ORIGINAL RESEARCH

Comparison of efficacy of lumbar epidural block using 0.125% bupivacaine alone and 0.125% bupivacaine with ketamine for postoperative analgesia

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ABSTRACT

Background: A lumbar epidural block is a procedure commonly used to provide pain relief or anaesthesia for various conditions involving the lower abdomen and lower extremities. The present study was conducted to assess efficacy of lumbar epidural block using 0.125% bupivacaine vs 0.125% bupivacaine with ketamine. **Materials & Methods:** 50 ASA grade I and II patients undergoing various elective surgical procedures involving lower abdomen, pelvis, infrainguinal vascular surgeries, hip surgeries, femur surgery (surgeries requiring analgesia below T6 level) under general anaesthesia of both genders and age between 18-65 years were divided into 2 groups of 25 each. Group I received 0.125% bupivacaine 10-15 ml (as per dermatomal requirement to be blocked) and group II received bupivacaine 0.125% 10-15ml plus preservative free 1% ketamine in a dose of 0.5 mg/kg/body weight. Parameters such as weight, height, ASA grade I and II, VAS score for 24 hours and complications were recorded. **Results:** Both the groups were comparable (P> 0.05) in terms of demographic characteristics like age, sex, weight, height and ASA status. VAS score was similar in both the groups at 0 and 2 hours postoperatively but the difference was found statistically significant thereafter till 24 hours (p<0.05) between the two groups. Common complications were shivering, bradycardia, urinary retention and hallucinations. The difference was significant (P< 0.05). **Conclusion:** Lumbar epidural block using 0.125% bupivacaine with 0.5mg/kg ketamine is more efficacious for postoperative analgesia than 0.125% bupivacaine alone.

Key words: Lumbar epidural block,ketamine, bupivacaine

INTRODUCTION

Lower abdominal and lower limb surgeries are associated with a significant postoperative pain. It has been evident from previous research that neural block is of greater benefit in these cases A lumbar epidural block is a procedure commonly used to provide pain relief or anesthesia for various conditions involving the lower abdomen and lower extremities. It involves injecting medication into the epidural space, which is the area surrounding the spinal cord and the nerves that exit the spinal cord.[1]

Without impairing motor skills or other sensory modalities like touch perception, administration of local anesthetics in lower concentrations (bupivacaine 0.125% and less) epidurally produces a reliable way of pain management. However, there are still some downsides to this technique of pain management especially when combined with opioids, the most important of which appears to be delayed respiratory depression, particularly when using hydrophilic drugs like morphine. Other typical side effects include urinary retention, pruritus, tolerance development, somnolence, and ineffectiveness against specific types of pain. Intraspinal opioids may produce hyperesthesia at larger doses.[2]

The understanding of the role of N-Methyl-D-Aspartate (NMDA) receptors in pain modulation has prompted the use of NMDA receptor antagonists such as magnesium and ketamine to control postoperative pain.[3]Ketamine, administered intrathecally or epidurally, targets the NMDA receptors located within the dorsal horn[4] and has been found to be effective in controlling postoperative pain.[5]

The present study was conducted to assess efficacy of lumbar epidural block using 0.125% bupivacaine vs 0.125% bupivacaine with ketamine in postoperative analgesia.

MATERIALS & METHODS

A prospective randomized double-blind study was conducted with 50 patients, after obtaining institutional ethical committee approval and written informed consent from patients.

Inclusion criteria –ASA grade I and II physical status patients of either sex between 18-65 years, BMI between 18.5 – 35kg/m2 undergoing lower abdominal, pelvic and lower limb orthopaedic and vascular surgeries (dermatomal level below T6) under general anesthesia.

Exclusion Criteria- patients refusal,bleeding diathesis, hemodynamically unstable patients,emergency surgeries, ASA physical status 3 and 4 patients, known case of hypersensitive reactions to local anesthetics, having coagulation disorders or on any anticoagulants. difficult airway, previous history of anaesthetic complications, spinal deformities, pre-existing neurological deficits or head trauma, pregnant patients.

Data such as name, age, gender, height and weight etc. were recorded. Patients were divided into 2 groups of 25 each. Group I received 0.125% bupivacaine 10-15 ml and group II received bupivacaine 0.125% 10-15ml plus preservative free 1% ketamine in a dose of 0.5 mg/kg.

