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ORIGINAL ARTICLE

# Dural Puncture Epidural Technique vs Standard Epidural Technique for Labor Analgesia: A Double Blind Randomized Trial

**Lalwani Jaya[1], Sundrani O.P.[2], Singh Sushma[3]**

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## ABSTRACT

***Context:*** Labor is one of the most painful experiences a woman may face during her lifetime. Labor pain is excruciating and a significant contributor of stress and anxiety. Epidural analgesia is the most effective method of intra-partum pain relief and provides excellent safety profile for both the mother and the foetus. The present study was designed to compare the dural puncture epidural technique and the standard epidural technique for labor analgesia.

***Aims:*** To compare dural puncture epidural technique for labor analgesia with conventional epidural technique. The primary outcome measures were onset of analgesia and patient satisfaction; secondary outcome measures being duration of analgesia, number of top-ups required, APGAR score, side effects.

***Settings and Design:*** A prospective randomized double-blind trial was conducted at Dr. Bheem Rao Ambedkar Memorial Hospital, Raipur on 50 uncomplicated term primigravida in active labor.

***Methods and Material:*** Double-blind randomization to the dural puncture epidural group and standard epidural group was accomplished by means of Toss method. The procedure was carried out by one anesthesiologist while the observations were done by the second one who was not present at the time of the procedure.

***Statistical analysis:*** The statistical analysis was carried out using Statics Kingdom Calculator in stat software and Medcalc's statistical calculator.

***Results:*** The mean VAS at 15 minutes was 1.32±0.48 and 1.76±0.44 in group DPE and group E respectively ($p < 0.0001$). The mean time of onset of analgesia was significantly earlier in group DPE (16.76 ± 1.39 vs 18.56±1.47 minutes). The mean duration of analgesia was significantly prolonged in group DPE (81.04 ± 4.69 vs 78.32±3.94 minutes) ($p = 0.03$). The mean number of top-ups of local anaesthetic was significantly lesser in group DPE (1.64 ± 0.49) than in group E (1.96 ±0.2) $p < 0.0001$). There was no incidence of nausea, vomiting, pruritus, hypersensitivity, shivering, respiratory depression or urine retention in any group. The patient satisfaction score in group DPE was excellent in 80% and good in 20% while in group E it was excellent only in 32%, good in 60% and fair in 8% patients.

**AUTHOR'S AFFILIATION:**

[1] Professor, Department of Anesthesia, Pt. JNM Medical College, Raipur Chhattisgarh, India.
[2] Professor, Department of Critical Care, Pt. JNM Medical College, Raipur, Chhattisgarh, India.
[3] Senior Resident, Department of Anaesthesia, Lt. BDMM Medical College, Korba, Chhattisgarh, India.

**CORRESPONDING AUTHOR:**

**O.P. Sundrani,** Professor, Department of Critical Care, Pt. JNM Medical College, Raipur, Chhattisgarh, India.
**E-mail:** Sundraniop@rediffmail.com

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***Conclusions:*** The dural puncture epidural technique has a rapid onset and prolonged duration of analgesia as compared to conventional epidural technique without any significant maternal or neonatal adverse effects.

**KEYWORDS**

• Labor pain • Dural puncture epidural Technique • Primigravida

**KEY MESSAGES**

DPE Technique provides good analgesia and stable haemodynamics with good maternal satisfaction.

## INTRODUCTION

Labor is one of the most painful experiences a woman may face during her lifetime. Labor pain is excruciating and a significant contributor of stress and anxiety. Pain during labor is different for every woman, it ranges widely from woman to woman and even from pregnancy to pregnancy. Vast majority of patients during labor request for pain relief. Providing effective and safe analgesia during labor has remained an ongoing challenge for the anesthesiologist. The American College of Obstetricians and Gynecologists (ACOG) and the ASA, reaffirmed and jointly published an opinion that stated "in the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor."[1]

There are various methods of providing pain relief to laboring mothers which are categorized into non pharmacological and pharmacological methods. Epidural analgesia is the most effective method of intrapartum pain relief and provides excellent safety profile for both the mother and the foetus.[1] Effective epidural analgesia decreases alpha and beta-adrenergic receptor stimulation which may result in better utero-placental perfusion and more effective uterine activity. Low dose bupivacaine 0.125% and 0.0625% has been reported to produce satisfactory analgesia for labor pain than the opioids.

