidural technique without any dural puncture Group B received a dural puncture using a 26 G whit acre needle through the 18 G Tuohy needle. After confirming free flow of CSF, needle has been taken out without the administration of any medication in to subarachnoid space. In both groups epidural catheter was inserted

### Methods

#### Preoperative Patient Preparation

All selected patients will undergo a routine pre-anesthetic assessment, and they will be informed about pain assessment using a visual analog scale. Baseline parameters, including pulse oximeter readings, non-invasive blood pressure (NIBP) measurements, and oxygen saturation (SPO<sub>2</sub>) levels, will be recorded before the procedure. Labouring patients will be randomly assigned to receive either standard epidural analgesia or dural puncture epidural analgesia. For both techniques, neuraxial procedures will be performed in either the L3-L4 or L4-L5 space using a 17G TUOHY needle while the patient is in a sitting position. The dural puncture epidural technique involves creating a single puncture in the dura using a 26G Whitacre

needle inserted through the shaft of an epidural needle, followed by placement of an epidural catheter into the epidural space. This puncture allows medications to move from the epidural space to the subarachnoid space, resulting in unique characteristics associated with this technique. The epidural space will be identified using the loss of resistance technique with saline. In both techniques, 19G epidural catheters will be inserted approximately 4 to 5 cm into the epidural space. A test dose of 3 ml will be administered, containing 1.5% lidocaine with 5 mcg/ml of epinephrine, to ensure proper catheter placement and check for any intravascular or subarachnoid placement.

Both groups will receive an epidural bolus of 12 ml, consisting of 0.125% bupivacaine with 50 mcg of fentanyl, administered at a rate of 4 ml per

minute over 3 minutes. This will be followed by an infusion of 0.1% bupivacaine with 2 mcg/ml of fentanyl every 90 minutes for on-going pain relief.

**Results**

In the present study in group A 64% study subjects were of less than 25 year, 28% subjects were of age 26-30 yrs, whereas 8% subjects had age more than 30 yrs. In group B the 64% of study subjects were of age less than 25 year, 32% study subjects were of age group 26-30 years. Both groups were similar with respect to age of the parturients and there was no statistically significant difference (P>0.05).

In the group A, the mean weight of the study subjects was 64.96 ± 7.35 kg, whereas in group B it was 61.76 ± 4.69, without any significant difference.

**Table 1: Comparison of mean VAS scores before procedure between two groups**

Parameter	Group		Unpaired ttest P value
	Group A	Group B	
VAS scores before procedure (Mean ± SD)	7.56 ± 1.3	7.24 ± 1.1	0.44

Table 1 shows Comparison of mean VAS scores before procedure between two groups, In group A the mean VAS score was 7.56 ± 1.3, whereas it was 7.24 ± 1.1 in grp B, On comparing there is non-significant difference with p value 0.44.

**Table 2: Comparison of mean cervical dilatation at the time of procedure between two groups**

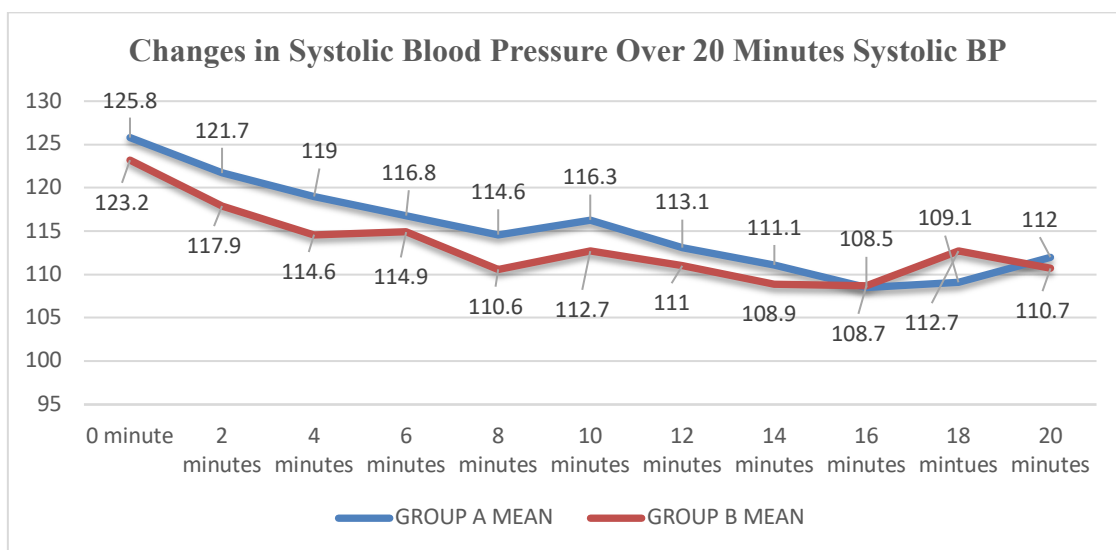
Parameter	Group		Unpaired ttest P value
	Group A	Group B	
Mean cervical dilatations (Mean ± SD)	4.3 ± 0.75	4.24± 0.66	0.69