The patients were instructed regarding the use of visual analogue scale (VAS) for assessing the pain scores (where 0 means no pain and 10 means worst pain imaginable) at their preoperative visit. Postoperative VAS score was recorded at 0, 2, 6, 12 and 24hours (0 hour is immediate postoperative period). Complications such as shivering, bradycardia, hypotension, urinary retention and hallucinations were also recorded. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

PROCEDURE

After getting pre-anesthetic clearance for surgery, all patients were given tab alprazolam 0.25mg on night before surgery and were kept nil per oral from midnight. On the day of surgery,an 18 gauge peripheral intravenous cannula was secured in one of the upper limb, all standard monitors were attached (ECG, NIBP, pulse oximeter) and local anaesthetic sensitivity was done. Before inducing general anaesthesia, epidural catheter was inserted in sitting position under all aseptic precautions at L2-L3 or L3-L4 level (using loss of resistance technique) with tip fixed around T10 level. Intrathecal or intravascular placement was confirmed after giving standard test dose of 3ml of 2% lignocaine with adrenaline (1:200000).The non-appearance of tingling and numbness in the lower limbs and absence of an increase in heart rate was confirmed. After fixation of epidural catheter, patients was made supine and an injection of normal saline was given through the catheter to check for its patency.

Baseline blood pressure, heart rate, and SpO2 were recorded. All patients were induced with standard institutional protocol for general anaesthesia. At the end of surgery, before giving reversal, epidural injection was given as per group allocation (1.5ml per segment to be blocked). Patient was then reversed and extubated and shifted to post-anesthesia care unit for monitoring.Patients were observed in the recovery room for one hour for any hemodynamic changes and then shifted to the postoperative ward.Whenever the vas score was 4 or more, iv paracetamol (15mg/kg) was given as rescue analgesic.

STATISTICAL ANALYSIS

The Statistical Analysis was done with SPSS software (Statistical Package for the Social Sciences for windows Version 23.0). For categorical variables Chi-Square test was used. For paired samples Paired t test was used. Pearson's correlation coefficient was used to correlate to continuous data. P-value <0.05 is considered as statistically significant.

RESULTS

Demographic parameters like age, sex, height, weight and ASA grade were comparable in both the groups.

Table I Distribution of patients

Groups	Group I	Group II
Agent	10-15 ml 0.125% bupivacaine	10-15 ml 0.125% bupivacaine+ 0.5mg/kg ketamine
M:F	15:10	12:13

Table I shows that group I had 15 males and 10 females and group II had 12 males and 13 females.

Table II Baseline parameters

Parameters	Group I	Group II	P value
Weight (Kgs)	68.2	68.7	0.92
Height (cm)	162.3	161.9	0.84
ASA status I/II	14/11	12/13	0.91

Table II shows that the difference was comparable (P> 0.05).

Table III- Comparison of mean VAS score between the two groups

Time Interval	Group 1 Mean ± SD	Group 2 Mean ± SD	T-value	P- value
0 hour	0.00 ± 0.00	0.00 ± 0.00	-	-
2 hour	0.42 ± 0.47	0.30 ± 0.57	0.70	0.48
6 hour	1.68 ±1.643	0.67±0.758	3.028	0.003
12 hour	4.06 ±1.494	3.03±1.790	2.306	0.012
24 hour	4.00±0.983	3.03±1.377	3.130	0.003

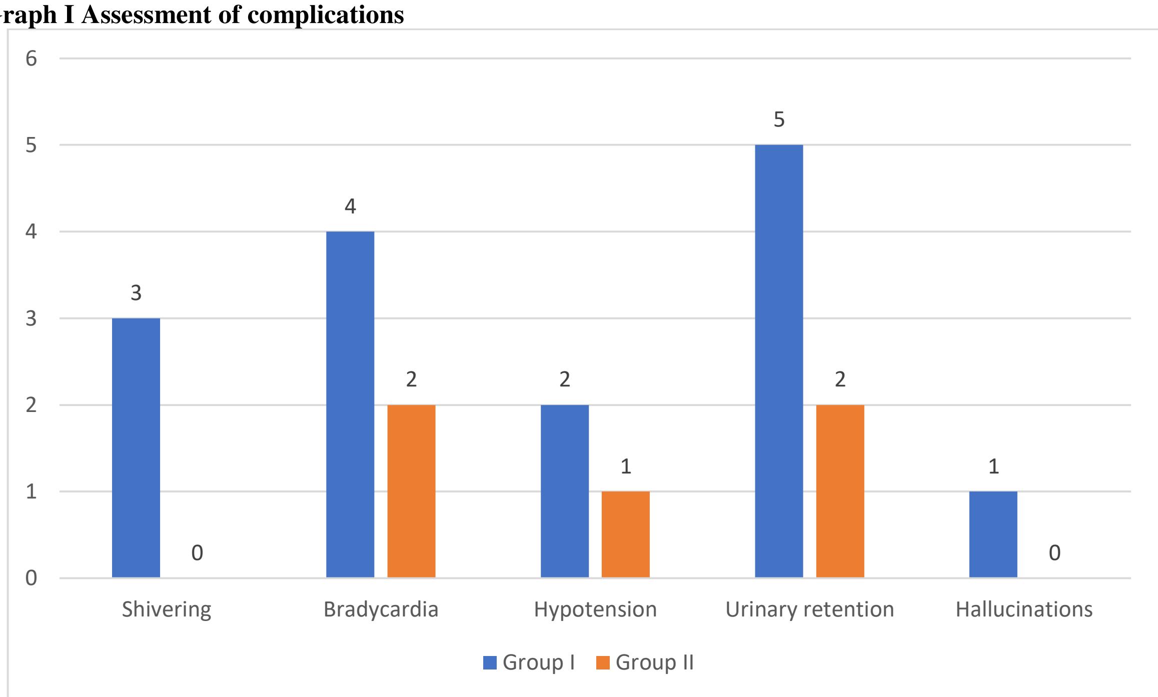
Table III shows that VAS score between the two groups was not significant at 0 and 2 hours, but was found significant at 6, 12 and 24 hours ($p < 0.05$)

