ORIGINAL ARTICLE

Comparison of Dexmedetomidine and Butorphanol as Adjuvants to Levobupivacaine for Epidural Anaesthesia in Hip and Lower Limb Surgeries: A Randomized Controlled Trial

Ankita Atri, Ajay Gupta, Smriti Gulati

Abstract

Background*:* Epidural anaesthesia is a useful anaesthetic technique with many applications ranging from analgesia with minimal motor block to dense anaesthesia with full motor block. Adjuvants added to local anaesthetics improve the quality of epidural block and prolong the postoperative analgesia. ***Aim:*** The study was aimed to compare the haemodynamic, sedative, sensory, motor and analgesic properties of dexmedetomidine and butorphanol as adjuvants to 0.5% levobupivacaine in epidural anaesthesia. ***Material and Methods****:* A randomized controlled study was carried out on 90 patients of either sex ranging in the age group between 18 to 60 years belonging to ASA grade I & II, undergoing elective hip and lower limb surgeries under epidural anaesthesia. Patients were randomly allocated to one of the three study groups, each group comprising of 30 patients. Group L received epidural levobupivacaine, Group LD received epidural levobupivacaine with dexmedetomidine and Group LB received epidural levobupivacaine with butorphanol. The haemodynamics, block characteristics, sedation and side effects were observed. The data was analysed using ANOVA test. Inter group comparisons were made using student´s *t*-test and Chi square test. Value of $p \leq 0.05$ was considered statistically significant. ***Results:*** Time to attain adequate sensory and motor block was faster in group LD in comparison to Group LB and Group L ($p<0.0001$). Regression to S1 segment, duration of sensory and motor blockade was prolonged in Group LD as compared to Group LB and Group L ($p<0.0001$). Sedation score was better in Group LD as compared to other groups. ***Conclusion:*** Dexmedetomidine is better adjuvant than butorphanol when added to epidural levobupivacaine in terms of faster onset of sensory and motor block, prolonged post operative analgesia and better sedation.

Key Words

Dexmedetomidine, Epidural Anaesthesia, Butorphanol, Levobupivacaine

Introduction

Spinal and epidural anaesthesia are regional anaesthetic techniques widely used in lower abdominal and lower limb surgeries (1). Epidural anaesthesia offers superior pain relief and early mobilization especially when local anaesthetic is combined with an adjuvant (2,3). Levobupivacaine is the levo-stereoisomer form of the racemic form of bupivacaine showing a profile close to bupivacaine in terms of onset, quality and duration of

Department of Anaesthesia and Intensive Care, Government Medical College, Jammu, Jammu and Kashmir, India

Correspondence to: Dr. Ajay Gupta, Assistant Professor, Department of Anaesthesia and Intensive Care, Govt. Medical College, Jammu (J&K), India

Manuscript Received: 02 January 2021; **Revision Accepted**: 19 March 2021;

Published Online First: 10 October 2021

Open Access at: https://journal.jkscience.org

Cite this article as: Atri A, Gupta A, Gulati S. Comparison of dexmedetomidine and butorphanol as adjuvants to levobupivacaine for epidural anaesthesia in hip and lower limb surgeries: a randomized controlled trial. JK Science 2021;23(4):195-199.

sensory block but with lesser cardiac and neurotoxic adverse effects. Greater intrinsic vasoconstrictor property of levobupivacaine may be responsible for longer sensory blockade as compared to racemic bupivacaine (4,5).

A number of agents have been used as adjuvants to improve efficacy of epidural analgesia with local anaesthetics. They provide dose sparing effect of local anaesthetics, accelerates the onset of sensory blockade of epidural anaesthesia and decrease the effective dose of local anaesthetic (6). Butorphanol, a partial mu opioid receptor antagonist and kappa opioid receptor agonist has been shown to be an effective adjuvant in epidural analgesia with minimal risk of side effects at low doses (7). Dexmedetomidine is the selective alpha 2 adrenoceptor agonist which acts on pre and post synaptic sympathetic nerve terminals and central nervous system to decrease the sympathetic outflow causing sedative, antianxiety, analgesic, sympatholytic and haemodynamic effects (8).