Dural puncture epidural technique is a newer technique in which a dural puncture is made with a small gauge spinal needle but no drug is injected into the subarachnoid space. After injection of local anesthetic in the epidural space, blockade of sacral dermatomes occurs presumably because of enhanced anesthetic solution migration across the dural puncture site.

Although there are so many myths and controversies related with progress and outcomes of deliveries in epidural labor, high quality evidence states that epidural analgesia with low dose local anesthetics is not associated with significant prolongation of duration of stage II of labor. There is no association between risk of caesarean delivery and neuraxial labor analgesia versus non-neuraxial analgesia, however an increased risk of instrumental vaginal deliveries was observed in the neuraxial group versus systemic analgesia group.[2] Thus present study was conducted with the aim to evaluate dural puncture epidural technique for labor analgesia and its comparison with conventional epidural technique in terms of onset of analgesia, duration of analgesia, number of top-ups required, patient satisfaction, APGAR score and side effects.

## MATERIALS AND METHODS

This prospective randomized double-blind trial, which was approved by the Institutional Scientific and Ethics Committee, was registered with CTRI (CTRI/2020/10/028493). The study included 50 term primigravida parturients in active labor (cervical dilatation = 4 cm) belonging to ASA physical status II with uncomplicated pregnancy in vertex presentation. Written informed consent was obtained from all patients included in the study. Patients with any history of allergy or bleeding, vertebral anomaly, local infection, those who received parenteral opioids, obstetric complication in delivery like macrosomia, pregnancy induced hypertension / eclampsia, diabetes, cephalo-pelvic disproportion were excluded from the study.

Double-blind randomization to the dural puncture epidural (DPE group) and epidural (E group) groups was accomplished by means of Toss method with head of the

Toss representing group DPE and tail of the Toss group E. Patients were kept unaware of the technique used for labor analgesia. The procedure was carried out by one anesthesiologist while the observations were recorded by another anesthesiologist who was not a part of the study.

**Procedure**

Patients were shifted to operation theater in the left lateral position and baseline vitals electrocardiograph( ECG ), non-invasive blood pressure (NIBP), heart rate (HR), and arterial oxygen saturation ($SPO_2$) were recorded with the multipara monitor (TFT GS20 Philips). Visual analogue scale (VAS) score (0 = no pain and 10 = worst pain) was also noted. An intravenous line was secured with 18 G cannula and all patients were hydrated with 10 ml/kg ringer lactate solution preoperatively. All patients were premedicated with intravenous ondansetron 4 mg and metoclopramide 10 mg. Under all aseptic precautions and with the patient in sitting position using a midline approach, 3ml of 2% lignocaine hydrochloride was infiltrated into L2-L3 or L3-L4 interspace. In the DPE group, after the epidural space was identified with 18-G Tuohy needle using loss of resistance to air technique, a 27-G Whitacre spinal needle was introduced through the Tuohy needle (needle through needle technique) and dura was punctured. After confirmation of CSF flow the spinal needle was withdrawn without injecting any drug and multi-orifice epidural catheter was threaded 4-5cm into the epidural space. In the E group dura was not punctured with spinal needle and multi-orifice epidural catheter was threaded into the epidural space similar to DPE group. After negative aspiration of CSF a test dose was given through the epidural catheter in both the groups. Patients were observed for 10 minutes for any signs of accidental intravascular or intrathecal administration. However no incidence of accidental intrathecal or intravascular catheter placement occurred in our study.

Patients in both the groups were administered a bolus dose of 10 ml of 0.125% bupivacaine in a fractionated manner of 2.5 ml fractions, waiting for 2 min between each aliquot while watching for clinical signs of an intravascular injection by asking the patient whether she had feeling of dizziness, tinnitus or met al.lic taste. This was the first bolus dose and the time was noted at the end of injection. After 15 min of the first dose, pain intensity was evaluated and the patient was asked to rate the pain experienced on VAS scale. An additional 10 ml of 0.125% bupivacaine was administered in case adequate analgesia (VAS ≤ 3) was not achieved after duration of 15 min from first bolus dose. If analgesia was inadequate after 15 min of second dose of bupivacaine, the given epidural was classified as epidural failure.

