

# Patient-controlled Analgesia with Epidural Bupivacaine-Fentanyl Combination for Labor Analgesia

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## Abstract

**Background:** Pain relief to the parturient in labor is one of the prime responsibilities of the anesthesiologist. Today with the availability of continuous epidural analgesia, we are able to achieve this goal with the patient satisfaction.

**Aim:** To evaluate the efficacy of bupivacaine-fentanyl combination in alleviating labor pain, study its effects on mother and fetus and progress of labor and delivery.

**Materials and Methods:** A total of 100 cases were selected at random and grouped 50 cases and 50 controls each. Satisfactory block was established with continuous epidural analgesia using initial loading dose of 10 ml of 0.25% bupivacaine with 50 µg of fentanyl followed by background infusion of 0.125% bupivacaine with 0.5 µg/ml of fentanyl, 10 ml/h. A patient-controlled analgesia dose of 5 ml with the lockout interval of 15 min was set. The patient's pulse, blood pressure, fetal heart rate, level of sensory analgesia, intensity of motor blockade, and sedation score noted. The nature of uterine contractions, duration of the first, second, and third stage, any complications during labor, nature of delivery, APGAR score were noted in both case and control groups.

**Results:** Labor analgesia was excellent in 70% of the cases and good in 22% of the patients.

**Conclusion:** We conclude that the patient-controlled continuous lumbar epidural analgesia with low dose bupivacaine-fentanyl combination provides effective pain relief during labor.

**Key words:** Bupivacaine, Fentanyl, Labor analgesia, Patient-controlled analgesia pump

## INTRODUCTION

In 1929, Haggard wrote, "The position of woman in any civilization is an index of the advancement of that civilization; the position of woman is gauged best by the care given to her at the birth of her child."<sup>1</sup> The Western civilization made a giant leap on January 19, 1847, when James Young Simpson used diethyl ether to anesthetize a woman with a deformed pelvis. John Snow anesthetized

Queen Victoria for the delivery of Prince Leopold and Princess Beatrice which made labor analgesia popular among layman.<sup>2</sup>

Childbirth is a very painful process. It represents the most common form of acute severe pain in adult life. The severity compared to that of causalgia, cancer pain, and amputation of digits and expressed as the worst pain experienced by the patient.<sup>3</sup> The vast majority of women in labor request pain relief. Failure to provide pain relief results in severe psychological trauma that lasts one's lifetime. It is the prime duty of the caregiver to provide analgesia during labor.<sup>4</sup>

In the first stage of labor, pain is caused by uterine contraction, stretching of lower uterine segment, and dilatation of cervix. Pain impulses are carried through T10

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to L1 fibers. In the second stage, additional pain impulses due to distention of vaginal vault and perineum are carried via pudendal nerve fibers, S2 to S4.<sup>5</sup>

Well-conducted labor analgesia, in addition to relieving pain, provides greater benefit to the mother. Pain will result in maternal hypertension and reduce uterine blood flow. Epidural analgesia blunts the increase in maternal cardiac output, heart rate, and blood pressure that the results with uterine contractions. Epidural analgesia reduces the release of catecholamines due to stress of labor and helps to convert a previously dysfunctional labor to become normal. It eliminates maternal hyperventilation and thereby prevents the leftward shift of fetal oxyhemoglobin dissociation curve.<sup>5</sup>

Lumbar extradural analgesia was described, in 1928, and was popularized by Hingson.<sup>6</sup> Regional analgesia provides pain relief and allows the parturient to remain awake and participate in labor and delivery. Compared to inhalational anesthetics, regional anesthesia is less likely to produce drug-induced depression in the fetus or aspiration pneumonitis in the mother. Continuous infusions of low concentration of local anesthetic into the epidural space provide continuous stable analgesia without fluctuations in pain relief. It allows the mother to be ambulant.<sup>7</sup> The advent of continuous epidural catheters and lipid soluble potent opioids like fentanyl has revolution patient management and labor analgesia in particular. Patient-controlled infusions using patient-controlled analgesia (PCA) pumps offer the patient a better control over pain.

### Aim

To evaluate the efficacy of bupivacaine-fentanyl combination in alleviating labor pain, study its effects on mother and fetus and progress of labor and delivery.

## MATERIALS AND METHODS

The randomized prospective controlled study was done in the Department of Anaesthesiology, Government Rajaji Medical College, Madurai, affiliated to the Tamil Nadu, Dr. M.G.R. Medical University, obtaining approval from the institutional ethical committee. Written informed consent was obtained from the patient and relatives after explaining the procedure. The study involved 100 patients in active labor with singleton pregnancy with vertex presentation at term belonging to American Statistical Association 1 category. The exclusion criterion includes women with cardiac or respiratory diseases, patients who have received systemic opioids in early labor, spinal deformities, bleeding disorders, local sepsis, and high-risk pregnancies. Parturient was selected in random to case and control groups. The control group was not given any analgesia and was well matched with the case group.

