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# EPIDURAL ANAESTHESIA WITH BUPIVACAINE AND KETAMINE & BUPIVACAINE AND DEXMEDETOMIDINE -A COMPARATIVE STUDY

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## Abstract

**Background:** Regional anaesthesia has lot of advantages as compared to general anaesthesia for lower abdominal and lower limb surgeries. Intrathecal and epidural anaesthesia are the most popular regional anaesthesia techniques used for lower abdominal and lower limb surgeries. Dexmedetomidine is a highly selectiveα2 adrenergic agonist with anxiolytic, perioperative sympatholytic anti hypertensive properties. It also enhances post operative analgesia. N-methyl-D-Aspartate (NMDA) receptor was found to play a significant role in injury induced spinal hypersensitivity. Also, sensitisation of the central nervous system may account for significant post operatve pain. Blockade of NMDA receptors before and during injury may prevent or reduce development of central sensitisation. **Materials and Methods:** After obtaining the approval from the hospital ethical committee and written informed consent from the patient, the study was conducted on 100 patients belonging to ASA Grade I and II, scheduled for various lower abdominal and lower limb surgical procedures. The study population was randomly divided using computer-generated randomization into 2 groups with 50 patients in each group. Group BK (Bupivacaine-Ketamine): n=50; 15 ml of 0.25% Bupivacaine (preservative free, Bupivacaine 0.5% in 20 ml ampoule)+0.5mg/kg Ketamine (preservative free, 1 ml ampoule = 50mg Ketamine). Group BD (Bupivacaine-Dexmedetomidine): n=50; 15 ml of 0.25% Bupivacaine (preservative free, Bupivacaine 0.5% in 20 ml ampoule)+0.5µg/kg of Dexmedetomidine (preservative free, Dexmedetomidine 1 ml ampoule=100µg). **Result:** The mean time of onset of sensory block was 16.86±2.44 minutes in Group BK and 11.8 ±2.42 minutes in Group BD which was statistically significant($p<0.001$). Time of onset of motor blockade in group BK was 21.6 ±2.36 minutes and in group BD was 16.6±2.3 minutes and the difference was statistically significant ($p <0.001$) as per unpaired t-test. The difference in highest dermatomal level of sensory blockade between Group BK and Group BD was statistically not significant.( p value=0.4008.) as per Chi-Square Test. The highest motor block of Grade 4 was 86% in Group BD and 78% in Group BK. The difference between the groups was however not significant(0.322) as per unpaired t test. The mean duration of sensory block was 183.8 ±14.3 minutes in Group BK and 208.3 ±15.03 minutes in Group BD. The difference was statistically significant ($p<0.001$) as per unpaired t test. The mean duration of motor block was 169.2 ±13.86 minutes in Group BK and 191.1 ±15.46 minutes in Group BD. **Conclusion:** The study was done with epidural 0.25% Bupivacaine with Ketamine and Dexmedetomidine for lower abdomen and lower limbs surgeries. Based on results of this study, and it was concluded that Onset of sensory blockade was faster with Dexmedetomidine as compared to Ketamine. Duration of sensory blockade was longer with Dexmedetomidine as compared to Ketamine. Duration of motor blockade was longer with Dexmedetomidine as compared to Ketamine. Intraoperative sedation score was higher with Dexmedetomidine as compared to Ketamine.

## INTRODUCTION

Regional anaesthesia has lot of advantages as compared to general anaesthesia for lower abdominal and lower limb surgeries. Intrathecal and epidural anaesthesia are the most popular regional anaesthesia techniques used for lower abdominal and lower limb surgeries.

Noxious impulses from damaged tissue evoke long lasting alteration in the central nervous system. Epidural anaesthesia reduces the surgical stress by blocking the nociceptive impulses from the operative site, reduces blood loss, improve respiratory and bowel function and decreased incidence of deep vein thrombosis.[1,2]

However, due to large volumes of local anaesthetic drugs used for achieving the desired effect, epidural anesthesia may be associated with haemodynamic fluctuations leading to deleterious consequences or even general anaesthesia defeating the very purpose of regional anaesthesia.[3]

The fear of surgery, strange surroundings of the operation theatre, the sight and sound of sophisticated equipments and presence of masked persons surrounding the table make the patient anxious.[4,5] The intense sensory and motor block, continuous posture for a prolonged duration and inability to move causes discomfort and phobia in many patients.[6]

To overcome these problems, there is an ongoing effort to find a better adjuvant in regional anaesthesia. Sedation, stable haemodynamics and ability to provide smooth and prolonged post operative analgesia are the main desirable qualities of an adjuvant in neuraxial anaesthesia.[3]

Various additives have been used for extending the duration of central neuraxial block to prolong the effect of local anaesthetic agents. These include drugs like Opioids, Ketamine, Midazolam, Neostigmine and α2 adrenergic agonists.