Table IV Assessment of complications

Complications	Group I	Group II	P value
Shivering	3	0	0.02
Bradycardia	4	2	0.05
Hypotension	2	1	0.94
Urinary retention	5	2	0.03
Hallucinations	1	0	0.21

Table IV, graph I shows that common complications were shivering in 3 and 0, bradycardia in 4 and 2, hypotension in 2 and 1, urinary retention in 5 and 2 and hallucinations in 1 and 0. The difference was significant ($P < 0.05$) for shivering, bradycardia and incidence of hallucinations.

Graph I Assessment of complications



DISCUSSION

Administration of analgesics through an epidural route is beneficial for postoperative pain relief, as they decrease perioperative morbidity and mortalityby attenuating autonomic and neuroendocrine response to surgical trauma[6]. Many epidural supplements augment and prolong postoperative analgesia beyond the local anesthetic effect, including opioids, ketamine, steroids, midazolam, clonidine, dexmedetomidine, neostigmine or epinephrine. Owing to its antagonistic activity on *N*-methyl-D-aspartate (NMDA) receptors, sodium channel blocking effect, monoaminergic descending inhibitory system activation, in addition to its opioid and cholinergic receptors activating effect, ketamine has been used with local anesthetic successfully to augment epidural anesthesia and analgesia[7-11].

Bupivacaine is a local anaesthetic frequently used for epidural blocks. When using 0.125% bupivacaine for a lumbar epidural block, the goal is to provide effective pain relief while minimizing potential side effects or complications. The specific dosage and volume of bupivacaine used in a lumbar epidural block can vary depending on several factors, including the patient's weight, the extent of the procedure, and the desired duration of anaesthesia or pain relief.[12] The combination of bupivacaine and ketamine can be used in certain cases to enhance the effectiveness of pain relief provided by a lumbar epidural block. Bupivacaine is a local anaesthetic that numbs the area, while ketamine is a dissociative anaesthetic and analgesic that works by blocking pain signals in the central nervous system.[13] When used together, bupivacaine and ketamine can produce a synergistic effect, meaning that the combined effect is greater than the sum of their individual effects. This combination can result in improved pain relief and potentially reduce the amount of each medication needed, minimizing side effects.[14]

The specific dosage and ratio of bupivacaine to ketamine will depend on various factors, such as the patient's weight, medical condition, and the desired level and duration of pain relief.[15] The administration of this combination should be performed by a qualified healthcare professional who will determine the appropriate dosage and closely monitor the patient during the procedure.[16] It's important to note that the use of bupivacaine and ketamine together may carry additional risks and considerations. Both medications have potential side effects and can interact with other medications or pre-existing medical conditions.[17] The present study was conducted to assess efficacy of lumbar epidural block using 0.125% bupivacaine vs 0.125% bupivacaine with ketamine.

Jankovic et al[18] did a study regardingthe effects of intraoperative epidural administration of ketamine added to bupivacaine were compared with fentanyl added to bupivacaine in patients undergoing total gastrectomy. Groups compared: group F: 20 patients receiving 20 ml of 0.125% bupivacaine and 50 ug of fentanyl and group K: 20 patients in whom 20 ml of 0.125% bupivacaine was combined with 50 mg of ketamine. Patients received an epidural injection through peridural catheter introduced through either T7-8 or T8-9 interspinous space. The groups were comparable with regard to patient's characteristics, operation and anaesthesia related factors. There were no difference between groups in mean intraoperative fentanyl requirements (F vs. K = 118.5 (122.5) ug vs. 122.5(122.5) ug) in the duration of epidural pain relief (F vs. K = 393.72 (98.75) min vs.403.63 (111.41) min, in the tracheal extubation time (F vs. K = 52.31 (50.4) vs.46.75 (48.35) min), postoperative sedation score (F vs. K = 1.26 (0.73) vs.1.11 (0.32)) ($p > 0.05$). Significantly higher systolic blood pressure was measured in group K comparing with group F in 20, 75, 105, 120, 150 min ($p > 0.05$). Statistically significant more ephedrine was applied in F group (F vs. K = 0.88(1.76) ml vs.0.05 (0.23) ml). There were no statistically significant differences between groups in heart rate during the operation. Hence, addition of fentanyl or ketamine with bupivacaine did not produce any significant difference in pain control, results were comparable but more ephedrine was required in fentanyl group. Thus, showing that ketamine offers more hemodynamic stability and is devoid of opioid side effects.

