

Comparison of two different doses of Epidural Butorphanol in Lower Limb Orthopedic Surgery

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Abstract

Introduction: Epidural and spinal anaesthesia both are effective alternative to general anaesthesia when surgical site is located in lower extremities. When post operative analgesia is required epidural anaesthesia is the choice. This study was conducted to assess the effect of Butorphanol added to local anaesthetic via epidural route and to optimize the dose of Butorphanol via epidural route i.e. 2mg and 3 mg and to observe the duration of postoperative analgesia with two different doses. **Methodology:** A randomized control study was conducted on 40 ASA I & II patients of either sex aged 18-60 yrs undergoing lower limb orthopedic surgery under epidural anesthesia. The patients were randomly allocated into two equal groups. Group A received 2 mg of Butorphanol along with local anaesthetic solution and Group B received 3mg of Butorphanol along with local anaesthetic. The onset and peak effect of sensory and motor block, level of sedation, hemodynamic changes and duration of postoperative analgesia and complications, if any were observed. **Results:** For sensory effect, onset was 25 ± 7.07 sec and peak effect 312.5 ± 12.4 sec in Group A patients as compared to Group B where it was 12.81 ± 21.68 sec and 162.8 ± 21.68 sec respectively, which is statistically significant ($P < 0.05$). For motor effect onset was 3.5 ± 1.01 min and peak effect 11.4 ± 3.91 min in Group A patients as compared to Group B patients where it was 2.7 ± 0.67 min and 6.09 ± 0.97 min ($P < 0.05$). Hemodynamics remained stable and comparable in both the groups ($P > 0.05$). Duration of postoperative analgesia according to VAS, pain relief in Group A patients was up to 8 hrs and in Group B it was up to 12 hours and rescue analgesia required only after 12hrs ($P < 0.05$). **Conclusion:** Newer synthetic opioid- Butorphanol can be used along with local anaesthetic solution via epidural route in lower limb surgeries with effective intraoperative sedation and prolonged postoperative analgesia without fear of nausea/vomiting and respiratory depression.

Key words: Butorphanol, Epidural anesthesia, Local anesthetics, Orthopedic surgery

Introduction

Epidural anaesthesia provides early postoperative mobilization and rehabilitation with minimal pain and discomfort. This advantage of epidural anaesthesia is needed in modern orthopedic surgery.

It has properties of central neuraxial blockade. It abolishes stress response to surgery, requires least manpower, reduced incidence of nausea and vomiting, decreased bleeding during surgery, decreased incidence of thrombo-embolic events and decrease use of postoperative analgesia [1].

Butorphanol, synthetic opioid is a strong κ receptor agonist, a weak μ receptor agonist-antagonist and is relatively lipid soluble. It produces less respiratory depression and a reduced incidence of pruritus, nausea and vomiting which is a common phenomenon with morphine [2]. In this study we added Butorphanol to local anaesthetic to assess the efficacy of Butorphanol and to optimize the dose of Butorphanol via epidural route i.e. 2 and 3 mg and to observe the duration of postoperative analgesia with two different doses.

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Methodology

This randomized prospective study was carried out at department of Anaesthesiology Chhattisgarh Institute of Medical Sciences, Bilaspur (C.G.). 40 patients of either sex, aged 18-60 yrs of ASA (American society of anesthesiologist) grade I or II undergoing lower limb orthopedic surgery were enrolled for study.

Exclusion criteria: Patients with history of drug abuse, respiratory and neurological disorder, bleeding disorder, patients on MAO inhibitors were excluded from the study.

All patients were thoroughly examined during pre anaesthetic check up and investigated. Patients were randomly allocated to one of the following two groups in a double blind fashion based on a computer generated code. Group A received 2mg of injection Butorphenol along with local anaesthetic solution. Group B received 3mg of injection Butorphenol along with local anaesthetic solution. Patients were kept nil orally 8 hours prior to induction. In the operating room, monitoring devices were attached which included heart rate, electrocardiograph (ECG), pulse oximeter (SPO₂), non invasive blood pressure (NIBP), respiratory rate. Baseline parameters were recorded, an intravenous line was secured and pre loading was done with Ringer lactate 10ml/kg.