α2 adrenergic agonists have both analgesic and sedative properties when used as an adjuvant in regional anaesthesia. Dexmedetomidine is a highly selectiveα2 adrenergic agonist with anxiolytic, perioperative sympatholytic anti-hypertensive properties.[7] It also enhances post operative analgesia.[8]

N-methyl-D-Aspartate (NMDA) receptor was found to play a significant role in injury induced spinal hypersensitivity. Also, sensitisation of the central nervous system may account for significant post operatve pain.

Blockade of NMDA receptors before and during injury may prevent or reduce development of central sensitisation. NMDA receptor antagonists like Ketamine can potentiate the effects of other analgesics like morphine, local anaesthetics and non steroidal anti-inflammatory agents.[9]

As an NMDA receptor antagonist, Ketamine may produce additive or synergistic effect with intra operative and post operative pain relief.

Hence, it would be ideal to compare Bupivacaine with Dexmedetomidine and Bupivacaine with Ketamine in lower abdominal and lower limb surgeries.

This study was undertaken to compare Bupivacaine with Dexmedetomidine as adjuvant and Bupivacaine with Ketamine (preservative free) as adjuvant in lower abdominal and lower limb surgeries.

## MATERIALS AND METHODS

After obtaining the approval from the hospital ethical committee and written informed consent from the patient, the study was conducted on 100 patients belonging to ASA Grade I and II, scheduled for various lower abdominal and lower limb surgical procedures at the S.C.B Medical College and Hospital, Cuttack, Odisha during the period October 2015 – November 2016.

The study population was randomly divided using computer-generated randomization into 2 groups with 50 patients in each group.

- Group BK (Bupivacaine-Ketamine): n=50; 15 ml of 0.25% Bupivacaine (preservative free, Bupivacaine 0.5% in 20 ml ampoule)+0.5mg/kg Ketamine (preservative free, 1 ml ampoule = 50mg Ketamine)
- Group BD (Bupivacaine-Dexmedetomidine): n=50; 15 ml of 0.25% Bupivacaine (preservative free, Bupivacaine 0.5% in 20 ml ampoule)+0.5µg/kg of Dexmedetomidine (preservative free, Dexmedetomidine 1 ml ampoule=100µg)

**Inclusion Criteria**

- ASA Grade I or II
- Adult patients between 18 years to 65 years of age
- Weight > 50 Kg
- Height :150-180 centimeters

**Exclusion Criteria**

- Patient's refusal for regional anaesthesia
- Pregnancy and lactation
- Emergency surgeries
- Obese patients with BMI(Body Mass Index)>30
- Patients having raised ICP(Intracranial Pressure)
- Severe hypovolemia
- Bleeding disorder, coagulopathy
- Uncontrolled hypertension/Diabetes mellitus
- Local infection
- Neurological disorder and deformities of spine
- Cardiac disease/Hepatic disease
- Allergy to local anaesthetics and Dexmedetomidine

The epidural procedure was explained to the patients and consent for the same was obtained. Preparation of patients included period of overnight fasting.

The patients were premedicated with Tablet Alprazolam 0.5 mg and Tablet Ranitidine 150 mg orally at bedtime on the night before surgery.

On the day of surgery, the anaesthesia machine was checked. Appropriate size endotracheal tubes,


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laryngoscope with medium and large size blades, stylet and working suction apparatus were kept ready before the procedure. Emergency drug tray consisting of atropine, adrenaline, mephenteramine, ephedrine, dopamine were kept ready.

The patient's Pulse rate and Blood Pressure were recorded. A peripheral I.V line was secured with an 18 G(gauge) cannula in one of the upper limbs.

**Anaesthetic Procedure**

With the patients in sitting position, under all available aseptic precautions, the epidural space was identified by the LOR(Loss Of Resistance) technique to air using 18 G(gauge) Tuohy needle via midline approach at either $L_{2-3}$ or $L_{3-4}$ interspinous space. An epidural catheter was threaded and fixed at 3cm inside epidural space. A test dose of 3ml of 2% Lignocaine with 1:200000 Adrenaline was injected through the epidural catheter after aspiration. After ruling out the intrathecal and intravascular placement of the tip of the catheter, the drug under study was injected in increments of 5ml. The patient was then turned to supine position after 1 minute.