Table 2 shows Comparison of mean cervical dilatation at the time of procedure between two groups, In grp A the mean cervical dilatation was 4.3 ± 0.75 cm, whereas it was 4.24± 0.66 cm in group B, On comparing there is non-significant difference with p value 0.69.

**Table 3: Comparison of mean time to achieve adequate analgesia between two groups**

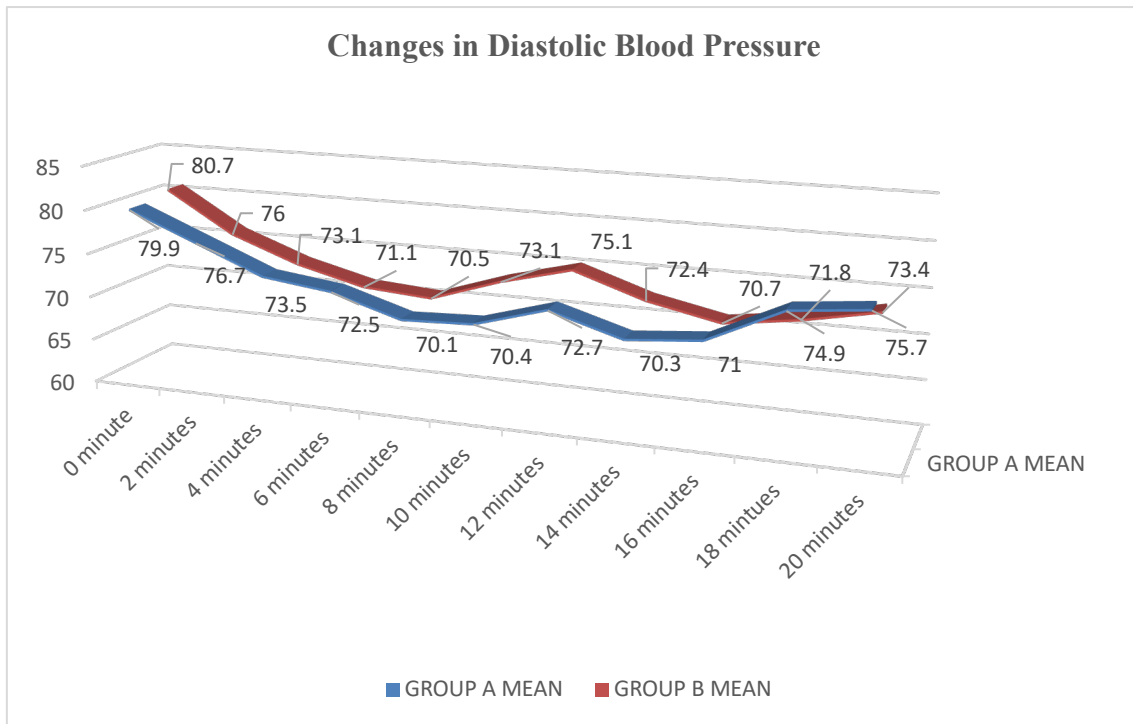
Parameter	Group		Unpaired t test P value
	Group A	Group B	
Time to achieve adequate analgesic	11.60 ± 2.36	10.04 ± 1.90	0.013

Time to achieve adequate analgesia in both groups was compared. The mean to achieve adequate analgesia in group B (dural puncture epidural technique) was lesser than group A (traditional epidural technique). (11.60 ± 2.36 vs 10.04 ± 1.90 min) P value < 0.05 and is statistically significant.



**Figure 1: Changes in Systolic Blood Pressure Over 20 Minutes Systolic BP**

Fig 1 shows changes in systolic blood pressure over 20 minutes systolic BP, the systolic BP at 0 min was 125.8 mm hg in grp A, and 123.2 in grp B, AT 10 MIN THE SYS BP was 116.3 mm hg in grp A and 112.7 in Grp B, and at 20 min the systolic BP was 112.0 and 110.7 mm hg in grp A and B respectively.



