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Original Article

Combined Spinal- Epidural in Labor Analgesia: Comparison of Fentanyl Bupivacaine Mixture versus Sufentanil - Bupivacaine Mixture

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Abstract

Background: We conducted a prospective randomized control trial on labor analgesia involving 30 parturient. We evaluated and compared the efficacy of bupivacaine fentanyl (BF) and bupivacaine-sufentanil (BS) administered in combined spinal-epidural for labor analgesia. The time required to achieve fitness for ambulation after intrathecal drug administration was also assessed. 30 parturients who voluntarily opted for labor analgesia were randomly divided into two groups to receive either BF or BS.

Methods: The intrathecal drug solution was bupivacaine (2.5 mg) with either fentanyl (25 μg) or sufentanil (5 μg). This was followed by continuous infusion of 10 ml/h 0.0625% bupivacaine with either fentanyl 2.5 μg/ml or sufentanil 0.5 μg/ml when the intrathecal drug effect weared off. Ambulation was assessed at 30, 45, and 60 min after intrathecal drug administration.

Results: Demographic data and labor characteristics were comparable between the groups, all parturient in both the group had rapid onset of analgesia (3.25 ± 0.29 min in group BF vs. 3.23 ± 0.19 min in group BS). There was motor block following intrathecal drug administration (Modified Bromage score of 1 or 2) in all parturients. The duration of analgesia following intrathecal drug administration was comparable between the two groups (89.29:I:15.78 min in group BF vs. 87.60 ± 14.47 min in group BS). The epidural drug solution was started when visual analog scale (VAS) pain score exceeded 40. After negative aspiration, bolus of 10 ml of drug solution was given in increments. VAS score, maternal heart rate (HR), blood pressure, saturation, and fetal HR were observed at 5, 10, 20, and 30 min after intrathecal drug administration and every 30 min until epidural was initiated. The duration of the first stage of labor was 218.56 ± 69.56 min in group BF and 211.56 ± 58.96 min in group BS. The duration of the second stage of labor was 54.90 ± 32.27 min in group BF and 51.78 ± 16.71 min in group BS.

Conclusion: Both the combination provided equally efficacious analgesia. The numbers of breakthrough pain episodes were comparable between the groups. The VAS score was comparable between the groups at all intervals during epidural drug infusion. The duration for which epidural drug was administered and the amount of bupivacaine consumed was similar between the two groups. 11 parturient in group BF and 13 in parturient in group BS rated their pain relief as excellent

Key words: Fentanyl, Intrathecal drug, Spinal-epidural anesthesia, Sufentanil, Visual analog scale score

INTRODUCTION

Labor is a physiologic process but associated with the severest form of pain.[1] Some parturients have rated pain as severe as amputation of the digit without anesthesia.[2] Unrelieved labor pain is associated with maternal hyperventilation during uterine contractions and increased oxygen consumption[3] and excess stress with increased plasma epinephrine and norepinephrine concentration.[4,5] ACOG and ASA jointly opined that maternal request is sufficient enough indication for the provision of labor analgesia.[6] Labor analgesia is being provided by various techniques. Nonpharmacological method of providing labor analgesia was comforting but do not provide adequate pain relief.[7] Pharmacological method of providing labor analgesia depends on

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the usage of inhalational agents, opioid, and local anesthetics. Inhalational agents provide some analgesia but were associated with uterine relaxation and maternal hypoxemia.[8] Opioid are used parenterally for providing labor analgesia but associated with maternal and fetal adverse effect such as maternal sedation and neonatal respiratory depression.[9,10] Regional analgesia is widely used for providing labor analgesia. They include both peripheral and central neuraxial block. Bilateral cervical and bilateral paravertebral block provide analgesia only during the first stage of labor bilateral pudendal block provides effective analgesia only during the second stage of labor. Central neuraxial block is the only method of providing effective analgesia during both stages of labor.[11] Spinal analgesia provides the short duration of action. This technique will not be able to provide adequate analgesia for the whole duration of labor.[12] Caudal epidural is lone of oldest method for providing labor analgesia, but the success rate is low.[13] Lumbar epidural analgesia is the most widely used technique for providing labor analgesia. This is considered gold standard in providing labor analgesia. It can provide analgesia for both the stages of labor and can be extended to provide anesthesia for cesarean section or instrumental delivery if the need arises. The drawback with this technique includes delayed onset of analgesia[14] and failure rate of 1.5–5% despite correct identification of epidural space.[15] Combined spinal epidural (CSE) is a relatively new technique which combines the advantage of both spinal (rapid onset) and epidural (prolonged duration of action). The analgesia in the intrathecal component can be provided by opioid only[12] or local anesthetic only.[16] However, the combination of opioid helps in reduction of the local anesthetics requirement and prolongation of the duration local anesthetic action. These also help in decreasing the incidence of maternal hypotension and motor block.[17] This reduced motor block allows maternal ambulation throughout labor. Ambulation during labor increases maternal satisfaction. Ambulation also observed to decrease the incidence of instrumental delivery,[18] decreased oxytocin requirement, and duration of labor.[19]

