

Intermittent versus continuous epidural infusion technique for post operative analgesia

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ABSTRACT

Background and Aim: A consensus is yet to evolve over which of the two techniques, continuous epidural infusion or intermittent epidural bolus is better for post-op pain relief. The present study was undertaken to compare the efficacy of postoperative pain relief between continuous and bolus administrations of epidural bupivacaine and fentanyl solution. **Material and Methods:** The prospective, randomized study was conducted in 60 ASA I and ASA II patients of either sex, 20-50 years age scheduled for orthopedic lower limb surgery. Combined spinal epidural anaesthesia was administered to all the patients. Following an epidural loading dose of 10 ml of 0.0625% bupivacaine with fentanyl 1.5 µg ml⁻¹ post-operatively, group I (n = 30) patients received intermittent bolus of 10 ml of 0.0625% bupivacaine with fentanyl 1.5 µg ml⁻¹ at an hourly interval for 24 hours and group II (n = 30) patients received same drug combination through continuous epidural infusion technique at a rate of 10 ml hr⁻¹ for 24 hours. Following variables were assessed during the study period of 24 hours: Pulse rate, blood pressure, respiratory rate, pulse oximetry (SpO₂), pain score (VAS), pruritus score, sedation score, sensory block and motor block. All the parameters were analysed statistically by adopting appropriate statistical tests. **Results:** On comparison, pain scores were statistically not significant in both groups (p>0.05). When compared within the respective groups, variation in pain score, both at rest and on movement, from the baseline value (zero hours postoperatively) were statistically not significant at all the time intervals in both the groups (p>0.05). Fifteen patients in the group I and five patients in group II required rescue analgesia (p<0.05). Thirteen patients (46.6%) in group I and 19 patients (63.33%) in group II assessed pain relief as excellent at the end of 24 hours of epidural analgesia (p<0.05). No adverse effects were observed in any of the patients. **Conclusion:** Continuous epidural infusion of a combination of bupivacaine and fentanyl provides better postoperative analgesia requiring less rescue analgesia than intermittent epidural bolus technique.

Key words: Bupivacaine, continuous epidural infusion, epidural analgesia, fentanyl, intermittent epidural bolus, postoperative analgesia

INTRODUCTION

Acute postoperative pain is a complex physiologic reaction to tissue injury which occurs as a part of any surgical procedure. It is a manifestation of autonomic, psychological and behavioral responses that result in, an unpleasant and unwanted sensory and emotional experience. Patients often perceive postoperative pain as one of the more ominous aspect of undergoing surgery. Orthopedic surgeries are often painful and inadequate relief of pain causes deleterious effects on all body systems by increasing blood levels of stress hormones^[1-4].

Common options available for management of postoperative pain include systemic opioids and non-opioids, central neuraxial analgesia, and peripheral nerve blocks. Epidural administration of local anaesthetics,

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opioid or a combination of both is now well-established technique for managing postoperative pain following abdominal, pelvic, thoracic or orthopedic procedures on lower extremity. These drugs can be administered either by continuous epidural infusion or by intermittent epidural bolus^[5-8].

Continuous infusion not only produces an unchanging block to maintain analgesia and minimize cardiovascular disturbances but also reduces medical and nursing workload. Although even with constant infusion of local anaesthetics, sensory block has been shown to regress with time resulting in requirement for supplementary analgesia. However, addition of opioids to local anaesthetics has been shown to prevent development of tachyphylaxis. On the other hand, administration of intermittent epidural boluses of local anaesthetics is technically simple and cheap as sophisticated costly infusion devices are not needed but it is often associated with fluctuating levels of analgesia and involves additional work on the part of nurses to repeatedly inject the local anaesthetic solutions. However, it has been observed that patients receiving intermittent administration of bolus doses maintain a more extensive block and report marginally better analgesia and less requirement of rescue medication^[9-12]. Nevertheless, a consensus is yet to evolve over which of the two techniques is better.

The present study was conducted to compare the efficacy of postoperative pain relief between continuous and bolus administrations of epidural bupivacaine and fentanyl solution.

MATERIAL AND METHODS

After institutional ethical committee approval and written informed consent of the patients, the prospective, randomized study was conducted in 60 patients of either sex ranging from 20 to 50 years of age, belonging to American Society of Anesthesiologists (ASA) physical status Grade I and II, scheduled for orthopedic lower limb surgery. Patients with bleeding disorders, polytrauma, renal and hepatic insufficiency or known hypersensitivity to local anaesthetics and opioids were excluded from the study.

