A comparative study of 0.5% bupivacaine and 0.5% bupivacaine with ketamine in lumbar epidural block

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Abstract

Background: Epidural block with bupivacaine alone can provide analgesia in the early post operative period but as the block wears off, systemic analgesics such as non-steroidal anti inflammatory drugs (NASID) or parenteral opioids are frequently required to relieve the pain. Epidural administration of opioids are an effective way of pain control in the post-operative period, but they produce side effects, like delayed respiratory depression. Ketamine when administered epidurally inhibits the nociceptive transmission. The present study was conducted to evaluate the efficacy of epidural 1% ketamine 0.5mg.kg body weight with 0.5% bupivacaine compared with 0.5% bupivacaine plain solution.

Methods: 60 patients were randomly assigned into two groups of 30 patients each. All patients were posted for elective surgery which required a sensory blockade level below T6 dermatome. After standard premedication, single shot lumbar epidurals were administered. Group I received bupivacaine 0.5% plain solution (1.5 ml.spinal segment to be blocked) Group II received bupivacaine 0.5% (1.5 ml.spinal segment to be blocked) plus 1% preservative free ketamine (0.5 mg.kg body weight). Heart rate, blood pressure, sensory and motor blockade, post-operative analgesia and pain score, supplementation during surgery, Intra and postoperative complications were recorded.

Results: Time of onset of sensory blockade and time of onset of the maximum motor blockade is faster in the group of epidural bupivacaine plus ketamine. Quality of motor block did not have a significant change in epidural bupivacaine ketamine group clinically, though the statistical analysis proved to be significant. The epidural bupivacaine plus ketamine group took more time to recover from the motor blockade. Postoperative analgesia was significantly more in the epidural bupivacaine plus ketamine group. Intraoperatively epidural bupivacaine plus ketamine group showed a lower incidence of hypotension and bradycardia, None of the patients required supplemental anesthetics during the study. Postoperative pain scores at the first request of analgesia were comparatively lower in the epidural bupivacaine plus ketamine group.

Conclusions: The addition of ketamine to bupivacaine improved significantly both quality and duration of analgesia compared with administration of bupivacaine alone, without increasing the incidence of side effects. Respiratory depression seen with epidural opioids was not seen with epidural ketamine in the present study.

Keywords: Epidural block, Bupivacaine, Ketamine, General anaesthesia, Local anaesthesia

Introduction

Epidural blocks with local anesthetics have been used in clinical practice for a long time. It was further changed in 1976 when Martin & Co-workers improved their understanding of opioid receptors. In 1979, intraspinal morphine was first administered, beginning a new and exciting era in pain management. Opioid therapy via intrathecal and epidural routes is still commonly utilized today. [1] Intrathecally or epidurally administered opioids provide consistent pain relief without impairing motor activities or other sensory modalities such as touch sensation. However, there are certain disadvantages to this form of pain management, such as respiratory depression, urinary retention, itching, tolerance building, and somnolence, and inefficiency against certain types of pain. Intraspinal opioids can produce hyperaesthesia at larger doses.

Intraspinal morphine's life-threatening consequence of delayed respiratory depression limits its use in today's era of day-care surgery and

anaesthesia. The search for new intraspinal medicines with fewer adverse effects has continued. Fentanyl, sufentanil, Clonidine, ketamine, and other opioids are now in use. These compounds are used in conjunction with local anaesthetics or on their own, with varying degrees of success. Stevens created ketamine, a phencyclidine derivative, in 1962, and Corrssen and Domino used it in people in 1965. Ketamine was first approved for therapeutic usage in 1970, and it is still frequently used today. When compared to other induction agents, ketamine has a strong analgesic characteristic. [2] Epidural ketamine was initially utilized in 1982 by Mankowitz et al. Patients with persistent pain in the back, lower abdomen, and legs were given 4 mg of ketamine hydrochloride in 10ml of 5% dextrose water epidurally. In every case, pain alleviation was achieved. The action lasted anywhere from half an hour to over six hours. In comparison to opiates, intraspinal ketamine has the advantage of preventing delayed respiratory depression. [3]

Epidural ketamine acts by depressing the excitation of a class of dorsal horn neurons. These cells have been associated with the central processing of pain. There has been evidence that ketamine binds to opioid receptors in the brain and spinal cord in a stereospecific manner. Ketamine has as a local analgesic. It works as a non-competitive NMDA (N-Methyl-D-Aspartic acid) receptor antagonist and is involved in both alpha and serotoninergic mediation. [4] In some studies low dose of ketamine is initially unable to relieve postoperative pain and epidural ketamine was found to be effective only when used in a higher dose. [5-7] Hence the present study was attempted to compare the clinical efficacy of free ketamine (0.5mg kg body weight) and 0.5% bupivacaine(1.5ml.spinal segment to be blocked) with bupivacaine 0.5% plain solution in single shot lumbar epidural block.