The primary outcome measures were onset of analgesia and patient satisfaction. Onset of analgesia was defined as duration from injection of first epidural bolus dose to attainment of VAS ≤ 3. The secondary outcome measures were duration of analgesia, number of top-ups required, APGAR outcome, side effects. Duration of analgesia was defined as time from onset of analgesia to the time at which contractions start causing discomfort again to the patient. Analgesia was maintained with the top-ups of 7.5 ml of 0.125% bupivacaine given in a fractionated manner of 2.5 ml fractions at 2 mins interval in both the groups. The number of top-up doses were noted. Level of sensory block was determined by a nontraumatic, blunt pinprick test which was started at the S2 dermatome and moved cephalad to identify the level of sensory block and time required to achieve this level was recorded. Preservation of motor function was assessed every 15 mins by using the modified bromage score.[2]

0. No paralysis, full flexion of knees and feet
1. Inability to raise the extended leg and ability to move knees and feet
2. Inability to move knees but ability to move feet
3. Inability to flex ankle joints, complete motor blockade of lower limbs

All the vital parameters were recorded before and after epidural block at every 5 minutes interval till 30 minutes, then at 10 minutes till 1h, every 15 minutes till 2h and then every 30 minutes till the delivery. Maternal hypotension was defined as systolic blood pressure <100 mmHg or a >20% reduction from baseline and it was treated with left uterine displacement, maternal oxygen administration, i.v. fluid bolus or i.v. mephentermine 6 mg stat. Maternal bradycardia was defined as heart rate less than 50 bpm and was treated with inj. Atropine 0.6 mg i.v. Arterial oxygen saturation (SpO2) and respiratory rate was monitored continuously. Oxygen saturation

below 94% was treated with supplemental oxygen. Foet al. bradycardia <110 bpm were documented. Pain was assessed on VAS scale at baseline and at every 15 minutes from the initiation of epidural block till the delivery. Foet al. heart rate was continuously monitored every 30 minutes and progress of labour was monitored by attending obstetrician. Neonatal outcome was assessed using APGAR score at 1 and 5 min. Maternal adverse effects during the procedure such as nausea, vomiting, hypotension, hypersensitivity reactions, pruritus, shivering, drowsiness, respiratory depression, retention of urine or weakness in limbs were recorded. Nausea and vomiting was managed by administration of i.v. ondansetron 4mg stat dose. Shivering was managed by warm blankets and warm i.v. fluids. Mode of delivery whether normal vaginal delivery or Assisted vaginal delivery (AVD) forceps or ventouse application] was recorded. Number of patients who underwent caesarean section was also recorded. Maternal satisfaction about labour experience was determined within 2 hours after delivery using a four-point scale (0 = failure of epidural block, 1 = fair, 2 = good, 3 = excellent).[3]

### Statistical Analysis

The statistical analysis was carried out using Statics Kingdom Calculator in stat software and Medcalc's statistical calculator. For all quantitative variables mean, median and standard deviation were calculated and it was compared using paired t-test. A p-value of < 0.05 was taken as a statistical significance.

## RESULTS

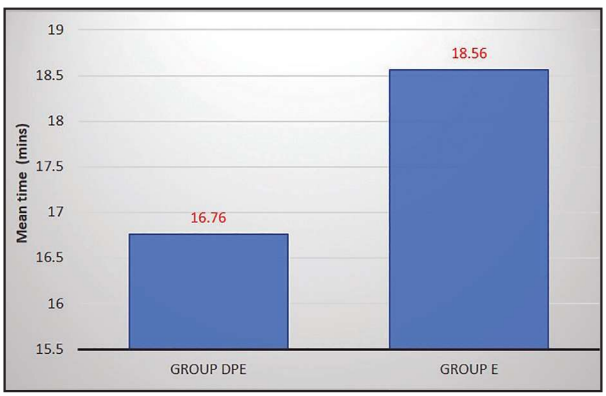
Both groups were comparable in terms of the demographic data (age, weight, height) and obstetric data (parity and cervical dilatation) [*Table 1*]. The characteristics of labor analgesia are depicted in Table 2. The incidence of hypotension was 4% in both the groups which was managed by giving 500 ml bolus Ringer lactate solution. There were no incidences of nausea, vomiting, pruritus, hypersensitivity, shivering, respiratory depression or urine retention in any group. The difference in mean APGAR score at 1 minute (PE-8.76±0.6, E-8.88±0.44) and at 5 minutes (DPE-9.4±0.58, E-9.48±0.51) was not significant between the two groups. The mode of delivery was comparable; in group DPE it was NVD-84%, AVD-16%) and in group E (NVD-68%, AVD-32%). The patient satisfaction score was excellent in 80%patients and good in 20% cases in group DPE while in group E it was excellent only in 32%, good in 60% and fair in 8% patients.