The patients were kept fasting for six hours prior to surgery and received tablet alprazolam 0.25 mg orally two hours before surgery with a sip of water as premedication. In operation theatre, intravenous line was established. Baseline heart rate, non-invasive blood pressure, ECG and peripheral arterial oxygen saturation (SpO₂) were

recorded. All the patients will be preloaded with 10 ml kg⁻¹ lactate Ringer's solution.

A standardized combined spinal epidural anaesthesia at L₃-L₄ interspinous space was administered to all the patients. Following subarachnoid block with 2.5 ml of 0.5% heavy bupivacaine, an 18G epidural catheter was introduced in the epidural space. Oxygen supplementation was provided at 2 lit min⁻¹ and monitoring of vitals was done. In the event of failure of subarachnoid block in a particular patient, the surgery was allowed to commence under epidural anaesthesia and the patient was excluded from the present study.

At the end of the surgery, a loading dose of 10 ml of 0.0625% bupivacaine with fentanyl 1.5 µg ml⁻¹ was administered through epidural catheter to all the patients in both the groups. Thereafter, group 1 (n = 30) patients received intermittent bolus of 10 ml of 0.0625% bupivacaine with fentanyl 1.5 µg ml⁻¹ at an hourly interval for 24 hours and group 2 (n = 30) patients received combination of 0.0625% bupivacaine and fentanyl 1.5 µg ml⁻¹ through continuous epidural infusion technique at a rate of 10 ml hr⁻¹ for 24 hours.

After giving first dose of epidural drugs following variables were assessed at hourly interval for six hours and then once every two hours up to 24 hours: Pulse rate, blood pressure, respiratory rate, SpO₂, pain score, pruritus score, sedation score, sensory block (using pin prick method) and motor block (using modified bromage scale). Pain intensity was assessed with the help of Linear Visual Analogue Scale (LVAS) using a 10 centimeter line where 0 denotes no pain at all and 10 denotes unbearable pain. Sedation Score was observed and scored as: awake and alert (0), awake but drowsy (1), drowsy but arousable (2) and unarousable (3). Pruritus was scored as: mild, not disturbing (1), moderate, disturbing, not requiring treatment (2) and severe, requiring treatment (3). Occurrence of side effects like nausea, vomiting, retention of urine etc., was noted. At the end of the study all the data was compiled and analyzed statistically by using Student's t-test and Chi-square test.

RESULTS

Both the groups were statistically comparable regarding age, height, weight, sex distribution and duration of surgical procedure (p>0.05) [Table 1]. Both the two groups were statistically comparable with respect to peri-operative haemodynamic and respiratory parameters viz. pulse rate, systolic blood pressure, diastolic blood pressure and respiratory rate, peripheral arterial oxygen saturation (p>0.05).

Although the pain scores were less at all the time intervals, both at rest and on movement, in the continuous infusion group, but there was no statistical significance when compared with the intermittent bolus group ($p>0.05$). When compared within the respective groups, variation in pain score, both at rest and on movement, from the baseline value (zero hours postoperatively) were statistically not significant at all the time intervals in both the groups ($p>0.05$) [Table 2 and 3].

Rescue analgesia was administered in form of injection diclofenac sodium 75 mg intramuscularly to the patients whenever pain score (LVAS) was ≥ 4 . Fifteen patients in the group 1 and five patients in group 2 required rescue analgesia. Out of 15 patients in group 1, 10 patients required rescue analgesia once and 5 patients required 2 doses of rescue analgesia. In group 2, all the five patients required single dose of rescue analgesia and none required it twice. The mean dose of injection diclofenac sodium administered per patient was 50 mg in group 1 as compared 12.5 mg in group 2. This difference in rescue analgesia (no. of patients, no. of doses and mean dose) when compared between the two groups, were statistically significant ($p<0.05$). Thirteen patients (46.6%) in group 1 and 19 patients (63.33%) in group 2 assessed pain relief as excellent at the end of 24 hours of epidural analgesia. The number of patients assessing pain relief as good were nine (30%) in group 1 and 11 (36.66%) in group 2. Eight (23.3%) patients in group 1 assessed pain relief as fair. No patient in both the groups reported analgesia as poor. The difference in assessment of pain relief by patients in the two treatment groups was statistically significant ($p<0.05$). No adverse effects like sedation, pruritus, motor block, nausea, vomiting, urinary retention or respiratory depression were observed in any of the patient in both the groups throughout the study period.