The combination of local anesthetic and opioid used in epidural delivered by include intermittent boluses, continuous infusion, and patient-controlled epidural analgesia (PCEA). Studies comparing the different modes of epidural drug administration found increased drug consumption and motor block with continuous infusion technique.[20,21,22] These studies were refuted by other authors who observed no difference in the drug consumption or motor block with continuous infusion compared to intermittent boluses or PCEA.[24] Fentanyl and sufentanil most commonly used in combination with local anesthetics were found to be effective in providing labor analgesia. Studies comparing fentanyl and sufentanil in labor analgesia are few and give conflicting results. Some studies observed sufentanil had a prolonged duration of action than fentanyl[25] while others did not find any difference in the duration of action between the two drugs. Hence, we did a study to compare the efficacy between fentanyl and sufentanil combined with low dose bupivacaine intrathecally and low concentration bupivacaine by continuous infusion in the epidural route using CSE technique.

Aims and Objectives

The objectives are as follows:

1. To compare the efficacy of intrathecal bupivacaine fentanyl (BF) mixture with bupivacaine sufentanil (BS) mixture for providing labor analgesia.
2. To compare the efficacy of continuous epidural infusion of BF mixture and BS mixture following intrathecal analgesia when used to alleviate labor pain by CSE.
3. To compare the time required to achieve fitness criteria for ambulation after intrathecal BF mixture and BS mixture administration.

MATERIALS AND METHODS

The study was prospective, double-blind, and randomized control study. The parturients who opted for labor analgesia were randomly divided into two groups. The parturients were explained about the CSE procedure and visual analog scale (VAS) score for pain. 30 ASA I and II, singleton primigravidae with vertex presentation were divided randomly into two groups after obtaining informed written consent. One group received CSE with fentanyl and bupivacaine (Group BF), while the other group received sufentanil and bupivacaine (Group BS) intrathecally followed by continuous epidural infusion of the same combination of drugs when the intrathecal analgesia weared off. Both the parturient and observer were blinded to the study solution.

Exclusion Criteria

The following criteria were excluded from the study:

1. Parturient refusal
2. Parturients with any contraindication to neuraxial block
3. With multiple pregnancies
4. Parturient with obstetrics complication
5. Parturient who had received opioid by another route during previous 4 h.

Labor analgesia was initiated when cervix dilatation reached 3–5 cm. The baseline maternal heart rate (HR), blood pressure (BP), and oxygen saturation (SPO_2) were recorded. All parturients were preloaded with 10 ml/kg of Ringer

lactate intravenously. The CSE was administered in the operation theater with parturients in left lateral position at the level of $L2_{-3}/L_{3-4}$ space under all aseptic precautions.

Study Design

The technique of cse was the same in both groups. The CSE comprised of an 18G Tuohy needle, a 27G spinal pencil point needle and an epidural catheter with filter (Portex). The study drug solutions for intrathecal drug administration and epidural infusion were prepared by one of the investigators who did not participate further in the study observations. A needle through needle technique was followed for CSE. The parturients were randomly divided into two groups to receive one of the following study solutions.