Patients were administered epidural block with 18 gauge Touhy needle and catheter was secured 3-4 cm into the epidural space and test dose of 3ml of 2% Lignocaine hydrochloride solution containing adrenaline 1:200,000 was injected. After 4-6 minutes of administering the test dose epidural block was obtained with the local anaesthetic solution, which consisted of 20 ml of equal volume of Lignocaine 2% with Adrenaline (1:200,000) and injection Bupivacaine 5%. In group A along with local anaesthetic solution 2 mg of injection Butorphenol was added while in group B along with local anaesthetic solution 3mg of injection Butorphenol was added.

Patients were observed for onset (dull sensation to pin prick or decreased pain at injury site) and peak effect (no sensation felt) of sensory and motor blockade, level of sedation (Table-1), time for maximum level achieved, duration of surgery and postoperative analgesia. Top up dose was given after 1.5 hrs as half the initial dose. Sensory effect was observed at intervals of 30sec, 1, 3, 6,9,12 and 15 minutes after completing the drug injection. Sedation was graded as shown in (Table-1). For the motor effect Bromage's criteria [3] were used at intervals of 5, 10,15,20,30 minutes. Onset was considered when there was grade 1 blockade and peak effect when the blockade was of grade 3.

Time for maximum level achieved was also noted. Patients were monitored for hemodynamics, RR and SpO₂ at 5, 10,15,30,60 minutes interval. Postoperatively patients were observed for pulse, B.P., VAS (visual analogue scale), analgesia score (Table 1) and complications if any at intervals of 2, 4,6,8,10,12 hrs. The data was compiled systematically and analyzed using Analysis of variance and chi –square test. To compare the continuous variables between two groups SPSS version was used.

Table-1: Scores for sedation, motor and analgesia.

Sedation score

- 0 = No sedation
- 1 = Drowsy
- 2= Asleep but arousable
- 3= Asleep and not arousable

Bromage's criteria

- 0 = No motor block
- 1 = Partial block, able to flex knees
- 2 - Acceptable, unable to flex knees.
- 3 = Unable to move legs

Analgesia score (AS)

- 1 = No pain
- 2 = No pain at rest but duringvoluntary movement
- 3 = Pain at rest but tolerable
- 4 = Intolerable pain

Results

In our study, the demographic data (Table-2) of the both groups were comparable ($p>0.05$).

Table-2: Demographic data.

Demographic Data	Group A	Group B	Significance
Age (years)	31.31±8.17	41.22±11.44	P > 0.05 Not Significant
Male	13 (65%)	11 (55%)	
Female	7(35%)	9(45%)	
ASA I	11(55%)	10(50%)	
ASA II	9(45%)	10(50%)	
Duration of surgery	3.28±1.27	3.16±1.08	

Onset time for sensory effect (sec) in group A was 25 ± 7.07 ; while in group B it was faster i.e. 12.81 ± 21.68 ($p<0.05$) (Table-3). Peak effect in group A was 312.5 ± 12.4 sec, while in-group B it was 162.8 ± 21.68 (sec) ($p<0.05$). For the motor blockade onset time (minutes) and peak effect in-group A was 3.5 ± 1.01 and 11.4 ± 3.91 respectively while in group B it was 2.7 ± 0.67 and 6.09 ± 0.97 ($p<0.05$). Thus, we observed faster onset as well as peak effect of both sensory and motor effect in group B patients as compared to group A patients.