Table 1: Patient profile

Parameters	Group-1 (n = 30) (Mean \pm SD)	Group-2 (n = 30) (Mean \pm SD)	p value
Age (years)	33.57 \pm 9.84	32.10 \pm 10.28	>0.05
Weight (Kg)	63.23 \pm 7.94	62.10 \pm 5.84	>0.05
Height (Inches)	66.07 \pm 5.45	66.37 \pm 3.44	>0.05
Sex (M:F)	26 : 4	25 : 5	>0.05
Duration of Surgery (Minutes)	115.50 \pm 22.06	105.00 \pm 20.00	>0.05

Student 't' test for age, sex, weight and height. Chi-square test for sex distribution.

Table 2: Pain scores in the two groups at rest at different time intervals postoperatively

Hours postoperatively	Group-1 (n = 30) (Mean \pm SD)	Group-2 (n = 30) (Mean \pm SD)	p value
0	1.40 \pm 0.62	1.30 \pm 0.60	> 0.05
1	1.93 \pm 0.98	1.60 \pm 0.77	> 0.05
2	2.30 \pm 1.06	1.93 \pm 0.87	> 0.05
3	2.60 \pm 0.81	2.33 \pm 0.84	> 0.05
4	2.73 \pm 0.74	2.47 \pm 0.82	> 0.05
5	2.63 \pm 0.56	2.50 \pm 0.73	> 0.05
6	2.60 \pm 0.67	2.43 \pm 0.68	> 0.05
8	2.40 \pm 0.67	2.23 \pm 0.68	> 0.05
10	2.27 \pm 0.64	2.20 \pm 0.60	> 0.05
12	2.33 \pm 0.71	2.23 \pm 0.61	> 0.05
14	2.33 \pm 0.66	2.13 \pm 0.57	> 0.05
16	2.20 \pm 0.66	2.17 \pm 0.64	> 0.05
18	2.27 \pm 0.58	2.17 \pm 0.64	> 0.05
20	2.23 \pm 0.57	2.17 \pm 0.74	> 0.05
22	2.20 \pm 0.66	2.17 \pm 0.65	> 0.05

Paired and unpaired Student 't' test, $p>0.05$

Table 3: Pain scores in the two groups on movement at different time intervals postoperatively

Hours postoperatively	Group-1 (n = 30) (Mean \pm SD)	Group-2 (n = 30) (Mean \pm SD)	p value
0	1.67 \pm 0.84	1.50 \pm 0.78	>0.05
1	2.13 \pm 1.04	2.03 \pm 0.93	>0.05
2	2.73 \pm 1.08	2.40 \pm 1.04	>0.05
3	2.90 \pm 0.92	2.83 \pm 1.12	>0.05
4	3.10 \pm 0.99	2.90 \pm 0.71	>0.05
5	2.97 \pm 0.81	2.93 \pm 0.52	>0.05
6	2.83 \pm 0.59	2.77 \pm 0.67	>0.05
8	2.97 \pm 0.61	2.87 \pm 0.56	>0.05
10	2.90 \pm 0.61	2.87 \pm 0.67	>0.05
12	2.90 \pm 0.61	2.88 \pm 0.69	>0.05
14	2.80 \pm 0.55	2.73 \pm 0.65	>0.05
16	2.73 \pm 0.64	2.67 \pm 0.63	>0.05
18	2.67 \pm 0.48	2.60 \pm 0.56	>0.05
20	2.63 \pm 0.49	2.57 \pm 0.68	>0.05
22	2.63 \pm 0.56	2.57 \pm 0.63	>0.05

Paired and unpaired Student 't' test, $p>0.05$

DISCUSSION

Orthopedic surgeries produce pain of moderate to severe intensity lasting up to days. Many techniques are used to provide adequate analgesia after orthopedic lower limb surgery. Epidural analgesia has established itself as

one of the most effective methods of postoperative pain relief. This method is the treatment of choice for pain relief following orthopedic lower limb surgery. Epidural analgesia incorporating the use of local anaesthetics or local anaesthetics with opioids provides better pain control during activity, improved pulmonary function, decreased side effects, and faster recovery of bowel function while allowing a reduction in the total doses of opioid used and fewer side effects^[1-5].

Although epidural route provides good quality analgesia, being a central neuraxial block it has some disadvantages like variability in the degree of sensory, motor and sympathetic blockade and cardiovascular instability. When bolus dose is given intermittently, patients may have painful intervals between the two consecutive doses. Wrong choice of technique may lead to ineffective analgesia and painful intervals despite the use of appropriate concentration and combination of analgesic drugs^[9-11].