Intrathecal

Group I (BF): Bupivacaine 2.5 mg	0.5 ml 0:0.5% heavy bupivacaine
±	±
Fentanyl 25 μg	0.5 ml of fentanyl

Total volume of injectate = I ml

Group II (BS): Bupivacaine 2.5 mg	0.5 ml of 0.5% bupivacaine
±	±
Sufentanil 5 μg	0.1 ml sufentanil ± 0.4 ml of NS

Total volume of injectate= I ml

The time of intrathecal injection of the above study solution was noted, the spinal needle removed, and epidural catheter was placed about 4 cm toward cephalic end inside epidural space and secured. After intrathecal drug administration, the parturient was made to lie in the supine position. The maternal HR, BP, SPO_2, motor power, sensory block level, VAS score for pain, the fetal heart rate (FHR), the time for onset of analgesia, and intrathecal duration of action were monitored.

When intrathecal analgesia weaned off and VAS > 40, an epidural bolus and continuous epidural infusion were initiated. No test dose was given, but bolus dose was given in increments, injected slowly after negative aspiration test to rule out intrathecal intravascular placement of the catheter.

Epidural

Group I (BF): 0.0625% bupivacaine ± 2.5 μg/ml fentanyl.

Group II(BS): 0.0625% bupivacaine ± 0.5 μg/ml sufentanil.

The 10 ml of the above study solution was given as a bolus. Initially, 4 ml of study solution was injected slowly, and maternal non-invasive BP, HR, SpO_2, VAS, motor block, and sedation were recorded for 10 min. If no sign suggestive of intrathecal or intravascular placement of the catheter, remaining 6 ml was injected slowly again after negative aspiration test, and the maternal and fetal vitals were monitored for another 20 minutes before initiating infusion. The infusion rates were as follow:

Group I (BF): 0.0625% bupivacaine ± fentanyl 2.5 μg ml at 10 ml/h.

Group II (BS): 0.0625% bupivacaine ± sufentanil 0.5 μg ml at 10 ml/h.

Preparation of Epidural Drug Solution

Group I (BF)

6.25 ml of 0.5% heavy bupivacaine
±
2.5 ml (125 μg) of fentanyl
±
41.25 ml of NS

→ Total volume of 50 ml

Group II (BS)

6.25 ml of 0.5% heavy bupivacaine
±
0.5 ml (25 μg) of sufentanil
±
43.25 ml of NS

→ Total volume of 50 ml

Whenever the VAS score was >40, a bolus of 5 ml of the above study solution was given and observed for 20 min. If pain relief is still inadequate another bolus of 2.5 ml of study solution was given and again observed for 20 min before the administration of another top-up if required. The same drug solution at the same rate was continued in the second stage of the labor until the fetus was delivered.

All women in both groups were allowed to ambulate, after meeting the fitness criteria for ambulation and under the supervision of a doctor or nurse. The parturient ambulated only if she wished to do so. If the women in any group suffered hypotension (≥20% fall in the baseline and systolic BP), it was treated by intravenous fluid, supplemented by 2, positioning patient in left lateral position, and incremental bolus dose of IV ephedrine. In both groups, in case of inadvertent dural puncture, the epidural needle was removed, and epidural analgesia was provided one space above with 0.25% bupivacaine as per standard departmental protocol. The parturient was taken out of the study, and

the same was noted as technique complication. Number of attempts in establishing CSE and difficulty in epidural catheter placement was noted. Nausea and vomiting were treated with ondansetron 4 mg IV. Pruritus was usually self-limiting. Hence, parturients were given reassurance and treated with chlorpheniramine maleate 12.5–25 mg intravenously if it was severe. In case of instrumentation delivery, a 8–10 ml of 0.5% bupivacaine was given through the epidural catheter. Occurrence of fetal bradycardia was dealt with reliving aortocaval compression by putting the mother in left lateral position, discontinuing IV oxytocin drip if any and 2 supplementations. Naloxone was kept ready to treat if any neonatal respiratory depression occurs. The epidural catheter was removed 12–24 h after the delivery.

Observations and Assessment

The pain was assessed by 0–100 mm, VAS scale taking 0 as no pain and 100 as maximum pain. VAS score was measured at the peak of uterine contractions. After intrathecal drug administration, the VAS was assessed at 5, 10, 20, and 30 min and then every 30 min until the requirement of epidural analgesia.

Onset of Analgesia

From time of intrathecal drug administration to time of VAS < 40.

Duration of Analgesia

From VAS <40 to time for requirement of epidural analgesia.