Material and Methods

A prospective randomized double-blind study was conducted with 60 patients who required blockade below T6 dermatome was only selected.

Inclusion criteria

ASA physical status patients
Both male and female
20 - 40 years age groups
Weight 40 - 90 kgs

Exclusion Criteria

Difficult airway
Previous history of anaesthetic complications
History of local anaesthetic allergy
Spinal deformities
Pre-existing neurological deficits
Cases with contraindication to regional anaesthesia

The institutional ethical committee approved the study. Total sample sizes of 60 patients were randomly allocated into two groups. Control groups --Group-1-received 0.5% bupivacaine, 1.5 ml.spinal segment to be blocked (n=30), (Not exceeding 2mg kg body weight) and Group - II(n=30) received bupivacaine 0.5% 1.5ml spinal segment to be blocked plus preservative free 1% ketamine in a dose of 0.5mg kg body weight. On the previous day of surgery, detailed pre anaesthetic evaluations were done in all cases. The procedure was explained and written informed consent was obtained from the patients and relatives. From 10 p.m. on the prior day of operation, all patients were kept nil per oral and premedicated with a tablet. 0.2 milligrammes of diazepam per kilogramme of body weight

Procedure:

All patients received IV diazepam 0.2mg.kg body weight mixed with 21.3mg of lignocaine 2% over 5 minutes as premeditation. Baseline blood pressure and heart rate were recorded. Before the epidural block, all patients were given 10ml of intravenous fluid-ringer lactate per kilogram of body weight. All patients were put in left lateral position and under all aseptic precautions lumbar L3-L4 interspace was identified and infiltrated with 1ml of 2% lignocaine. Treatment drugs were given to respective groups. Change in heart rate and blood pressure, time of onset of sensory blockade (Pinprick method), time of onset of maximum motor blockade, quality of motor blockade (Modified Bromage scale - by Logan wild smith), duration of motor blockade (Bromage scale), any supplementation needed during surgery, duration of postoperative analgesia (Time for the first request for analgesics), postoperative pain score by modified visual analog scale (VAS), intra or post operative complications were monitored for 24 hours in a postoperative ward after surgery.

Statistics:

All parameters studied were statistically analyzed and interpreted. Proportional data were compared using heterogeneity or 2-test. For ordinal data the Mann-Whitney-U- test was used to compare the difference in mean score. Student's T-test-for independent samples were used to compare the differences in the mean time to onset of sensory blockade, recovery of motor blockade, and postoperative analgesia between group I and II. All haemodynamic data (Mean heart rate and mean arterial pressure) were analyzed using two-way ANOVA with time observations and groups as factors, the interaction between groups over time.

P-value <0.05 was considered statistically significant.

Result:

This study was conducted in 60 ASA physical status-I-Patients posted for elective surgical procedures, which required sensory blockade below the level of T6 dermatome and operated under single shot lumbar epidural block. Patients were randomly assigned into two groups. Groups 1 and Group II. (30 patients in each group).

Age

Table 1 shows the distribution of patients according to the age in group I and group II. No significant difference in age was observed in both the groups (Table 1) (p>0.05)

Weight

The majority of the patients were in the weight range of 50-99 kgs in both the groups However, the distribution of patients in the two groups were not significantly different with respect to weight (Table 1) (p>0.05)

Sex

The majority of patients were male in both groups (96.7%) Distribution of male and female patients were equal in both groups (Table 1).

Table 1 Demographic details of patients like age weight and gender

	Group I (n=30)	%	Group II (n=30)	%
Age(Years)				
20-24	7	23.3	6	20.0
25-29	8	26.7	9	30.0
30-34	10	33.3	9	30.0
35-40	5	16.7	6	20.0
Total	30	100.0	30	100.0
Weight(in Kg)				
40-49	4	13.3	1	3.3
50-59	18	60.0	13	43.3
60-69	7	23.3	12	40.0
70-79	1	3.3	4	13.3
Total	30	100.0	30	100.0
Sex				
Male	29	96.7	29	96.7
Female	1	3.3	1	3.3
Total	30	100.0	30	100.0

Type of Surgery

Among the patients admitted into the study 66.7% and 76.7% of the patients respectively in Group I and Group II underwent inguinal Herniorrhaphy. This is followed by 10% in Group I and 13.3% in Group II underwent evasion of sac for hydrocele distributions of patients do not differ significantly between the two groups (p>0.05). The number of patients ranged between 1 and 3 for other types of surgeries in both groups.