This study made a comparison of efficacy and safety between two adjuvants butorphanol and dexmedetomidine used with epidural levobupivacaine in hip and lower limb surgeries. We conducted the study with the aim of comparing the sensory, motor, analgesic, haemodynamic and sedative properties of dexmedetomidine and butorphanol as an adjuvant to epidural levobupivacaine.

Material and Methods

After obtaining approval from Hospital Ethical Committee (IEC/2015/154, dated 19-05-2015), the present study was undertaken in the Department of Anaesthesiology and Intensive Care, Govt. Medical College, Jammu. Informed written consent was obtained from the patients preoperatively. 90 patients of either sex ranging in the age group between 18 to 60 years belonging to ASA grade I & II, scheduled for hip and lower limb surgeries were included and patients with any contraindication to regional anaesthesia and allergy to study drugs were excluded from study. Demographic profile of the patient including age, sex, height, weight was recorded.

All the patients were kept fasting for a period of 8 hours preoperatively and were given oral pantoprazole 40 mg and alprazolam 0.25 mg night before surgery. Before starting the procedure, all patients were preloaded with 10 ml/kg infusion of ringer lactate solution.

Patients were randomly allocated to one of the three study groups, each group comprised of 30 patients. After taking all precautions standardized epidural anaesthesia technique was used and epidural catheter was inserted 5 cm into the epidural space in cephalic directions at L4-L5 interspace. The drug combination depending upon the group and according to randomization schedule was slowly injected through catheter. Group L received levobupivacaine (0.5%) 19 ml with 1 ml of normal saline (control), Group LD received levobupivacaine (0.5%) 19 ml with dexmedetomidine (1 µg/kg) in 1 ml normal saline and Group LB received levobupivacaine (0.5%) 19 ml with butorphanol (10 µg/kg) in 1 ml normal saline.

The sensory blockade was assessed by bilateral pin prick method using a short bevelled 26 G hypodermic needle every 5 minutes for the first 30 minutes and every 15 min for the rest of the surgery. The time of onset of sensory block at T10 dermatome, peak level of sensory block and the time to reach peak level of sensory block was recorded. Sensory block to reach to T10 level was accepted as sufficient to start the surgery. The duration of the sensory blockade was measured from the epidural injection till the regression of the sensory level to S1.

Degree of motor blockade according to Modified Bromage scale was assessed every 5 minutes for first 30 min after epidural drug administration and then every 15 minutes for the rest of the surgery. Grading of sedation was evaluated by using Ramsey sedation score. Sedation score was recorded at the start of the procedure and at every 15 minutes during the surgery. Post operatively sedation score, sensory level and Bromage score was recorded every 30 minutes in the recovery room. The sensory regression to S1 dermatome and motor regression to Modified Bromage 0 was recorded.

Pain intensity was assessed every 30 minutes with the help of Linear Visual Analogue Scale (VAS). Duration of analgesia was taken as time period from the onset of sensory block till VAS score of 4 was recorded. After this, postoperative pain was managed with rescue injection of 3 ml of levobupivacaine (0.5%) and 50 mg of tramadol in 1 ml diluted to total of 10 ml with normal saline given through epidural catheter. The epidural catheter was kept for 24 hours in the postoperative period and postoperative analgesia was maintained with epidural top up depending upon the patient's need for analgesia.

Cardio respiratory parameters of heart rate, blood pressure and SpO_2 were monitored continuously and recorded before (baseline) and every 5 minutes for first 30 minutes after the epidural injection, then every 10 minutes till the end of the surgery. Side effects seen with epidural drug administration like hypotension, bradycardia, pruritis, nausea, vomiting, respiratory depression and post

epidural shivering was carefully observed, recorded and managed symptomatically.

Statistical Analysis: The data was analysed with the help of computer software MS Excel and SPSS version 16.0 for windows. The quantitative variable was reported as mean and standard deviation. One way ANOVA was used to evaluate statistical significance among the groups. Intergroup comparisons were made using student's *t*-test and non-parametric variables were analysed by using Chi square test. All *p* values reported were two tailed and a *p* value of ≤0.05 was considered as statistically significant.

Results

90 patients were successfully operated under epidural levobupivacaine anaesthesia. The demographic profile, duration of surgery and haemodynamic parameters were comparable between the groups. The three groups remained statistically comparable at all times as regards to the heart rate, blood pressure and SPO_2. The difference was found to be statistically insignificant.