After epidural bolus and starting of infusion, VAS was recorded every 10 min for first 30 min and every 30 min thereafter until the end of delivery. Maternal HR, noninvasive BP, SPO_2, and FHR were recorded as per the same interval. Upper level of sensory block was determined in the midclavicular line using bilateral pinprick testing. Motor block was assessed by straight leg rising against resistance using a modified Bromage scale. Both these parameters were monitored at 10, 20, and 30 min after intrathecal drug administration and every 30 min, until the end of intrathecal analgesia. After epidural analgesia, the motor and sensory block was monitored initially at 10, 20, and 30 min and every 30 min later, until the delivery of the baby. The criteria for fitness of ambulation were assessed at 30, 45, and 60 min after intrathecal analgesia. Sedation was assessed by four-point scale at every 15 min intervals after intrathecal analgesia. Pruritus and nausea were rated subjectively as none, mild, moderate, or severe. Hypotension and bradycardia were treated and documented. Similarly, urinary retention, if it occurs, was treated by catheterization and documented. Neonatal APGAR at 1 and 5 min were recorded. At postpartum each study participant was asked to rate overall satisfaction on 3 point scale. The patients were followed for post-dural puncture headache until she was in a hospital stay.

Duration of First Stage of Labor

Time of onset of labor to full cervical dilatation.

The Duration of Second Stage of Labor

Time of full cervical dilatation to the delivery of the baby.

The mode of delivery, the need for instrumentation with its cause and type of instrument used, need for cesarean section with its cause, was recorded. The total amount of bupivacaine in each group individually; fentanyl and sufentanil required in corresponding groups were recorded. Numbers of top-up required in each group were noted. All the data collected were analyzed statistically with the appropriate test.

RESULTS AND OBSERVATION

The study was a randomized, double-blind control study on 30 primiparous parturients. CSE procedure was done, and cerebrospinal fluid (CSF) was identified in all parturient. 15 parturient in each group received intrathecal BF or BS followed by continuous infusion of the same drug solution till the end of delivery. In one parturient CSF was identified, and intrathecal drug was given, but there was technical difficulty in threading the epidural catheter. Hence, this parturient was excluded from the study, and one more parturient was included in her place to complete the study for further statistical analysis.

Demographic Characters

The demographic characters (age, weight, and height) were comparable in both the groups [Table 1].

Onset of Action

Onset of action was defined as the time of intrathecal drug administration to the VAS score to become <40. In Group BF, the onset of action was 3.25 ± 0.29 min and in group BS the onset of action was 3.23 ± 0.19 min. All parturient had no pain on the first contraction after intrathecal drug administration which usually occurred within 2–4 min of drug administration [Table 2].

Duration of Action

Duration of action was the duration from the time of onset of action (VAS < 40) to the time for the requirement of epidural analgesia. 1 parturient in group BF and five parturient in group BS were taken for the emergency cesarean section before the request for additional analgesia. In group BF another parturient delivered before initiation of epidural. In both the groups, the duration of action

Table 1: Demographic characteristics

Variable	Group BF (*n*=15)	Group BS (*n*=15)	*P*
Age (year)	25.87±2.59	26.87±3.07	NS
Weight (kg)	67.10±9.75	63.05±6.80	NS
Height (cm)	160.33±4.92	160.80±6.80	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

Table 2: Onset and duration of intrathecal drug action

Variables	Group BF (*n*=15)	Group BS (*n*=15)	*P* value
Onset of action (min)	3.25±0.29	3.23±0.19	NS
Duration of action (min)	89.29±15.78	87.60±14.47	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

was comparable (89.29 ± 15.78 min in BF and 87.60 ± 14.47 min in BS group) [Table 2]. The minimum duration was 65 min in BF group and BS group it was 64 min. The maximum duration was 114 min in BF group and 110 min in BS group (65–114 min in BF group and 64 –110 min in BS group).

Fitness Criteria for Ambulation Achieved

The fitness criteria for ambulation were achieved in 53.35 ± 5.77 min in BF group and 50.80 ± 8.11 min in BS group. Ambulation was assessed at 30, 45, and 60 min after intrathecal drug administration. No parturient achieved fitness criteria for ambulation at 30 min. All parturient fulfilled the criteria for ambulation within 45–60 mm.