We used a combination of bupivacaine and fentanyl for epidural administration for post operative analgesia in our study because use of epidural bupivacaine alone has the potential for motor and sympathetic blockade. Addition of fentanyl to bupivacaine potentiates and prolongs the analgesia, thereby allowing the use of lower concentration of bupivacaine. Similar to our study combination of fentanyl and bupivacaine for epidural administration for post operative analgesia have been used in other studies^[12-14].

Some authors have compared continuous epidural infusion of drugs at one concentration and rate with intermittent epidural bolus of a different concentration and volume^[15]. In the present study concentration and volume of drugs was similar in both the groups. We used low concentration of bupivacaine i.e., 0.0625% and low dose of fentanyl ($1.5\mu\text{g ml}^{-1}$) at the rate of 10ml hr^{-1} in our study because we wanted to achieve effective analgesia with minimum adverse effects. Most of the studies have reported earlier have used higher concentration of bupivacaine (0.125–0.25%) and higher dose of fentanyl ($2-3\mu\text{g ml}^{-1}$)^[9-11,13,14].

Few authors have used intermittent epidural bolus on patient's demand basis^[16]. However; such a technique leads to inadequate pain relief and tachyphylaxis. We administered intermittent epidural bolus at fixed intervals i.e., every hour. This also maintained uniformity in the total dose of drugs administered in the two groups.

In the present study, whenever $\text{VAS} \geq 4$, rescue analgesia was administered. In the continuous epidural infusion

group, VAS remained ≤ 4 in 25 patients throughout the study period as compared to 15 patients in the intermittent epidural bolus group, requiring no rescue analgesia. Moreover, out the 15 patients in intermittent epidural bolus group, five required two doses of rescue analgesia. As rescue analgesia was administered whenever $\text{VAS} \geq 4$, the pain scores were statistically comparable between the two groups. Patient's satisfaction for postoperative analgesia was better in the continuous epidural infusion group. Similar to our study, Lamont *et al.*^[9] and Hicks *et al.*^[17] observed better postoperative analgesia with continuous epidural infusion technique than intermittent epidural bolus technique.

The continuous epidural infusion technique is better as it involves infusion of the local anaesthetic at the rate equal to that at which the drug is removed from the epidural space. The peaks and troughs seen in the level of analgesia with intermittent epidural bolus are avoided with the continuous infusion and the level of block does not change acutely. Moreover, toxicity is not a problem since there are no peaks in plasma concentration of local anaesthetic agents as seen with the intermittent bolus technique. Also tachyphylaxis occurs more rapidly in the intermittent bolus technique leading to ineffective analgesia^[1,8,17]. This was also evident in our study as rescue analgesia was required by half the patients in intermittent epidural bolus group and five patients required two doses of rescue analgesia.

Salim *et al.* recorded comparable analgesia with continuous epidural infusion and intermittent bolus^[14]. However, they used different concentration, volume and drug combination in the two techniques, Duncan *et al.*^[10] and Fettes *et al.*^[11] in their studies observed that intermittent epidural bolus technique is better than continuous epidural infusion technique. They stated that faster bolus injection may create a higher pressure in the extradural space and cause solution to spread further. In contrast, low volume continuous infusion is less likely to spread far from the epidural catheter, leading to early regression of block. However, in their study they observed marginally better analgesia with intermittent bolus technique. Moreover, they used special electromechanical pumps to deliver hourly epidural boluses. Such pumps are expensive and not readily available. Also rapid bolus injection has the potential risk of inadvertent intravascular or intrathecal injection in the event of epidural catheter migration.

In our study haemodynamic stability was maintained in all patients of the two groups and no side effects were observed. This could be attributed to low concentration of drugs, i.e., 0.0625% bupivacaine and $1.5\mu\text{g ml}^{-1}$ fentanyl.

The drug combination used provided adequate analgesia with optimal hemodynamic stability and no adverse effects. Scott *et al.* reported side effects attributable to the use of epidural fentanyl, like sedation, pruritus, nausea, vomiting, respiratory depression; and those due to the use of bupivacaine as unpleasant sensory block, motor block and hypotension^[18]. However, no adverse effects occurred in our study presumably due to the use of low concentration of bupivacaine and fentanyl than used by other authors^[9-11,13,14].

One major constraint of the study was that it was not blinded and this might have introduced some degree of observer bias. Another major limitation of this study was constant volume of the drug that was used irrespective of the height and weight of the subject.