In our study we observed that the time taken in minutes for onset of sensory block at T10 level was 20.00 ± 2.94 minutes in group LB, 15.17 ± 2.82 minutes in group LD, 21.80 ± 5.80 minutes in group L (*Table 1*). The highest level of sensory block (T5-T6) was obtained in 80.00% of the patients in group LD, 26.6 % of patients in group LB and 3.33 % of the patients in group L (*Table 2*). It was observed that in group LD there was a faster onset of sensory block as compared to group LB and group L. The difference was found to be statistically highly significant among the three groups (*p* value <0.0001). The mean time to reach the highest level of sensory block was found to be 25.33 ± 1.56 minutes in group LB, 20.30 ± 2.40 minutes in group LD and 28.50 ± 2.26 minutes in group L. The above observations were found to be statistically highly significant by ANOVA test (*Table 3*).

The *Table 4* shows that the time to attain maximum bromage score was 22.62 ± 2.76 minutes in group LB, 18.64 ± 3.80 minutes in group LD, and 30.26 ± 2.41 minutes in group L. Maximum bromage score was attained earlier in group LD as compared to group LB or group L. The above observations were found to be statistically highly significant by ANOVA test.

The results of our study showed that the time taken to segmental regression to S1 dermatome was 230.0 ± 30.20 minutes, 290.60 ± 33.60 minutes and 182.0 ± 20.24 minutes in group LB, LD and L respectively. The above observations were found to be statistically highly significant by ANOVA test (*Table 5*).

Table 1: Onset of Sensory Block at T10 (in minutes)

Groups	Mean ± SD	F-value	*p*-value
Group LB	20.00 ± 2.94	17.35	0.0001
Group LD	15.17 ± 2.82		
Group L	21.80 ± 5.80		

Table 2: Highest Level of Sensory Block

Highest Level	No. of Patients (%)		
	Group LB	Group LD	Group L
T5 – T6	8 (26.67)	24 (80.00)	1 (3.33)
T7 – T8	19 (63.33)	5 (16.67)	16 (53.33)
T9 – T10	3 (10.00)	0 (0.00)	13 (43.34)
p value	<0.0001		

Table 3: Time to Reach Highest Level Sensory Block (in minutes)

Groups	Mean ± SD	F-value	*p*-value
Group LB	25.33 ± 1.56	40.41	<0.0001
Group LD	20.30 ± 2.40		
Group L	28.50 ± 2.26		

Table 4: Time to Attain Maximum Bromage Score Between the Study Groups (in minutes)

Groups	Mean ± SD	F-value	*p*-value
Group LB	22.62 ± 2.76	26.84	<0.0001
Group LD	18.64 ± 3.80		
Group L	30.26 ± 2.41		

Table 5: Regression to S1 Segment Between the Study Groups (in minutes)

Groups	Mean ± SD	F-value	*p*-value
Group LB	230.0 ± 30.20	109.66	<0.0001
Group LD	290.60 ± 33.60		
Group L	182.0 ± 20.24		

Table 6: Complete Motor Regression to Bromage 0 Between the Study Groups (in minutes)

Groups	Mean ± SD	F-value	*p*-value
Group LB	210.60 ± 25.93	56.82	<0.0001
Group LD	255.20 ± 36.00		
Group L	175.62 ± 18.96		

In our study we observed that the time taken to complete motor regression to bromage 0 was 210 ± 25.93 minutes, 255.20 ± 36 minutes and 175.62 ± 18.96 minutes in group LB, LD and L respectively. The above observations were found to be statistically highly significant by ANOVA test. (p<0.0001) (*Table 6*).

The duration of analgesia is defined as the time to reach a VAS of 4 and provision of first rescue analgesia in form of epidural top up and was found out to be significantly different between the three groups. We observed that the mean duration of analgesia was 292.0 ± 29.41 minutes in group LD, 225.0 ± 33.19 minutes in group LB and 178.0 ± 19.19 minutes in group L. The above observations were found to be statistically highly significant by ANOVA test (p<0.0001).

Sedation was assessed by using Ramsay Sedation score. The results of our study showed that sedation score of 3 was seen in 60% of the patients in group LD and 3.33% of the patients in group LB. Most of the patients in group L and LB had sedation score ≤ 2. All patients remained arousable to verbal commands and sedation score of more than 3 was not seen in any patient during this study. Sedation scores were much better in LD group and highly significant on statistical comparison (p<0.0001).