Table-3: Sensory and Motor Blockade

		Group A	Group B	Significance
Sensory Blockade	Onset (sec)	25 ± 7.07	12.81 ± 21.68	p < 0.05 significant
	Peak effect (sec)	312.5 ± 12.4	162.8 ± 21.68	
Motor Blockade	Onset (min)	3.5 ± 1.01	2.7 ± 0.67	
	Peak effect (min)	11.4 ± 3.91	6.09 ± 0.97	

Table- 4 shows the volume of drug (ml) required, time for maximum level of sensory blockade achieved (minutes), duration of surgery (hrs) and top up dose requirement in both the groups and they were comparable ($P>0.05$).

Table-4: Volume of drug and maximum sensory blockade

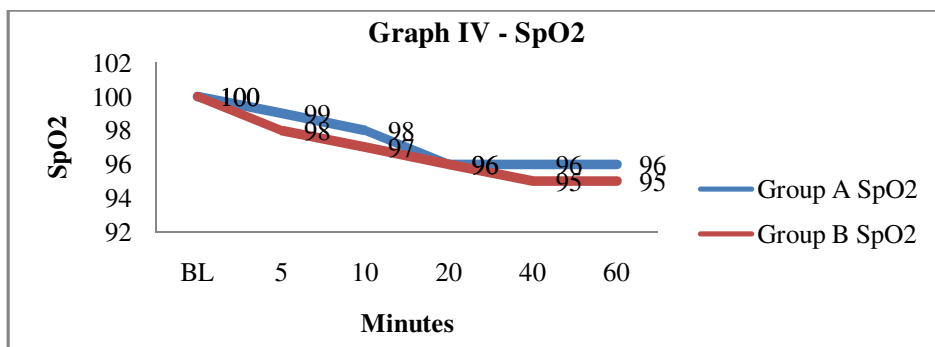
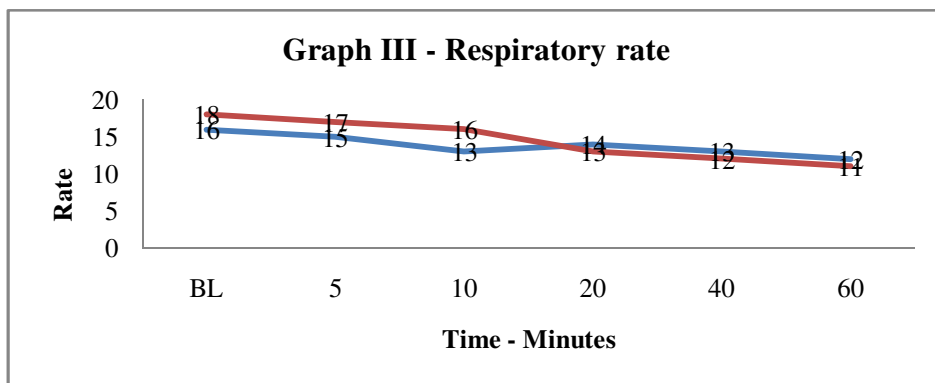
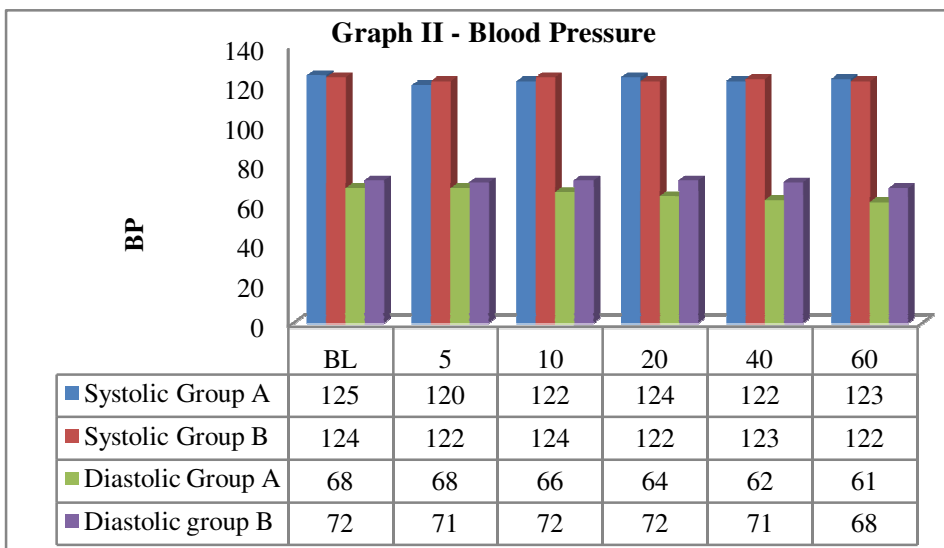
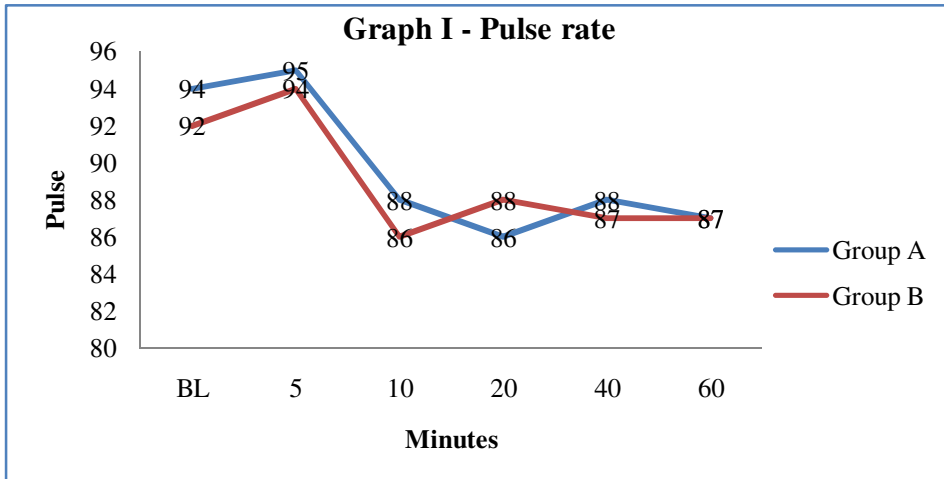
	Group A	Group B	Significance
Volume of drug (ml)	23.31 ± 2.25	24.65 ± 2.05	P < 0.05 Not significant
Time for maximum level (min)	13.95 ± 3.91	11.25 ± 3.91	
Top up dose (ml)	8.7 ± 4.49	8.01 ± 4.45	