**Table 1:** Demographic Profile and Mean Cervical Dilatation at onset (cm)

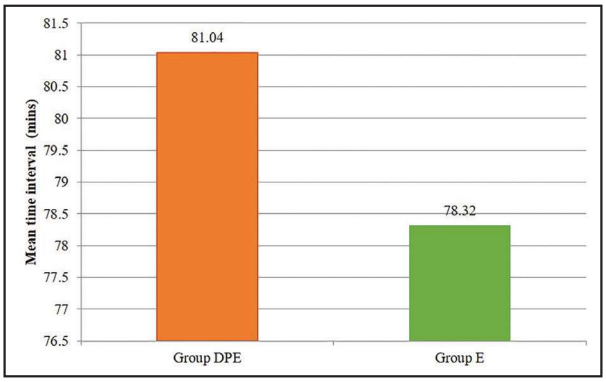
| Demographic profile | Group DPE | Group E | p-value |
|---|---|---|---|
| Age (year) | 26.72±1.95 | 26.28±2.05 | 0.44 |
| Weight (kg) | 55.8±4.4 | 56.68±4.11 | 0.47 |
| Height (m) | 1.63±0.05 | 1.61±0.05 | 0.29 |
| BMI | 21.06±1.35 | 21.91±2.25 | 0.11 |
| Cervical dilatation at onset(cm) | 3.76±0.44 | 3.52±0.51 | 0.08 |
| ASA Grade-II | 25(100%) | 25(100%) | |

**Table 2:** Characteristics of Labor Analgesia

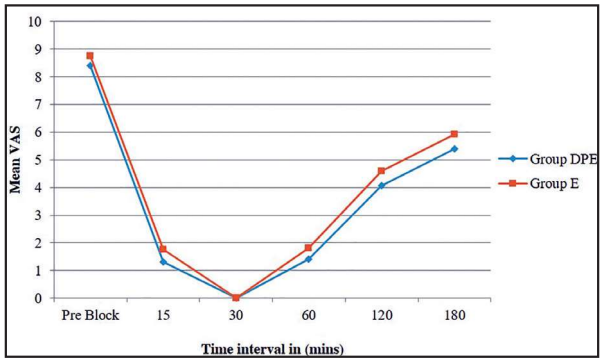
| Parameters | Group DPE | Group E | p-Value |
|---|---|---|---|
| Mean total duration of analgesia(min) | 81.04±4.69 | 78.32±3.94 | 0.03 |
| Mean LAs top-ups of bupivacaine (7.5ml of 0.125%) | 1.64±0.49 | 1.96±0.2 | <0.0001 |
| Mean total duration of labor (mins) | 383.2±54.9 | 387.6±51.58 | 0.77 |
| Mean total LAs consumed (mg) | 27.88±4.59 | 30.88±1.88 | <0.0001 |
| Mean Onset of analgesia (min) | 16.76±1.39 | 18.56±1.47 | <0.0001 |
| Mean VAS at 15 min | 1.32±0.48 | 1.76±0.44 | |




**Graph 1:** Mean Onset of analgesia




**Graph 2:** Mean Duration of Analgesia




**Graph 3:** Mean Visual Analogue Scale (VAS)

## DISCUSSION

The earlier onset and longer duration of analgesia in the DPE group than in the E group in our study may be explained by the translocation of epidural medications through a dural puncture into the subarachnoid space and has been postulated as a possible mechanism by which the DPE technique improves analgesia.[4]