CONCLUSION

Hence we conclude that the continuous epidural infusion of a combination of bupivacaine and fentanyl provides better postoperative analgesia requiring less rescue analgesia than intermittent epidural bolus technique. Thus, continuous epidural infusion of a combination of bupivacaine and fentanyl provides better postoperative analgesia requiring less rescue analgesia than intermittent epidural bolus technique. Haemodynamic stability is maintained and there are no adverse effects with either technique when low concentration of drugs, 0.625% bupivacaine and 1.5µg ml⁻¹ fentanyl, is used.

REFERENCES

1. Bell SD, Seltzer JL. Postoperative pain management. In: Kaplan JA, editor. *Vascular Anaesthesia*. 1st ed. New York: Churchill Livingstone; 1991. p. 565–86.
2. Rutberg H, Hakanson E, Anderberg B, Jorfeldt L, Martensson J, Schildt B. Effects of the extradural administration of morphine or bupivacaine on the endocrine response to upper abdominal surgery. *Br J Anaesth* 1984;56:233–7.
3. Scott NB, Mogensen T, Bigler D, Lund C, Kehlet H. Continuous thoracic extradural 0.55 bupivacaine with or without morphine: Effect on quality of blockade. *Br J Anaesth* 1989;2:253–7.
4. Shulman M, Sandler AN, Bradley JW, Young PS, Brebner J. Post thoracotomy pain and pulmonary function following epidural and systemic morphine. *Anesthesiology* 1984;61:569–75.
5. Cuschieri RJ, Mussan CG, Howie JC, Mordle CS. Post operative pain and pulmonary complications: Comparison of three analgesic regimens. *Br J Surg* 1985;72:495–8.
6. Liu S, Carpenter RL, Neal JM. Epidural anesthesia and analgesia: Their role in postoperative outcome. *Anesthesiology* 1995;82:1474–506.
7. Brodner G, Aken HV, Hertle LO, Fobker M. Multimodal perioperative management combining thoracic epidural analgesia, forced mobilization and oral nutrition reduces hormonal and metabolic stress and improves convalescence after major urologic surgery. *Anesth Analg* 2001;92:1594–600.
8. Renck H, Edström H. Thoracic epidural analgesia III-prolongation in the early postoperative period by intermittent injections of etidocaine with adrenaline. *Acta Anaesthesiol Scand* 1976;20:104–10.
9. Lamont RF, Pinney D, Rodgers P, Bryant TN. Continuous versus intermittent epidural analgesia. A Randomized trial to observe obstetric outcome. *Anaesthesia* 1989;44:893–6.
10. Duncan LA, Fried MJ, Lee A, Wildsmith JA. Comparison of continuous and intermittent administration of extradural bupivacaine for analgesia after lower abdominal surgery. *Br J Anaesth* 1998;80:7–10.
11. Fettes PDW, Moore CS, Whiteside JB, McLeod GA, Wildsmith JAW. Intermittent vs continuous administration of epidural ropivacaine with fentanyl for analgesia during labour. *Br J Anaesth* 2006;97:359–64.
12. Kanai A, Kinoshita S, Suzuki A, Okamoto H, Hoka S. Advantage of ropivacaine for postoperative epidural analgesia following leg orthopedic surgery. *Masui* 2005;54:8–13.
13. Kampe S, Randebrock G, Keinke P, Hunseler U, Cranfield K. Comparison of continuous epidural infusion of ropivacaine and sufentanil with intravenous patient-controlled analgesia after total hip replacement. *Anaesthesia* 2001;56:1189–92.
14. Salim R, Nachum Z, Moscovici R, Lavee M, Shalev E. Continuous compared with intermittent epidural infusion on progress of labour and patient satisfaction. *Obstet Gynecol* 2005;106:301–6.
15. Pitimana AS, Visalyaputra S, Komoltri C, Muangman S, Tiviraj S, Puangchan S, *et al.* An economic evaluation of bupivacaine plus fentanyl versus ropivacaine alone for patient controlled epidural analgesia after total knee replacement procedure: A double blinded randomized study. *Reg Anesth Pain Med* 2005;30:446–51.
16. Smedstad KG, Morison DH. A comparative study of continuous and intermittent epidural analgesia for labour and delivery. *Can J Anaesth* 1988;35:234–41.
17. Hicks JA, Jenkins JG, Newton MC, Findly IL. Continuous epidural infusion of 0.075% bupivacaine for pain relief in labour. A comparison with intermittent top-ups of 0.5% bupivacaine. *Anaesthesia* 1988;43:289–92.
18. Scott DA, Beilby DS, McClymont C. Postoperative analgesia using epidural infusion of fentanyl with bupivacaine. A prospective analysis of 1,014 patients. *Anesthesiology* 1995;83:727–37.