Table 5 shows sedation score. In group A 80% of patients and in group B 85% of patients had sedation score of 2 (asleep but arousable) ($p>0.05$).

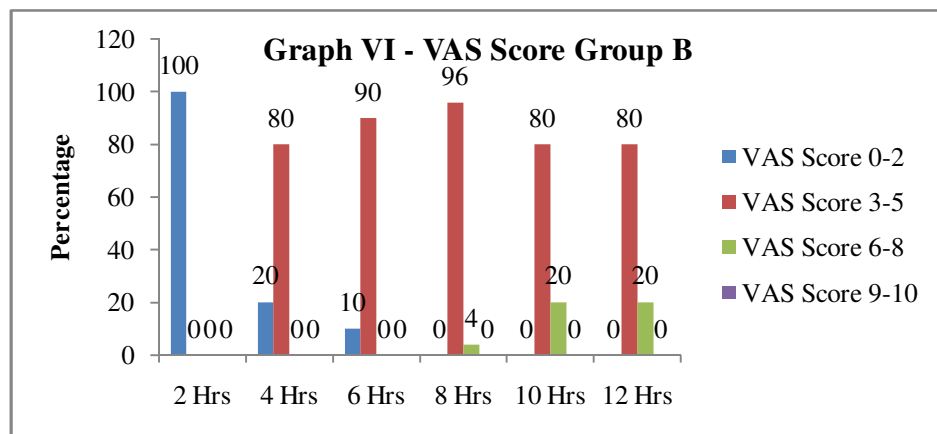
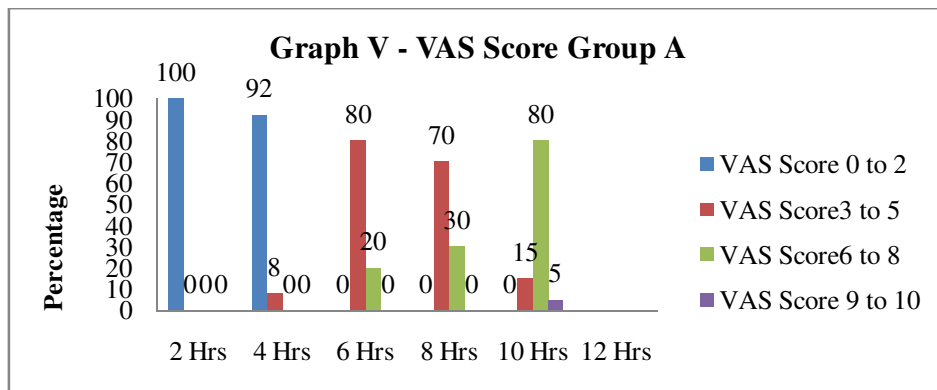
Table- 5: Sedation Score