VAS Score

After intrathecal analgesia

VAS score reached 0 within 5 min of intrathecal drug administration in all parturients. The score persisted at 0 at 30 min in all except 2 parturients. One parturient in group BF had a score of 18, and another parturient in group BS had score of 10 at 30 min [Table 3].

After epidural analgesia

VAS score was comparable between two groups at any interval during epidural infusion. The baseline VAS score recorded before initiating epidural was 42.93 ± 12.45 in the BF group and in BS group it was 44.24 ± 10.47. VAS score was higher (39.46 ± 16.99 in BF group and 33.71 ± 5.79 in BS group) at 10 min after initiating epidural. It remained at a higher level for next 20 min [Table 4].

Labor characteristics and obstetric outcome

The cervical dilatation at which CSE initiated was 3.471 ± 0.40 cm in BF group and 3.80 ± 0.41 min BS group. The gestational age was 37.86 ± 0.74 weeks in BF group

Table 3: Pain score (VAS) after intrathecal drug injection

Interval (min)	Group BF (*n*=15)	Group BS (*n*=15)	*P* value
0	83.00±11.48	82.93±10.97	NS
5	0.00±0.00	0.00±0.00	-
10	0.00±0.00	0.00±0.00	-
20	0.00±0.00	0.00±0.00	-
30	1.28±4.81	0.60±2.58	NS
60	3.54±8.86	9.67±12.22	NS
90	27.46±11.08	27.78±14.46	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil, VAS: Visual analog scale

Table 4: Pain score (VAS) during epidural infusion

Interval (min)	Group BF (*n*=13)	Group BS (*n*=10)	*P* value
0	42.93±12.45	44.24±10.47	NS
10	39.83±17.99	34.13±5.49	NS
20	34.45±12.34	30.12±7.09	NS
30	31.18±8.72	29.99±6.34	NS
60	26.20±8.04	24.40±11.37	NS
90	28.78±15.64	26.80±6.83	NS
120	30.75±8.71	26.00±7.81	NS
150	27.83±6.97	31.00±11.86	NS
180	28.00±15.39	29.00±10.89	NS
210	32.87±12.76	31.97±12.93	NS
240	35.00	-	-
270	27.00	-	-
300	36.00	-	-

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil, VAS: Visual analog scale

(37–40 weeks) and 38.73 ± 0.70 weeks (38–40 weeks) in BS group. Both these labor characters were similar and statistically insignificant. Labor was induced with dinoprostone (cerviprime) in 20 parturients (11 in BF group and 9 in BS group). 10 parturient had spontaneous onset of labor (4 parturient in BF group and 6 parturient in BS group). Oxytocin augmentation for labor was done in 25 parturients (12 in BF group and 13 in BS group). Oxytocin augmentation was done at the discretion of attending obstetrician [Table 5].

Duration of Labor

The average duration of the first stage of labor was 218.56 ± 69.56 min in group BF and 211.56 ± 58.96 min in group BS, the range being 69–320n: In BF group and 135–235 min in group BS. The average duration of the second stage of labor was 54.90 ± 32.27 min in BF group versus 51.78 ± 16.71 min in BS group. This difference was not statistically significant [Table 6] (*n*=9 after excluding parturients who underwent cesarean section).

Mode of Delivery

14 parturients had spontaneous vaginal delivery (6/15 in BF group and 8/15 in BS group). 3 in group BF and 1 in group BS had forceps-assisted delivery. In all the four Parturients, the indication was poor maternal effort. Six

Table 5: Labor characteristics

Interval (min)	Group BF (*n*=15)	Group BS (*n*=15)	*P*
Cervical dilatation (cm)	3.471±0.40	3.80±0.41	NS
Estimated gestational age (week)	37.86±0.74	38.73±0.70	NS
Induction (%)			
Yes	11 (73.3)	9 (60)	NS
No	4 (26.7)	6 (40)	NS
Augmentation (%)			
Yes	12 (80)	13 (8.7)	NS
No	3 (20)	2 (13.3)	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

Table 6: Duration of labor

Stage of labor	Group BF (*n*=9)	Group BS (*n*=9)	p value
First stage (min)	218.56±69.56	211.56±58.96	NS
Second stage (min)	54.90±32.27	51.78±16.71	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

parturient in each group underwent emergency cesarean section [Table 7]. Fetal bradycardia was the indication for cesarean section in 6 parturients in group BF and 6 parturient in group BS. In one parturient in group BF, the indication was fetal tachycardia, and in another, the indication was nonprogression of labor. None of the parturients in group BS had nonprogression of labor or fetal tachycardia.