Hypotension was reported in 3 patients (10%) in group LD, in 2 patients (6.67%) in LB and in 2 patients (6.67 %) in L group. Bradycardia was seen in 1 patient (3.33%) in group LB, 3 patients (16.67%) in group LD and 1 patient (3.33%) in L group. On statistical analysis these results were statistically insignificant among groups.

Nausea/vomiting was observed in 6.6% patients in group LB as compared to 3.33% in LD and L group. This result was also found to be statistically insignificant among the groups with increased incidence of nausea/ vomiting in LB as compared to LD and L group. Shivering was seen in 1 patient in L group, 1 patient in LB group and was not observed group LD. This result was statistically insignificant among three groups. None of the patients in our study developed any complaints in the form of respiratory depression, headache, dry mouth, urinary retention and pruritis throughout the observation period of the study.

Discussion

Epidural anaesthesia is the most commonly used technique for providing not only perioperative surgical anaesthesia but also postoperative analgesia in lower abdominal and limb surgeries. Various adjuvants have been used in various studies to shorten the onset and prolong the action of local anaesthetic e.g., morphine, magnesium, fentanyl, clonidine, butorphanol, dexmedetomidine, etc. The rationale for comparing the two selected doses of dexmedetomidine (1 μg/kg) and butorphanol (10 μg/kg) was derived from earlier studies which advocated the use of such doses to prolong the duration of analgesia without significant side effects (9,10). Dexmedetomidine does cause a manageable hypotension and bradycardia but the striking feature of this drug is the lack of opioid related side effects like respiratory depression, pruritis, nausea and vomiting (11).

The three groups were found to be statistically comparable as regards to the distribution of baseline haemodynamic characteristics and these groups remained haemodynamically stable throughout the study period.

The time taken in minutes for onset of sensory block at T10 level was significantly earlier in Group LD as compared to Group LB and Group L. This difference was found to be statistically significant between group LD and LB. This was in accordance with finding of Fatima *et al.* (12). The addition of butorphanol also hastened the onset of sensory block. These findings are in accordance with Chattopadhyay *et al*. (13) who concluded that the addition of butorphanol to bupivacaine accelerated the onset of sensory block during epidural anaesthesia.

Peak level of sensory block (T5-T6) was obtained in 80.00% of the patients in group LD, 26.6% of patients in group LB and 3.33% of the patients in group L. The difference was found to be statistically significant among the three groups. Our results were in accordance with Attri *et al.* (14) who showed onset of sensory block and time to reach maximum sensory block was rapid in group LB as compared to group L.

The total duration of sensory block was found to be significantly prolonged in group LD and group LB as compared to group L. The difference was found to be statistically significant among the three groups. These results are in accordance with earlier studies (12,15).

The total duration of motor block was found to be significantly prolonged in group LD and group LB as compared to group L. The difference was found to be statistically significant among three groups. In our study, in the dexmedetomidine group we found longer duration of both sensory and motor blockade, stable haemodynamic parameters and good patient satisfaction. Our results are in accordance with Salgado *et al.* (16). On intergroup comparison the time taken in establishment of highest level of sensory block was found to be significantly decreased in Group LD as compared to Group LB and Group L. Pothan *et al*. (17) concluded that dexmedetomidine when added to levobupivacaine fastens the onset of analgesia.

Our results suggest that epidural usage of dexmedetomidine as an adjuvant to levobupivacaine is associated with better sedation as compared to butorphanol. Oriol-Lopez *et al.* (18) stated that the use of dexmedetomidine by epidural route at 1 µg/kg dose with local anaesthetics is an alternative to achieve an anaesthetic quality that enables us to keep the patient in a state of active sedation which reduces the likelihood of respiratory depression which can arise when adjuvant drugs are administered intravenously.