Sedation score	Group A	Group B	Significance
0	0	0	P < 0.05, not significant
1	4(20%)	3(15%)	
2	16(80%)	17(85%)	
3	0	0	

Graph 1 and 2 shows changes in pulse, systolic blood pressure and diastolic blood pressure of both the groups and it was not significant. Respiratory parameters (Graph 3) shows that there was significant fall in respiratory rate in both the groups, but it was never $<10/\text{min}$ (a sign for respiratory depression) ($P<0.05$). Reading on pulse-oximetry as shown in graph 4 further supported this.



Evaluating the postoperative analgesia, according to visual analogue scale (graph 5), in group A 70% of patients had visual analogue scale of 3-5 up to 8 hrs and 30% of patients had visual analogue scale of 6-8. In group B 80% of patients had visual analogue scale of 3-5 up to 12hrs and 20% of patients had visual analogue scale of 6-8.



Discussion

Central neuraxial blockade is an important tool in the armamentarium of the anesthesiologists as the alterations in physiology and biochemistry and thereby morbidity and mortality brought about by central neuraxial blockade are minimal as compared to general anaesthesia. Subarachnoid block is the most popular and widely practiced technique all over the world. But there has been resurgence of interest even in the epidural blockade as it can be used alone or in combination with general anaesthesia and can be used for postoperative analgesia [1].

Opioids acting on spinal cord receptors provide distinct advantage over its systemic administration like the quality of analgesia is better, sedation is less, function is preserved and outcome is improved. Side effects are no more frequent or severe as compared to systemic opioids required to produce equivalent analgesia [4]. For epidural anaesthesia, we have used combination of local anesthetics and opioid. Local anesthetics act by producing a reversible blockade of sodium channels in nervous tissue preventing the transmission of electrical

impulses and produce sympathetic blockade, while epidural opioids have their major site of action on pre- and post-synaptic receptors in the substantia gelatinosa of the dorsal horn producing selective block of nociceptive pathways. Studies have reported obtaining effective analgesia from the concomitant use of Morphine-Bupivacaine and Fentanyl-Bupivacaine continuous epidural infusions. Another rational for these combinations is to reduce dosage of the individual agents with concomitant reduction in the incidence and severity of side effects [4].

Earlier studies have advocated routine combination of long and short acting local anesthetics together, as it significantly attenuated the 1-hour rebound increase in pain scores seen after short acting anaesthesia alone [5]

Epidural analgesia after surgery in addition to providing patient comfort can facilitate accelerated recovery. This anaesthesia approach is labeled postoperative rehabilitation [6]. With this approach post surgical patient receive not only effective pain relief but also

immediate postoperative intake of oral nutrition, reduction in perioperative stress responses and organ dysfunction, avoidance of fatigue, early mobilization and postoperative discharge [7]. Studies have shown that Butorphanol has significant analgesic potency, narcotic antagonistic properties, anti-tussive effect, reversibility with naloxone and low physical dependence liability. The potency of Butorphanol was found to be approximately 5 times that of morphine and 40 times that of Meperidine[8].