Number of Breakthrough Pain Episodes

15 parturients (8 in SF group and 7 in BS group) had no breakthrough pain during epidural continuous infusion. 7 parturient had I episode of breakthrough pain (4 in BF group and 3 in BS group). 6 parturients had 2 episodes of breakthrough pain (3 parturient in each group). The breakthrough pain episode usually occurred as the labor progressed. These differences were statistically not significant [Table 8].[23]

Epidural Bupivacaine Consumption

Bupivacaine consumption was 23.89 ± 12.77 mg in BF group as compared to 22.84 ± 9.96 mg in group BS. This was not statistically significant. In both groups, the same concentration of bupivacaine was used, and rescue analgesia for breakthrough pain during epidural analgesia was managed with same amount of bupivacaine in both the groups. Hence, the difference in the amount bupivacaine used was related to the difference in the duration of labor, duration of epidural drug administered and the number of breakthrough pain episodes. We did not perform statistical analysis for the epidural opioid since the potency of fentanyl and sufentanil is not same. Hence, the amount of fentanyl would be high [Table 9].

Table 7: Mode of delivery

Made of delivery	Group BF *n*=15 (%)	Group BS *n*=15 (%)	*P* value
Spontaneous vaginal	6 (40)	8 (53)	NS
Forceps application	3 (20)	1 (6.7)	NS
Cesarean section	6 (40)	6 (40)	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

Table 8: Number of break through pain episode

	Group BF (*n*=15)				Group BS (*n*=15)				*P* value
	0	1	2	3	0	1	2	3	
	Number of pain episodes								
Number of parturients	8	4	3	0	7	3	3	0	NS

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

Table 9: Epidural duration, bupivacaine, and opioid used

Variables	Group BF (*n*=13)	Group BS (*n*=10)	*P* value
Duration (min)	154.77±94.22	160.60±94.22	NS
Bupivacaine (mg)	23.89±12.77	22.84±9.96	NS
Opioid (μg)	92.05±54.09	35.50±39.30	-

P<0.05 is considered significant. BF: Bupivacaine fentanyl, BS: Bupivacaine sufentanil

DISCUSSION

The goal of labor analgesia is to provide adequate pain relief without causing any maternal or fetal jeopardy. Epidural analgesia is the common method of providing labor analgesia while CSE is gaining popularity in labor analgesia. Opioids are commonly being used in combination with local anesthetic drugs through central neuraxial route for labor analgesia. Opioids help in reducing the minimum analgesic dose of the intrathecal local anesthetic drug[26] and the concentration of local anesthetic agent given epidurally.[27] This helps in preserving maternal ambulation throughout the process of labor by avoiding motor block CSE technique provides rapid onset of action similar to spinal analgesia, and the analgesic duration can be prolonged by activating the epidural. In our study, we used either 25 μg fentanyl or 5 μg sufentanil added to 2.5 mg bupivacaine in the intrathecal component of CSE. Addition of opioid to local anesthetic epidurally helps to reduce the local anesthetic concentration. Both fentanyl[28] and sufentanil[27] were found to have dose-sparing effect on bupivacaine when coadministered epidural. Chestnut *et al.* in their study found both 0.0625% bupivacaine and 0.125% bupivacaine produced similar quality of analgesia. In both