Evaluation of medical and obstetric condition of the patient was done. The patient weight and height were recorded. The patient was explained about the procedure, the usage of infusion pump (PCA PUMP), and description of the 10 point visual analog scale (VAS) given. Obstetrician recorded the nature of uterine contraction, cervical dilatation, station of fetal head, and the fetal heart rate. Under all aseptic precautions, epidural was established in L<sub>2-3</sub> or L<sub>3-4</sub> space. A test dose of 3 ml of 1.5% bupivacaine with epinephrine 5 µg/ml was given. Satisfactory block was established with the initial loading dose of 10 ml of 0.25% bupivacaine with 50 µg of fentanyl. The loading dose was further adjusted according to the height of the patient to establish a block of T<sub>10</sub> level.

PCA pump was connected to the epidural catheter. A background infusion of 0.125% bupivacaine with 0.5 µg/ml of fentanyl, 10 ml/h was set. A PCA dose of 5 ml of above preparation with the lockout interval of 15 min was set. In our study, we used the Becton-Dickinson's advanced PCA infuser syringe-based programable infusion system for drug delivery. During the second stage of labor when perineal analgesia is desired, 0.25% bupivacaine 8-10 ml is given in either semi-recumbent or sitting position.

The patient's pulse and fetal heart rate were continuously monitored. Maternal blood pressure was monitored every 5 min using noninvasive blood pressure monitoring device. The level of sensory analgesia and intensity of motor blockade was assessed at half hourly intervals. The frequency of uterine contractions and nature of cervical dilatation and position of head of fetus were monitored. Pain was evaluated using a 10 point VAS with 0-2 (excellent), 3-4 (good), 4-6 (satisfactory), 6-8 (slight), and 8-10 (poor) scoring of quality of pain relief. Sedation was evaluated using modified Ramsay sedation score and motor blockade using Bromage scale.

The following obstetric parameters are noted:

1. Duration and frequency of uterine contractions recorded every 15 min
2. Rate of cervical dilatation and progress of labor
3. Duration of first, second, and third stage of labor
4. Mode of delivery
5. APGAR score.

The patient was monitored for full cervical dilatation. If the second stage is prolonged more than 3 hours in primigravida and 2 hours in multigravida,<sup>8</sup> delivery was assisted with forceps delivery. As the baby is born, APGAR score was noted and neonatal outcome recorded by a pediatrician, duration of the third stage was noted.

In the control group, maternal and fetal parameters are noted. The nature of uterine contractions, duration of

the first, second, and third stage, any complications during labor, nature of delivery, APGAR score were noted in both case and control groups.

## RESULTS

There was no statistical difference between the case and control groups with variables such as age, height, and weight. Of 50 patients in the case group, 35 patients (70%) had excellent pain relief and 11 patients (22%) had good pain relief. Patients with VAS score of more than four were considered to have satisfactory analgesia (8%) (Table 1).

The amount of drug bupivacaine used in primigravida was between 56 mgs and 118.25 mgs with mean of 76.69 mgs, whereas, in multigravida, the range was between 50 mgs and 96.5 mgs with mean of 72 mgs. The amount of fentanyl used in primigravida was between 62.5 µg and 87.5 µg with the average mean of 71 µg, and in multigravida, the range was between 60 µg and 78.75 µg with average mean of 68.6 µg. Labor analgesia was excellent in 70% of the cases and good in 22% of the patients.

The mean rate of cervical dilatation in primigravida (case) group was 2.48 cm, whereas, in primigravida (control) group, it was 1.63 cm. The difference was statistically significant. In the multigravida, case group was 2.96 cm when compared to control group of 2 cm; the difference was statistically significant  $P < 0.05$ .

**Table 1: Quality of pain relief**

VAS	Cases (%)
0-2 excellent	35 (70)
2-4 good	11 (22)
4-6 satisfactory	4 (8)
6-8 slight	-

VAS: Visual analog scale

**Table 2: Duration of labor**

Stages of labor	Control		Case		P value
	Range	Mean	Range	Mean	
First stage of labor					
Primigravida	105-640	323±180.78	90-135	145±38.83	<0.05
Multigravida	75-570	248±114.85	90-225	248±114.85	<0.05
Second stage of labor					
Primigravida	20-72	37.85±20.9	27-90	52.04±18.84	<0.05
Multigravida	11-70	24.76±12.8	17-55	32.56±10.23	<0.05
Third stage of labor					
Primigravida	2-15	6.6±3.3	4-15	5.72±2.32	<0.05
Multigravida	2-16	5.7±3.4	3-7	4.76±0.83	<0.05
Total duration					
Primigravida	127-730	368.45±24.25	121-420	273.76±55.61	<0.05
Multigravida	88-656	279.46±15.44	110-317	182.31±6.91	<0.05

The duration of the first stage of labor (active phase) in the primigravida (case) group was between 90 min and 315 min with average mean duration of 216 min ( $\pm 49.11$ ). The duration in primigravida (control) group was between 105 min and 640 min with the mean duration of 323 min ( $\pm 180.78$ ). The difference was statistically significant.