Assessment of sensory and motor blockade was done at the end of each minute with the patient in supine position, after completion of injection of 15 ml of the study drug, which was taken as the starting time. The onset time for sensory and motor blockade, the maximum level of sensory block, intensity of motor block and sedation score was recorded.

The sensory blockade was assessed by pinprick method using a short bevel 22G needle and tested in mid-clavicular line on the chest, trunk and lower limbs on either side. Motor blockade was assessed using modified Bromage scale.

Modified Bromage scale for motor blockade:

- 0 -= No block
- 1=inability to raise extended leg
- 2=inability to flex knee
- 3=inability to flex ankle and foot, able to move toes
- 4=inability to flex ankle and foot, not able to move toes

Measurement of Blood Pressure, Heart Rate and $O_2$ saturation was recorded every 5 minutes till the end of first hour and then every 15 minutes till the end of surgery.

After the surgery, patients were referred to the recovery room where they remained till the complete recovery from sensory and motor blockade.

Epidural analgesic dose (epidural top-up) was given with 8 ml of 0.25% Inj. Bupivacaine added with desired adjuvants (Dexmedetomidine or Ketamine), when the patient complained of pain. Postoperatively, the vital parameters was recorded every 15 minutes; also the duration of sensory blockade and motor blockade or any adverse events were noted.

## RESULTS

1. Onset of sensory and motor blockade

**Assessment of onset of Sensory blockade:** The time of onset of sensory blockade was taken from time of injection of the drug under study into the epidural space to loss of pin prick sensation. Time of onset of T10 sensory block and peak sensory block was noted using pin prick method.

**Assessment of onset of Motor blockade:** It was taken as the time from the completion of the injection of the drug under study till the patient developed modified Bromage scale Grade 1.

2. Maximum level of sensory blockade

The highest level of sensory block was noted from time of injection of drug to loss of pinprick sensation at highest dermatomal level.

3. Grade of motor blockade

The maximum motor blockade was noted from time of injection of the drug to maximum degree of motor block. Grading of block done a per modified Bromage Scale

4. Sedation score

Grading of sedation was evaluated by Five point scale:[103]

- 1=Alert and wide awake
- 2=Arousable to verbal command
- 3=Arousable with gentle tactile stimulation
- 4=arousable with vigorous shaking
- 5=unarousable

Sedation score was recorded just before initiation of surgery and every 5 minutes till 1 hour and then every 15 minutes throughout the surgical procedure.

5. Duration of sensory blockade

It was recorded as the interval from the time of onset of sensory blockade till the patient complains of pain at T10 dermatome.

6. Duration of motor blockade

Duration of motor block was recorded from onset time to time when the patient was able to lift the extended leg

**Statistical Analysis**

At the end of the study, all the data was compiled systematically and analysed using student's t-test, Pearson chi-square test. All the values were expressed as mean ± standard deviation. Statistical Package for Social Sciences Version 21.0 for Windows was used to compare the variables between two groups. Value of $P<0.05$ considered significant and $P< 0.001$ as highly significant.

**Table 1: Comparison of Age Distribution of Group BK and Group BD**

| Age (in years) | 15-25 | 26-35 | 36-45 | 46-55 | 55-65 | Mean | SD | p value |
|---|---|---|---|---|---|---|---|---|
| Group BK | 5 | 15 | 14 | 8 | 8 | 39.88 | 12.87 | 0.100 |
| Group BD | 4 | 12 | 11 | 11 | 12 | 44.12 | 12.67 | |

The age distribution in both the age group was comparable and statistically insignificant as per unpaired t test.


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**Table 2: comparison of the sex distribution in group BK and group BD**

| Sex | | Group | | p value |
|---|---|---|---|---|
| | | BK | BD | |
| Female | No. | 15 | 12 | 0.499 |
| | % | 30 | 24 | |
| Male | No | 35 | 38 | |
| | % | 70 | 76 | |
| Total | no | 50 | 50 | |
| | % | 100 | 100 | |

The sex distribution was comparable between the two groups. The difference between the two groups was statistically insignificant as per Chi-square test.

**Table 3: comparison of the mean duration of surgery in group BK and group BD**

| Variable | Mean Duration of Surgery(min) | SD | p value |
|---|---|---|---|
| Group BK | 118.8 | 4.55 | 0.7031 |
| Group BD | 118.5 | 4.11 | |

The mean duration of surgery was comparable with no significant difference between the two groups as per unpaired t test.