Demographic data of both the groups were comparable. We observed faster onset as well as peak effect of both sensory and motor effect with group B patients as compared to group A patients ($p < 0.05$). Similar finding of faster onset of sensory blockade was found in another study where 2 and 4 mg of epidural Butorphanol has been used [9]. Lipid soluble opioids, such as Fentanyl and Sufentanyl cross the dura and penetrate the cord quickly producing a rapid onset of action and it corresponds to a high CSF concentration which occurs before the blood level is sufficiently high enough to be analgesic [10]. This may be the reason for faster onset of both sensory and motor effect with Butorphanol.

More water-soluble opioids like morphine have a slower onset of analgesia but a more prolonged duration action and side effects. Sedation score shows that majority of patients of both the groups were asleep but arousable. From our previous experience we have found that orthopedic patients demand sedation during central neuraxial blockade but in our study this was not the case. Thus, the sedative effect of Butorphanol was used to advantage intraoperatively.

Hemodynamic changes following epidural Butorphanol in both the groups were clinically and statistically insignificant ($p > 0.05$). Previous workers have found that healthy volunteers receiving 0.03mg/kg and 0.06mg/kg of Butorphanol IV did not show any statistically significant hemodynamic changes [11, 12] but respiratory parameter shows that there was significant fall in respiratory rate from baseline in both the groups. Still it was never < 10 /min. Thus, none of the patients from either group had respiratory depression and reading on pulse – oximetry graph further supported this. Earlier study found that no patient developed a clinically important change in heart rate or blood pressure and none experienced a decrease in respiratory rate below 12/min[12].

The measurement of respiratory rate as an indication of drug induced respiratory depression is not as sensitive

as the determination of minute ventilation or response to carbon dioxide. But we used respiratory rate rather than other measures of respiratory depression and our data are in agreement with those previously published for Butorphanol [13]. Epidural morphine and Butorphanol both are associated with a decreased central sensitivity to CO₂ however duration of depression is shorter after Butorphanol than after Morphine.

Respiratory depression can occur with Butorphanol, but unlike morphine the dose-response curve for this effect is plateau-like or bell-shaped and higher doses (> 1 or 2 mg in healthy subject) producing a lesser effect than lower doses, as it is not dose related [13]. None of the patients from either group experienced the well-known side effects of opioid like respiratory depression, pruritus, nausea/vomiting etc. Reason is Butorphanol a κ receptor agonist and m agonist-antagonist, produces analgesia but fewer side effects. Its high lipid solubility for opioid receptor is additional factors that contribute to the paucity of side effects with its use [14].

Evaluating the postoperative analgesia according to visual analogue scale, group A patients had pain relief up to 8 hrs and rescue analgesia was required between 8-10hrs as seen in table and graph. Group B patients had a relief up to 12 hrs and rescue analgesia was required only after that period.

Thus the difference between group A and group B is significant ($p < 0.05$). This is also supported on evaluation with analgesia score. Thus, 3 mg of epidural Butorphanol provides longer duration of postoperative analgesia in comparison to 2 mg of the same drug.

We did not find any well-known complications of opioid. Earlier study had found high rate of pruritus (43%) with epidural morphine as compared to epidural Butorphanol [15].

Conclusion

Newer synthetic opioid; Butorphanol can be used along with local anaesthetic solution via epidural route in lower limb orthopedic surgeries with effective intraoperative sedation and postoperative analgesia without fear of nausea/vomiting and respiratory depression. The comparison of two groups shows that 3 mg of Butorphanol provides faster onset and peak effect, with longer duration of analgesia post-operatively.

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Permission of IRB: Yes

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