In the multigravida (case) group, it was between 90 min and 225 min with the mean duration of 145 min, whereas, in the multigravida (control) group, it was between 75 min and 570 min with the mean duration of 248 min ( $\pm 114.85$ ). The difference was statistically significant. The duration of the first stage of labor (active phase) was shorter in the case group when compared to the control group. The duration of the second stage of labor in both primigravida and multigravida in the case group was prolonged when compared to control group, but the difference was not statistically significant  $P > 0.05$ .

The duration of third stage of labor was similar between the case and control groups in both primigravida and multigravida; and the difference was not statistically significant  $P > 0.05$ .

The total duration of labor in the primigravida (case) group was between 121 min and 420 min with an average mean duration of 273.76 min ( $\pm 55.61$ ), whereas, in the control group, the range was between 127 min and 730 min with the average mean of 368.45 min ( $\pm 24.25$ ). The duration of labor was reduced in the case group, and it was statistically significant. The duration of labor in multigravida (case) group was between 110 min and 317 min with an average mean duration of 182.32 min ( $\pm 36.91$ ). In the control group, it was between 88 min and 656 min with an average mean of 276.45 min ( $\pm 15.44$ ). The duration of labor in the multigravida (case) group was reduced when compared with the control group (Table 2).

About 64% of primigravida (case) group and 80% of primigravida (control) group had normal deliveries. In multigravida, 88% of both case and control groups had normal deliveries. Forceps delivery was conducted for 36% of primigravida (case) group, of which, 20% had outlet forceps and 16% had Lead Maternity Care forceps delivery. In the control group, only 12% of the patients had forceps delivery. In the multigravida group, both the case and control groups had similar forceps delivery of 12%. Lower-segment cesarean section was done in two cases of the primigravida (control) group (Table 3).

Urinary retention was the most common complication occurring during epidural analgesia (60%) followed by nausea and vomiting in 22% of cases. In the control group, 30% of patients had urinary retention and 10% had nausea and vomiting.

## DISCUSSION

Regional blocks for labor and vaginal delivery are the most commonly used technique for pain relief in labor. When administered properly, regional analgesia has no serious maternal or neonatal complications.<sup>2</sup> It does not impede the progress of the first stage of labor.

Continuous infusion of low concentrations of local anesthetic into the epidural space provides continuous, stable anesthetic levels, avoiding fluctuations in pain relief often found with conventional intermittent epidural injections during labor.<sup>7</sup> Because dilute local anesthetic concentrations are used (0.125% bupivacaine), the amount of motor blockade is reduced. Hence, the pelvic muscle tone is maintained and better expulsive forces during the second stage of labor.

During the second stage of labor, 0.25% bupivacaine 8-10 ml was used. This was supported by studies done by Capogna *et al.*,<sup>8</sup> 1998, who noted that increased concentration of local anesthetic is required in second stage of labor. The authors attributed this to compression of pelvic structures by the fetal presenting part resulting in increased frequency of stimulation of A delta fibers.

Porter *et al.*,<sup>9</sup> in 1996, noted that addition of fentanyl to bupivacaine allows the use of reduced concentration of bupivacaine without compromising analgesia and achieving a reduction in motor block. McCoy *et al.*,<sup>10</sup> 1993, concluded that continuous infusions increase dosage without improving pain.

Chumbley *et al.*,<sup>11</sup> in 1999, studied regarding PCA use. They found that patients felt extremely positive about PCA and not worrying about giving oneself too much of a drug.

**Table 3: Mode of delivery**

Mode of delivery	Primigravida		Multigravida	
	Case (%)	Control (%)	Case (%)	Control (%)
Labor natural	64	80	88	88
Outlet forceps	20	8	12	12
LMC forceps	16	4	-	-
LSCS	-	8	-	-

LMC: Lead Maternity Care, LSCS: Lower-segment cesarean section

PCA allows patients to titrate the analgesics to relieve pain, better pain relief, and control over pain. No clear strategy was expressed for pressing or not pressing the PCA button, and the principle of control of pain by the patient was questioned. In our study, patients felt positive about pain relief and PCA.

Russell and Reynolds<sup>12</sup> (1996) have conducted similar study and reported 85% of the patient having good quality analgesia with opioid-bupivacaine combination. In our study, 92% of patients had effective pain relief. Russell and Reynolds found perineal pain in 21% of cases, more so in primigravida. The authors concluded that higher concentrations of 0.25% bupivacaine to relieve perineal pain.

Chestnut and associates<sup>13</sup> have reported that continuous infusion of 0.0625% bupivacaine with 2 µg of fentanyl given to primipara did not prolong but tended to decrease the duration of active phase of first stage of labor.

Fogel<sup>14</sup> (1997) had shown that epidural analgesia does not increase the rate of cesarean delivery.

In our study, the APGAR score in both study and control groups were similar in both primigravida and multigravida. Fernando *et al.*<sup>15</sup> (1997) found that there was no correlation between APGAR score, umbilical blood gases, and umbilical venous concentration of either fentanyl or bupivacaine.

## CONCLUSION

We conclude that patient-controlled continuous lumbar epidural analgesia with low dose bupivacaine-fentanyl combination provides effective pain relief during labor. PCA has added advantage for the patient has control over pain with minimal side effects.<sup>16</sup>

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