**Figure 2: Changes in Diastolic Blood Pressure**

Fig 2 shows changes in diastolic blood pressure, at 0 min the diastolic BP was 79.9 mm hg in grp A, and 80.7 mm hg in grp B, At 10 MIN, the diastolic BP was 70.4 mm hg in grp A, and 73.1 in grp B, At 20 min the mean diastolic BP was 73.4 mm hg in grp A and 75.7 in grp B, there is no significant difference at all time interval.

**Table 4: Distribution of study subjects as per side effects**

Side effects	Grp A	Grp B
Nausea	2	1
Fetal bradycardia	1	0
pruritis	1	0
Headache	0	1

Table 4 shows Distribution of study subjects as per side effects, Nausea was present in 2 study subjects in grp A whereas in 1 patient in grp B, Fetal bradycardia was present in 1 study subject in grp A whereas none in grp B, pruritis was present only one study subject in grp A, whereas headache was present in 1 subjects of grp B.

**Table 5: Comparison of mode of delivery between two groups**

Mode of delivery	Group		Total	Chi square	P value
	Group A	Group B			
C section	6 (24%)	6 (24%)	12 (24%)	9.862	0.063
Forceps delivery	1 (4%)	0 (0%)	1 (2%)		
Instrumental delivery	0 (0%)	7 (28%)	7 (14%)		
NVD	17 (68%)	12 (48%)	29 (58%)		
Vacuum	1 (4%)	0 (0%)	1 (2%)		
Total	25 (100%)	25 (100%)	50 (100%)		

Mode of delivery between both the groups were compared and there was no statically significant difference (P value>0.05)

**Discussion**

Central neuraxial analgesia is considered the most reliable and versatile technique for pain control during labor in obstetrics. This approach represents

a shift in obstetrical anesthesia, focusing not only on pain relief but also on enhancing the overall quality of analgesia. Advances in understanding pain physiology and pharmacotherapy, along with the development of obstetric anesthesia as a specialized field, have led to improved training and better labor analgesia outcomes. Patients'

satisfaction with their birth experience is notably higher with neuraxial techniques.

The field of neuraxial analgesia has seen exciting progress, including refined techniques and the availability of newer drugs and adjuvants. Technological advances have enabled novel drug delivery systems, such as patient-controlled infusion regimes, and more randomized controlled trials (RCTs) have resolved controversies related to neuraxial analgesia.

Among the neuraxial techniques, epidural analgesia is widely used for labor pain relief. Combined spinal epidural analgesia (CSE) has emerged as an effective method to improve the quality, efficacy, and safety of neuraxial blockade. CSE involves the intrathecal administration of local anaesthetics and opioids, leading to rapid and profound analgesia. However, despite the advantages of CSE, such as minimal motor blockade and high patient satisfaction, it also presents drawbacks like hemodynamic instability, fetal bradycardia, and potential complications and side effects related to dural puncture and intrathecal drug administration.

The Dural Puncture Epidural (DPE) technique is a modified version of combined spinal epidural, involving the creation of a dural perforation using a spinal needle, but without administering medication intrathecally. DPE has been found to enhance the spread of analgesia compared to traditional epidural techniques, while avoiding some of the side effects observed with Combined Spinal Epidural (CSE). One postulated mechanism for the improved analgesia in DPE is the translocation of epidural medications into the subarachnoid space through the dural puncture.

To evaluate the efficacy of DPE compared to traditional epidural, a study was conducted with a total of 50 patients. The participants were randomly divided into two groups, Group A and Group B, each containing 25 patients. Group A received the traditional epidural technique using an 18 G Tuohy needle followed by epidural catheter placement. In contrast, Group B received the DPE technique, wherein the dura was punctured using a 26 G Whitacre needle through the Tuohy needle. The demographic data, including age, body weight, and height, were carefully matched between the two groups.

The mean age for Group A was 24.12 with a standard deviation of 4.26, while for Group B, it was 24.92 with a standard deviation of 3.83. The p-value for the mean age difference between the groups was greater than 0.05, indicating no statistical significance in age between the two groups. Consequently, both groups were considered comparable in terms of age. Similarly, the mean body weight for Group A was 64.96 with a standard deviation of 7.35, and for Group B, it was

61.76 with a standard deviation of 4.69. The p-value for the mean body weight difference between the groups was greater than 0.05, suggesting no statistical significance in body weight between the two groups. Thus, both groups were considered matched based on body weight.

The mean height for Group A was 73.56 with a standard deviation of 4.77, while for Group B, it was 72.40 with a standard deviation of 5.31. The p-value for the mean height difference between the groups was greater than 0.05, indicating no statistical significance in height between the two groups. Therefore, both groups were matched regarding height.