Himanshu Aneejwal et al[19] in 2021 did a comparative studyfor post-operative pain relief after lumbar epidural block using 0.2% Ropivacaine with two different doses of Ketamine (0.3 mg/kg and 0.5 mg/kg) for lower abdominal and lower limb surgeries and found that VAS score average was significantly lower in group 2 in which they administered 5ml (0.2%) Ropivacaine + 0.5 mg/kg Ketamine than group 1 in which they administered 5ml (0.2%) Ropivacaine + 0.3 mg/kg Ketamine at different intervals up to 48 hours. It was found that difference in mean VAS scores was significant only after 4 hours. In group 1 at 4 hours the average VAS score was 2.53±1.479. In group 2 at 4 hours the average VAS score was 1.23±2.112. This result was similar to our study also where the difference in VAS score was significant at 6 hour and later. They concluded that adding ketamine (preservative free) to ropivacaine (0.2%) improves the post-operative pain outcome without any systemic side effects.

S. J. Martindale et al[20] in 2004 did a double-blind randomized controlled trial of caudal versus intravenous S(+)-ketamine for supplementation of caudalanalgesia in children undergoing hernia repairor orchidopexy, were prospectively randomized to one of three groups: the bupivacaine groupreceived plain bupivacaine 0.25% 1ml/kg; the caudal ketamine group received caudal plainbupivacaine 0.25% 1ml/kg with S(+)-ketamine 0.5 mg/kg; the i.v. ketamine group receivedcaudal plain bupivacaine 0.25% 1/ml kg plus S(+)-ketamine 0.5 mg/kg i.v.. Postoperativemeasurements included analgesic requirements and modified objective pain score for the first 24 h. They found that median time to first analgesia was significantly longer in the caudal ketamine group (10 h) than in the i.v. ketamine (4.63 h) or bupivacaine (4.75 h) groups (P=0.01).Significantly fewer doses of analgesia were required over the first postoperative 24 h by subjectsin the caudal ketamine group (median 1) compared with the i.v. ketamine (median 2) orbupivacaine (median 2.5) groups ($P<0.05$). There was no difference between the groups in theincidence of postoperative nausea and vomiting or psychomotor reactions. The finding is consistent with our study which also showed adding ketamine to epidural prolonged analgesic duration.

D. Semple, D. Findlow[21] et al in 1996 published an article to find out optimal dose of ketamine for caudal epidural blockade in children. They enrolled sixty boys aged up to 9 years undergoing orchidopexy, were randomly allocated to receive one of three solutionsfor caudal epidural injection: group A received 1ml/kg of 0.25% bupivacaine with 0.25mg/kg of preservative -free ketamine, group B received 1ml/kg of 0.25% bupivacaine with ketamine 0.5mg/kg andgroup C received 1rn1/kg of 0.25% bupivacaine with 1mg/kg of ketamine. Postoperative pain was assessed by means of a modified Objective Pain Score and analgesia was administered if this score exceeded four. The median duration of caudal analgesia was 7.9 h in group A, I1 h in group B and 16.5h in group C. There were no differences between the groups in the incidence of motor block, urinary retention, postoperative vomiting or postoperative sedation. Group C had a significantly higher incidence of behavioural side effects, including slightly odd behaviour, vacant stares and abnormal effect than groups A and B. They concluded that when ketamine is used to prolong the duration of caudal epidural blockade in children, doses of 0.5 mg/kg and 1 mg/kg are significantly more effective than 0.25mg/kg. A dose of 1 mg/kg produces significantly more side effects than either of the other two doses and for this reason the optimum dose is probably 0.5 mg/kg. Hence, based on this study we used ketamine in a dose of 0.5mg/kg in epidural blockade to get maximum analgesic benefit and least complications.

CONCLUSION

This randomised controlled study comparing 0.125% bupivacaine and 0.125% bupivacaine with 0.5mg/kg ketamine in lumbar epidural block for postoperative analgesia in lower abdominal and lower limb surgeries concluded that adding epidural ketamine 0.5mg/kg (preservative free) offers prolonged analgesia and lower complication as compared to bupivacaine alone.

STUDY LIMITATION

The limitation the study is small sample size.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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