The subarachnoid flux of an epidurally administered drug through a previous dural puncture, by 18 to 25-G needles is directly proportional to the size of the dural puncture and inversely proportional to the intact meningeal surface area exposed to the drug, the intrinsic diffusion capacity of the drug through an intact dura, and the distance of the dural puncture from the site of epidural drug administration.[5]

Dural puncture improves the sacral spread, onset, bilateral pain relief produced by analgesic concentration of bupivacaine in nulliparous patients.[6]

Opioids as epidural adjuvants to local anaesthetics improve the quality of the block and provide a dose-sparing effect.[7,8] Fentanyl when administered through epidural route crosses dura and binds to spinal opioid receptors. It is readily absorbed into the systemic circulation, binds to supraspinal opioid receptors to produce analgesia.[9,10] The higher lipophilicity of fentanyl results in shorter duration of action, lower incidence of side effects, and reduced risk of respiratory depression.[11] The combination of bupivacaine with fentanyl has been shown to result in longer and more effective analgesia,[12] and is in accordance with the fentanyl clearance from the CSF, and with the mean duration of fentanyl analgesia of four to five hours.[13]

Bupivacaine 0.125% has been reported to produce satisfactory analgesia for labor.[3] There is evidence that diluted solutions of local anaesthetics in a larger volume are more effective than concentrated solutions in a small volume.[14] Local anaesthetics (diluted) when given in limited dosage are sufficient to block the non–myelinated C-fibres in the first stage of labor, but may be inadequate to block the myelinated A-delta fibres in the second stage.[14]

Diluted concentrations of bupivacaine, having less motor effects may be useful in reducing operative deliveries.[6]

On the other hand, when low concentrations of local anaesthetics are used alone, analgesia may be incomplete, especially in the second stage of labor.

Cappiello *et al.*[2] observed a reduction in VAS score at 20 min in DPE group but no difference in VAS scores at any time interval before or after 20 min of onset of analgesia. This contrast in observation from our study can be possibly explained by use of 27G needle in our study as compared to 25G needle used by Cappiello *et al.*, which resulted in smaller size of dural hole. This smaller size dural hole resulted in flux of epidural drugs to intrathecal space up to 10 minutes but not after that. The differing demographic profile and analgesia technique could be the other reasons for varying observations.

In contrast to our study, Gupta et al when comparing dural puncture epidural and continuous epidural techniques observed no difference in patient satisfaction as per numerical rating scale. Their use of 25G needle and continuous epidural infusion via a 19G catheter in contrast to use of 27G needle in our study and intermittent bolus top up through 18 G catheter along with differing demographic profile could have contributed to the contrasting observations. Yadav P *et al.*[15] have also reported the mean satisfaction

score in DPE group to be excellent in 100% cases which is similar to our study. The greater patient satisfaction score in DPE group can be explained by the improvement in the sacral spread, early onset and bilateral pain relief produced by epidural bupivacaine in nulliparous patients when preceded by dural puncture with a spinal needle. Other authors have used parameters other than patient's satisfaction scale to define quality of analgesia, so could not be compared with our study. The prolonged duration of analgesia and fewer top ups in DPE also led to a better patient satisfaction.

This difference in results of our study from others can be possibly explained by the use of higher volume and concentration of local anaesthetic (12 ml of 0.25% bupivacaine) and use of patient controlled epidural analgesia (PCEA) pump along with background infusions.

There are several limitations that must be considered. Intermittent boluses of local anaesthetics were used in our study for relief of pain instead of standardized technique of patient controlled epidural analgesia (PCEA) or continuous infusion technique due to non-availability of equipments. Also the ultrasound guided neuraxial blocks in difficult cases should be used to minimize the adverse effects on progress and outcome of labor along with improving analgesia, patient satisfaction and reducing motor block.

## CONCLUSION

The present study concluded that the use of 0.125% bupivacaine via DPE technique for relief of labour pain in parturients provides good analgesia, adequate level of sensory block, good motor function with stable haemodynamics. Maternal satisfaction level was “Excellent” or “Good” in most of the patients without any significant maternal or neonatal adverse effects.

***Conflict of Interest:*** Nil

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