groups, fentanyl 2 μg/ml was added to the local anesthetic drug solution.[29]. In another study by Chestnut *et al.* found that a combination of 0.0625% bupivacaine with 2 μg/ml of fentanyl provided adequate analgesia during both stages of labor including the second stage of labor.[30] Bernard *et al.* in their study compared two different concentrations of ropivacaine 0.1% and 0.2% in 6 different volumes. 3 groups received diluted solution in both stages of labor analgesia while the other 3 groups received concentrated solutions for the second stage of labor. They found no difference between the two groups in terms of adequate pain relief in the second stage of labor. This led them to conclude that there was no role for increasing the concentration of local anesthetic drug during the second stage of labor to improve analgesia. Rather increasing the volume of drug solution is sufficient.[31] Similarly sufentanil at 0.5 μg/ml added to local anesthetic drug solution epidurally observed to produce adequate analgesia and helps in the reduction of local anesthetic concentration.[32] Herman *et al.* in their study found that the potency ratio of epidural fentanyl and sufentanil, when coadministered along with 0.125% bupivacaine, was 5:1.[33] In our study, we compared the efficacy of 0.0625% bupivacaine with either 2.5 μg 1 ml fentanyl or 0.5 μg ml of sufentanil as a continuous epidural infusion. The concentration of bupivacaine remained the same in both stages of labor and rescue analgesia for breakthrough pain was provided by boluses of the same drug solution. One of the advantages of using a low concentration of a local anesthetic opioid combination is limited to absent motor block. This helps the parturient to ambulate or move about in their bed on their own. There is a general agreement that ambulation provides better maternal satisfaction as parturients can carry out their self-requirements. In our study, we used a low dose of and low concentration of bupivacaine epidurally. We allowed parturients to ambulate under supervision after achieving the criteria for fitness of ambulation.

Pain Score after Intrathecal Analgesia

In our study, we planned to assess the VAS score 5 min after intrathecal drug administration. However, we noticed initially that the VAS score was 0 within 5 min of intrathecal drug administration and all the parturients had no pain on the first contraction after intrathecal drug administration, which usually occurred within 2–4 min. We found the onset of action was comparable in both groups (3.25 ± 0.29 min vs. 3.23 ± 0.19 min). All parturients had a VAS score of 0 within 5 min of intrathecal drug injection. The score was 0 in all parturients until 20 min after intrathecal analgesia. After half hour still, the VAS score remained 0 in all parturients except parturients in BF group and one parturient in the BS group. They had a VAS score of 18 and 10 at 30 min, respectively. The duration of intrathecal analgesia was comparable in both the groups. 5 parturients in BS group and one in the BF group were taken for emergency cesarean section due to fetal bradycardia before intrathecal effect had weared off. One parturient in BF group delivered before intrathecal analgesia weared off. After excluding these parturients, the subgroup analysis showed the duration of action to be 89.29 ± 15.78 min in the BF group and 87.60 ± 14.47 min in the BS group. Buvanendra *et al.* in their study found the duration of 25 μg of fentanyl added to 2.5 mg bupivacaine was 94.5 min.[34] Wong *et al.* found that the duration of 5 μg sufentanil added to 2.5 mg bupivacaine was 93 ± 45 min.[35] Cheng *et al.* in their study compared the duration of action of intrathecally administered 25 μg fentanyl and 5 μg sufentanil added to 1.25 mg of bupivacaine. They found that the duration of action was 109 ± 49 min in fentanyl group and 18 ± 54 min in sufentanil group.[24] Stocks *et al.* they found the minimum local analgesic dose of intrathecal bupivacaine to be 1.99 mg when coadministered with 25 μg fentanyl.[36] The bupivacaine dose used by Cheng *et al.* was lower than the minimum local analgesic dose.[24] Despite this the duration of action in both fentanyl and sufentanil groups was more than in our study.

VAS Score after Epidural Drug Administration

In epidural route, after negative aspiration for blood or CSF, a bolus of 10 ml of analgesic drug solution as given as a slow bolus over 30 min (4 ml in 10 min ± 6 ml in 20 min) when the intrathecal analgesia weared off. After bolus dose, the epidural drug solution of 0.0625% bupivacaine with either 2.5 μg/ml of fentanyl or 0.5 μg/ml of sufentanil started as an infusion at the rate of 10 ml/h. In our study, we did not use the traditional epidural test dose. D'Angelo *et al.* similarly administered the epidural drug in increments without any test dose and did not had any case of accidental intrathecal or intravascular drug injection.[37] Rawal *et al.* described that the possibility of serious sequelae was avoided when low dose local anesthetic drug and opioid mixture was accidentally administered through a catheter either intravascularly or intrathecally. If intravascular injection occurs that the result would be minimal analgesia with regressing sensory level and maternal or fetal effects were absent or minimal. If the drug solution was administered accidentally by the intrathecal route, the possible worst scenario may be a slowly increasing motor blockade with minimal loss of sympathetic tone.[38] Morgan *et al.* described that they administered 1200 CSE at Queen Charlotte's hospital in labor analgesia without administering test dose and they did not have any serious adverse event such as intravascular or intrathecal placement or migration.[39] We wished to avoid the test dose because the high concentration of local anesthetic drug used in test dose may preclude ambulation.[40] VAS pain score was comparable at varying intervals in both groups during epidural infusion [Table 5]. Number of breakthrough