Sensory blockade

The Mean (±SD) time to onset of sensory block was significantly greater in Group I (16.75±1.89min) than that for group II (12.99 ±1.8min) (p<0.05).

Time to onset of maximum motor blockade

The mean (±SD) time to onset of maximum motor blockade was significantly greater in group I (42.53±5.79min) than that for Group II (33.28±4.94min) (p<0.05)

Quality of motor blockade

The mean degree of motor blockade was significantly higher for patients in group II (2.03±0.18) than that in patients of group I (1.87±0.35) (p<0.05).

Recovery of motor blockade

The mean (±SD) time to recovery of motor blockade was significantly greater for Group II (211.92±31.54) patients than for those in Group I (179.77±24.69) (p<0.05).

Time of postoperative analgesia

The mean (±SD) duration of analgesia was 117.91 (51.5) for group I and 302.63(12.6) minutes for group II. The mean duration of analgesia was significantly longer in group II compared to group I (p<0.05).

Pain score

The mean(±SD) pain score for Group II (2.89±2.9) was significantly less than Group I (5.62±1.25) (p<0.05)

Complications

Figure -1 shows the distribution of patients according to complications. It was observed that the percentage of patients with shivering, Shivering & urinary retention, and urinary retention were not significantly different between the two groups. However, the overall percentage of patients with postoperative complications were significantly lower in group II(20.0%) than that in group I(50%).

Haemodyanamine changes

Both Heart rate and mean arterial pressure appeared to be lower for Group I than for group II. However the change in these parameters over the

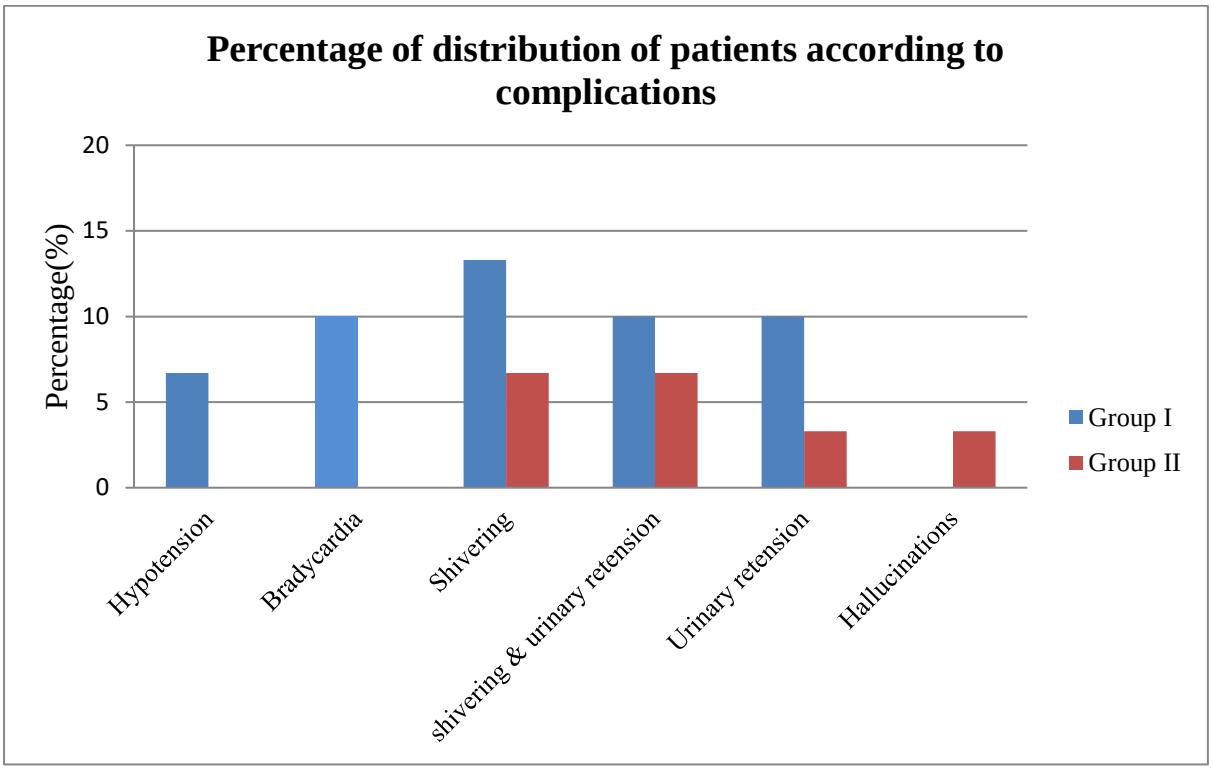

Figure 1- **Percentage of distribution of patients according to complications**

intraoperative period does not differ significantly between the two groups (p>0.05).