**Table 4: comparison of mean time of onset of sensory block and motor block in group BK and BD**

| Variable | Group BK | | Group BD | | unpaired t Test |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | p value |
| Mean Time of onset of sensory Block | 16.86 | 2.44 | 11.80 | 2.42 | <0.001 |
| Mean Time of onset of motor Block | 21.6 | 2.36 | 16.6 | 2.35 | <0.001 |

The mean time of onset of sensory block was 16.86±2.44 minutes in Group BK and 11.8 ±2.42 minutes in Group BD which was statistically significant($p<0.001$)

Time of onset of motor blockade (Bromage scale 1=inability to raise extended leg) in group BK was 21.6 ±2.36 minutes and in group BD was 16.6±2.3 minutes and the difference was statistically significant ($p <0.001$) as per unpaired t-test.

**Table 5: comparison of the highest dermatomal level of sensory blockade in group BK and group BD**

| Highest dermatomal level of sensory blockade | | Group | | p value (Chi-square) |
|---|---|---|---|---|
| | | BD | BK | |
| T8 | No | 6 | 9 | 0.4008 |
| | % | 12 | 18 | |
| T6 | No | 44 | 41 | |
| | % | 88 | 82 | |
| T4 | No | 0 | 0 | |
| | % | 0 | 0 | |
| Total | No | 50 | 50 | |
| | % | 100 | 100 | |

The difference in highest dermatomal level of sensory blockade between Group BK and Group BD was statistically not significant.( p value=0.4008.) as per Chi-Square Test.

**Table 6: comparison of the motor block in group BK and group BD**

| Grade of Motor Block (Bromage Score) | | Group | | p value |
|---|---|---|---|---|
| | | BD | BK | |
| 4 | No | 43 | 39 | 0.322 |
| | % | 86 | 78 | |
| 3 | No | 7 | 11 | |
| | % | 14 | 22 | |
| 2 | No | 0 | 0 | |
| | % | 0 | 0 | |
| 1 | No | 0 | 0 | |
| | % | 0 | 0 | |
| 0 | No | 0 | 0 | |
| | % | 0 | 0 | |
| Total | No | 50 | 50 | |
| | % | 100 | 100 | |

The highest motor block of Grade 4 was 86% in Group BD and 78% in Group BK. The difference between the groups was however not significant (0.322) as per unpaired t test.


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**Table 7: comparison of mean duration of sensory block and motor block in group BK and BD**

| Variable | Group BK | | Group BK | | Test |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | p value |
| Duration of Sensory Block | 183.8 | 14.3 | 208.3 | 15.03 | <0.001 |
| Duration of Motor Block | 169.2 | 13.86 | 191.1 | 15.46 | <0.001 |

The mean duration of sensory block was 183.8 ±14.3 minutes in Group BK and 208.3 ±15.03 minutes in Group BD. The difference was statistically significant (p<0.001) as per unpaired t test

The mean duration of motor block was 169.2 ±13.86 minutes in Group BK and 191.1 ±15.46 minutes in Group BD. The difference was statistically significant (p<0.001) as per unpaired t test.

## DISCUSSION

The demographic data with respect to age, sex, weight and height was comparable in both groups as shown in Table No.1 to 3. and Graph 1 to 3.

The mean age in group BK was ¬¬¬¬¬ 39.88±12.87 years and in group BD was 44.12±12.67 years. By applying unpaired t- test, (p=0.1001), difference in the age was not significant.

The mean weight in group BK was 63.96±8.958kg and in group BD was 63.48±8.502 kg. By applying, unpaired t- test, (P = 0.780) the difference in weight was not significant.

There was no significant difference in the height distribution between the two groups as per unpaired t test(p=0.907).

The gender distribution in Group BK was, females = 15(30%), males =35(70 %) and in Group BD was, females =12(24%), males =38(76%). By applying Chi square test, difference in gender distribution was not significant.

The mean duration of surgery was comparable in both groups, and the difference between the two groups was statistically insignificant (p=0.730)

The onset of sensory block in both the groups are shown in Table 10 and Graph 10.

The mean time of onset of sensory block was 16.86±2.44 minutes in Group BK and 11.8 ±2.42 minutes in Group BD which was statistically significant(p<0.001).

Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S, et al,[10] (2011) concluded that dexmedetomidine is a better neuraxial adjuvant compared to Clonidine and provides an earlier onset of sensory analgesia.

Kumkum Gupta, Bhawna Rastogi, Prashant K. Gupta, Manish Jain, Suneeta Gupta, Deepti Manglaet al (2014),[11] reported significantly faster onset of sensory blockade with dexmedetomidine as adjuvant as compared to fentanyl.

This study found Dexmedetomidine to have a faster onset of sensory block as compared to Ketamine.

Highest sensory dermatome levels in both groups are shown in [Table 11 and Figure 12].