Additionally, cervical dilatation at the time of the procedure was compared between the groups. The mean cervical dilatation for Group A was 4.32 with a standard deviation of 0.75, and for Group B, it was 4.24 with a standard deviation of 0.66. The p-value for the mean cervical dilatation difference between the groups was greater than 0.05, signifying no statistical significance in cervical dilatation at the time of the procedure between the two groups.

Moreover, the mean VAS (Visual Analog Scale) score before the procedure in Group A was  $7.56 \pm 1.3$ , and in Group B, it was 7.34 with a standard deviation of 1.1. The p-value for the mean VAS score difference before the procedure between the groups was greater than 0.05, indicating no statistical significance in VAS scores before the procedure in both groups. Consequently, both groups were matched based on their preprocedural VAS scores.

Lastly, in Group A, the mean time to achieve adequate analgesia was 11.60 with a standard deviation of 2.36, and in Group B, the mean time was  $10.04 \pm 1.90$  min. Sylvania H et al [6] conducted a study and reached the conclusion that there was no difference in the percentage of parturients achieving adequate labor analgesia at 10 minutes following epidural bolus between the Dural Puncture Epidural (DPE) technique and the Traditional Epidural technique. Both methods were found to be equally effective in providing prompt analgesia.

Furthermore, the study compared the time taken to achieve adequate analgesia between the two groups. The mean time to achieve adequate analgesia in Group A (DPE technique) was 10.04 minutes with a standard deviation of 1.90, while in Group B (Traditional Epidural technique), it was 11.60 minutes with a standard deviation of 2.36. The mean difference in time between the groups was 1.56 minutes, and the p-value for this mean difference was found to be less than 0.05, indicating statistical significance.

Thus, based on the study's findings, it can be concluded that the Dural Puncture Epidural technique leads to faster attainment of adequate labor analgesia compared to the Traditional Epidural technique, and this difference is statistically significant.

Pritam Yadav et al [7] conducted a study comparing the efficacy of the Dural Puncture Epidural (DPE) technique with the Conventional Epidural technique for labor pain relief in primigravida. Their conclusion was that the DPE technique has the potential to hasten the onset of analgesia and improve the quality of labor analgesia when compared to the Conventional Epidural technique. The findings from their study were consistent with the results obtained in this current study. Study by Wahba Z. Bakhet et al [8] shows in their study time to complete analgesia (NPRS  $\leq$  1) was significantly faster in the CSE group compared with the EPL and DPE group. This difference was statistically significant when comparing the EPL and CSE group. Chau and colleagues [4] conducted studies using the same Dorsal Paramedian Epidural (DPE) technique with a 25-G Whitacre needle but employed different dosing schedules: one involving 20 mL of 0.125% bupivacaine and another with 12 mL of 0.25% bupivacaine. Their findings indicated that when using a more diluted, larger initial dose, there was a quicker onset of sensory block in the thoracic region and a more extensive spread upwards. Additionally, the concentration of the local anesthetic solution and the properties of the anesthetics themselves can influence how these medications move from the epidural space to the subarachnoid space. Wang et al [5] used a lower concentration of ropivacaine in the DPE technique for labor pain relief, which resulted in a faster onset of action and more effective sacral block compared to the Epidural Analgesia (EA) technique.

Numerous other studies have also been conducted to establish the efficacy of various techniques, including DPE, Traditional Epidural, and Combined Spinal Epidural techniques. However, this study focused on comparing the efficacy of DPE and Traditional Epidural techniques specifically.

Both the DPE and Traditional Epidural techniques demonstrated a favorable safety profile, as no adverse events such as cardiovascular catastrophes, total spinal, inadvertent dural puncture, or catheter kinking were reported. Complications like nausea, pruritus, headache, fetal bradycardia, hypotension, and mode of delivery were comparable between both groups, and there was no statistically significant difference observed.

In summary, the study's results align with findings from other research studies, showing that Dural

Puncture Epidural technique offers advantages over Traditional Epidural technique in terms of faster onset and improved quality of labor analgesia. Additionally, both techniques were found to be safe, with no significant differences in the occurrence of complications between the two groups

### Conclusions

When comparing the Traditional Epidural technique with the Dural Puncture Epidural technique for labor analgesia, it was found that the Dural Puncture Epidural technique provides faster attainment of adequate analgesia compared to the Traditional Epidural technique.

Additionally, the Dural Puncture Epidural technique has shown to enhance the spread of analgesia in the sacral region, leading to quicker onset and better bilateral pain relief in laboring women. Both the Traditional Epidural and Dural Puncture Epidural techniques have demonstrated improved block quality, with minimal maternal and fetal side effects and no adverse impact on the mode of delivery.

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