Conclusion

In our study we conclude that dexmedetomidine is a better adjuvant than butorphanol when added to epidural levobupivacaine, as it produces early onset and more prolonged motor and sensory block, better sedation, stable cardio respiratory parameters and good patient satisfaction.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

References

1. Kleinman W. Regional anaesthesia and pain management: spinal, epidural, and caudal blocks. In: Butterworth JF IV, Mackey DC, Wasnick JD, editors. Morgan & Mikhail's Clinical Anesthesiology. 3rd ed. New York, NY: The McGraw-Hill Companies, Inc.; 2002. p. 253-82.
2. Ben-David B, Swanson J, Nelson JB, Chelly JE. Multimodal analgesia for radical prostatectomy provides better analgesia and shortens hospital stay. *J Clin Anesth* 2007;19(4):264-68.
3. Visser L. Epidural anaesthesia. *Update in Anaesthesia* 2001;(13):11.
4. Kopacz DJ, Allen HW, Thompson GE. A comparison of epidural levobupivacaine 0.75% with racemic bupivacaine for lower abdominal surgery. *Anesth Analg* 2000;90(3):642-48.
5. Foster RH, Markham A. Levobupivacaine: a review of its pharmacology and use as a local anaesthetic. *Drugs* 2000;59(3):551-79.
6. Gabriel JS, Gordin V. Alpha 2 agonists in regional anesthesia and analgesia. *Curr Opin Anaesthesiol* 2001;14(6):751-53.
7. Kumar M, Lal AK, Kaur H, Singh G, Baghla N, Jhand HK. Comparative evaluation of butorphanol versus nalbuphine for postoperative epidural analgesia in lower limb orthopaedic surgeries. *Indian J Anesth Analg* 2019;6(2):611-18.
8. Bhana N, Goa KL, McClellan KJ. Dexmedetomidine. *Drugs* 2000;59(2):263-68.
9. Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S, *et al.* Dexmedetomidine and clonidine in epidural anaesthesia: a comparative evaluation. *Indian J Anaesth* 2011;55(2):116-21.
10. Pokharel K, Rahman TR, Singh SN, Bhattarai B, Basnet N, Khaniya S. The efficacy and safety of low dose epidural butorphanol on postoperative analgesia following cesarean delivery. *JNMA J Nepal Med Assoc* 2008;47(170):57-61.
11. Venn RM, Hell J, Grounds RM. Respiratory effects of dexmedetomidine in the surgical patient requiring intensive care. *Crit Care* 2000;4(5):302-08.
12. Fatima N, Singh NR, Singh LP, Doddaiah DB, Singh TH, Taloh Y. Comparative study of the effect of dexmedetomidine and butorphanol as epidural adjuvants in abdominal hysterectomy under intrathecal levobupivacaine anesthesia. *J Med Soc* 2016;30(3):166-71.
13. Chattopadhyay S, Sarkar S, Mandal M, Chakrabarti S. A comparative study of epidural bupivacaine and epidural bupivacaine with low-dose butorphanol for perioperative analgesia in patients undergoing elective gynaecological surgeries. J Evolution Med Dent Sci 2017;6(24):1985-91.
14. Attri JP, Kaur G, Kaur S, Kaur R, Mohan B, Kashyap K. Comparison of levobupivacaine and levobupivacaine with fentanyl in infraumbilical surgeries under spinal anaesthesia. *Anesth Essays Res* 2015;9(2):178-84.
15. Bommalingappa B, Channabasappa SM. Butorphanol as an adjuvant to levobupivacaine in supraclavicular brachial plexus block for upper limb orthopaedic surgeries: a randomized, double blind, placebo-controlled study. *J Evolution Med Dent Sci* 2016;5(60):4194-97.
16. Salgado PF, Nascimento P Jr, Módolo NSP, Sabbag ATR, Silva PC. Adding dexmedetomidine to ropivacaine 0.75% for epidural anesthesia. Does it improve the quality of the anesthesia? *Anesthesiology* 2005;103:A974.
17. Pothan ARV, Narayanan VS. A comparative study of epidural 0.5% levobupivacaine versus epidural 0.5% levobupivacaine with dexmedetomidine on analgesia and haemodynamics. *J Evolution Med Dent Sci* 2015;4(57): 9978-89.
18. Oriol-Lopez SA, Maldonado-Sanchez KA, Hernandez-Bernal CE, Castelazo- Arredondo JA, Moctezuma LR. Epidural dexmedetomidine in regional anaesthesia to reduce anxiety. *Rev Mex Anestesiol* 2008;31(4):271-77.