Discussion:

Epidural block for intraoperative and epidural analgesia for postoperative pain relief is widely used in all parts of the world. With a better understanding of opioid receptors, intrathecal and epidural opioids are commonly used now with or without local anaesthetics. However intraspinal opioids are known to have side effects such as delayed respiratory depression, pruritus and urinary retention with can result in increase morbidity. Search for an alternative to intraspinal opioids led to the use of ketamine for intra and epidural analgesia.

In previous studies, epidural ketamine found satisfying postoperative analgesia without delayed respiratory depression. [8] The present study reveals that the onset of sensory blockade was earlier in the epidural ketamine plus bupivacaine group(Group II) when compared to the bupivacaine group (Group I). The present study result correlated with the study of Koing H etal (2003). [9]

The result of the present study regarding the time of onset of maximum motor blockade did not correlate with the study of Nagib M et al. [6] The mean time to achieve maximum motor blockade was significantly lower in the ketamine plus bupivacaine group when compared to the bupivacaine group.

Quality of motor block in the present study was statistically significantly greater in bupivacaine plus ketamine group than bupivacaine group, though clinically it appeared insignificant. Most of the patients in both groups had partial 66% (Scale-2) blockade only one patient in the bupivacaine plus ketamine group had complete paralysis (Scale 3). This result correlated with the study of Weir PS et al. [10] They studied the effect of preservative-free epidural ketamine in 59 ASAIII patients undergoing knee replacement. Ketamine in doses of 0.3mg.kg, 0.5mg.kg and 0.67mg.kg was used along with 75mg of 0.5% bupivacaine. They found that there was no significant difference between the groups in the degree of motor block. It appears that only a very high dose of epidural ketamine causes motor blockade.

Motor blockade recovery in the case of Group II (bupivacaine plus ketamine) was found to be delayed when comparing with the group I (bupivacaine) in the present study. Clinically also

delayed recovery of motor block was found to be significant. The present study result correlated with the study of Johnston et al who conducted a randomized study in children one to five years undergoing orchidopexy but differed from the study of SCS Ressel et al ", Nagib M et al. [11] This difference may be due to the higher percentage of bupivacaine used in the present study.

In the present study postoperative analgesia was significantly more in the bupivacaine plus ketamine group compared with the ketamine group. The present study correlated with the results of Ozbek et al, Frank Weber et al, Marhofer P et al, Martindale SJ et al. in significant prolongation of analgesia. [12-15] Pain score using a modified visual analogue scale (VAS) was found to be lower in bupivacaine plus ketamine group compared to bupivacaine group. These observations were statistically and clinically significant. Our study correlated with the study of Martindale SJ et al regarding pain scores. [15]

Hemodynamic parameters like heart rate and mean arterial pressure do not differ significantly between the groups. This finding correlated with the study of Shigihare et al, Marhofer et al also observed no hemodynamic instability with epidural ketamine when used for postoperative analgesia. [16] Intra and postoperative complications were comparable between the bupivacaine plus ketamine group and bupivacaine group. However, overall complications were more in the bupivacaine group. Clinically hypotension requiring vasopressor therapy was seen in 2 patients and bradycardia requiring treatment with injection atropine was seen in 3 patients. These side effects were not observed in the bupivacaine plus ketamine group probably because of the sympathetic stimulation caused by ketamine. This observation correlates with the study of Jankovic et al. [17] Shivering was also less in the bupivacaine-ketamine group (67%) when compared to the plain bupivacaine group (13.3%). This result can also be attributed to the sympathetic stimulation caused by ketamine.

One patient in bupivacaine plus ketamine group had halluciantions. In our study, we found that ketamine in a dose of 0.5mg kg body weight combined with 0.5% bupivacaine in the lumbar epidural block provided good postoperative analgesia and a low Mican pain score (modified visual analogue scale). But this result does not correlate with the study of Weir PS et al who concluded that addition of ketamine even at a dose of 0.67mg kg along with 0.5% bupivacaine did not improve extra dual block in adult patients undergoing total knee replacement
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Conclusions

The present study, concludes that epidural ketamine appears to provide early onset of the sensory blockade, early onset of motor blockade, longer duration of recovery time from motor blockade better postoperative analgesia, and low pain score (VAS) when combined with bupivacaine for a lumbar epidural block for the various surgical procedure without many adverse effects.

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