About 18% (9/50) patients in the study group BK and 12%(6/50) patients of BD group achieved highest sensory dermatome level of blockade of T8.

About 82% (41/50) patients in the study group BK and 88% (44/50) in group BD achieved highest sensory dermatome level of blockade of T6.

The difference was statistically not significant. (p value=0.4008.) as per Chi-Square Test.

In 2011, Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S et al,[10] did comparative study on epidural Ropivacaine with Dexmedetomidine and Clonidine. In this study, RD group achieved maximum sensory block level of T5-6 and RC group achieved maximum sensory block level of T6-7.

In this study the Group BD achieved a higher level of blockade in more number of patients as compared to Group BK. The difference, however, was not significant.

Time of onset of motor blockade (Bromage scale 1=inability to raise extended leg) in group BK was21.6 ±2.36 minutes and in group BD was 16.6±2.3 minutes and the difference was statistically significant (p <0.001) as per unpaired t-test.

In 2011, Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S et al,[10] studied epidural Ropivacaine 0.75% with Clonidine and Dexmedetomidine. In this study, complete motor blockade was achieved earlier (17.24±.5.16 minutes) in patients who were administered Dexmedetomidine as adjuvant compared to those who received Clonidine as adjuvant (19.52±4.06 minutes). Complete motor blockade in group of Dexmedetomidine was earlier compared to group of Clonidine.

This study observed that Group BD had rapid onset of motor blockade compared to Group BK.

It was recorded as the interval from the time of onset of sensory blockade till the patient complained of pain at T10 dermatome level. The mean duration of sensory block was 183.8 ±14.3 minutes in Group BK and 208.3 ±15.03 minutes in Group BD. The difference was statistically significant(p<0.001).

In 2011, Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S et al,[10] did comparative study on epidural Ropivacaine with Dexmedetomidine and Clonidine and found the difference in duration of analgesia in the two groups was statistically significant (p value<0.05), with dexmedetomidine with longer duration of analgesia.

Kumkum Gupta, Bhawna Rastogi, Prashant K. Gupta, Manish Jain, Suneeta Gupta, Deepti Manglaet al (2014),[11] observed a significant prolongation of sensory block in epidural levobupivacaine-dexmedetimidine as compared to levo bupivacaine-fenanyl.

Nilesh Balu Sonawane, J Bala Venkatasubramanian, P Gurumoorthi, Poonam Ashok Jadhav et al (2016),[12] found that the difference of mean duration of sensory block in dexmedetomidine as adjuvant as compared to ketamine was statistically significant.


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The duration of motor block in both groups is shown in [Table 13 and Graph 15].

The duration of motor block was recorded from onset time to time when the patient was able to lift the extended leg.

The mean duration of motor block was 169.2 ±13.86 minutes in Group BK and 191.1 ±15.46 minutes in Group BD. The difference was statistically significant ($p<0.001$).

Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S et al (2011),[10] did comparative study on epidural Ropivacaine with Dexmedetomidine and Clonidine. Two segment dermatomal regression in group RD was 136.46±8.12 minutes and in group RC was 128.08±7.54 minutes and the difference was statistically significant (p value<0.05).

Kumkum Gupta, Bhawna Rastogi, Prashant K. Gupta, Manish Jain, Suneeta Gupta, Deepti Manglaet al (2014),[11] observed a significant prolongation of motor block in epidural levobupivacaine-dexmedetimidine as compared to levo bupivacaine-fentanyl.

Safiya I Shaikh, Sarala B Mahesh et al (2016),[12] concluded that dexmedetomidine as epidural adjuvant to ropivacaine provided a significantly longer motor blockade as compared clonidine.

Nilesh Balu Sonawane, J Balavenkatasubramanian, P Gurumoorthi, Poonam Ashok Jadhav et al(2016),[12] observed a longer duration of motor blockade with epidural Dexmedetomidine as compared to Ketamine.

This study was in concurrence to the above study.

## CONCLUSION

The study was done with epidural 0.25% Bupivacaine with Ketamine and Dexmedetomidine for lower abdomen and lower limbs surgeries. Based on results of this study, and it was concluded that:

1. Onset of sensory blockade was faster with Dexmedetomidine as compared to Ketamine.
2. Onset of motor blockade was faster with Dexmedetomidine as compared to Ketamine.
3. Duration of sensory blockade was longer with Dexmedetomidine as compared to Ketamine.
4. Duration of motor blockade was longer with Dexmedetomidine as compared to Ketamine
5. Intraoperative sedation score was higher with Dexmedetomidine as compared to Ketamine.

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