pain episodes requiring interventions were similar in both the groups. 4 parturient in BF group and parturient in BS group required 1 intervention. 3 parturient in each group required 2 interventions. This was statistically insignificant. All the interventions were required for breakthrough pain. No interventions were required for any untoward effects such as slow increase in motor block or loss of analgesic effect with regressing sensory level. Most of the breakthrough pain episodes occurred in one of the two following occasions. First when intrathecal analgesia effect weared off and epidural analgesia was just initiated. The reason was that we started epidural infusion only when the intrathecal analgesic effect weared off. The epidural effect took time to come and required 1 or 2 additional boluses to achieve adequate analgesia. Second occasion in which more interventions were required was advanced stage of labor. Connelly *et al*. compared the efficacy of fentanyl and sufentanil when administered by the epidural route for labor analgesia. They found that the duration of action and pain scores was comparable between the groups.[41] We also found that both sufentanil and fentanyl were equally efficacious in reducing the local anesthetic drug concentration when coadministered with low concentration bupivacaine.

Ambulation

Fitness criteria for ambulation were assessed at varying intervals starting from 30 min after intrathecal drug administration. The fitness criteria for ambulation included the absence of maternal hypotension, straight leg rising possible, able to perform partial knee bending, and negative Romberg's sign. In both groups, parturients achieved fitness criteria for ambulation at 53.35 ± 5.77 min in BF group (range 45–60 min) and 50.80 ± 8.11 min in BS group (range 45–60 min) [Table 3]. All parturients in our study were able to perform partial knee bending test. Some parturients expressed displeasure in performing partial knee bending test or uncomfortable in performing partial knee bending test. Cohen *et al*. in their study described that 37% of the parturients were not able to perform partial knee bending despite they were able to ambulate. In the same study, they had noticed some parturients were not able to perform partial knee bending even before initiating labor analgesia. In our study, parturients were allowed to ambulate under supervision once fitness for ambulation is achieved. Many mothers expressed satisfaction when they were able to change their position from supine to sitting or vice versa on their own. Chapelle *et al*. in their case–control study that in women who ambulated for a mean duration of 60 min had lesser instrumental delivery compared to who did not ambulate. They also noticed that the duration of labor was prolonged in ambulation group.[18] In contrast, Frenea *et al*. did not find any prolongation of labor duration or decreased incidence of instrumental delivery in parturients who ambulated for a mean duration of 64 min when compared to women who did not ambulate.[19] Despite all parturients fulfilling criteria for ambulation only one parturient wished to ambulate while others restricted themselves to bed. The reason was a senior member of their family accompanying them suggested not to ambulate. Hence, we were not able to assess the presence or absence of any benefit due to ambulation in terms of oxytocin requirement, bupivacaine consumption, or incidence of instrumental delivery.

Maternal Satisfaction

13 parturient in BF group and 11 parturient in BS group rated their pain relief as excellent. 4 parturient in BF group and 2 parturient in BS group had some pain relief. None of parturient rated their pain relief as no relief. The maternal satisfaction was assessed in the postpartum period irrespective of mode of delivery. The parturients were specifically asked to rate only their pain relief. This was done to rule out the influence of the impact of delivery outcome in rating pain relief. All parturients who underwent cesarean section before the spinal effect weared off rated their pain relief was excellent. This was obvious since all parturients had low VAS score during the spinal effect. All the parturients who rated their pain relief as some relief had received both spinal and epidural analgesia. They rated the spinal analgesia effect as excellent and pain relief with epidural as some relief. All these parturients had 1 or 2 episodes of breakthrough episodes. The maternal satisfaction was comparable between the groups. Both group parturients had equally efficacious analgesia both after intrathecal drug administration and during epidural drug infusion.

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