# COMPARATIVE STUDY OF DEXMEDETOMIDINE AND FENTANYL AS ADJUVANT TO EPIDURAL ROPIVACAINE FOR LOWER LIMB ORTHOPAEDIC SURGERIES

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**ABSTRACT**

**BACKGROUND**

Epidural anaesthesia is one of the preferred modes of regional anaesthesia for lower limb surgeries, provides not only peri-operative surgical anaesthesia but also post-operative analgesia for lower limb orthopaedic surgeries. Epidural anaesthesia reduces physiological stress related to surgery and improves surgical outcomes and gives good post-operative pain relief. Adequate post-operative pain relief is an integral part of anaesthesia, which is helpful in early ambulation of the patient as well as hospital discharge.

This study was done to evaluate and compare the efficacy, analgesic effects, post-operative analgesia of epidurally administered dexmedetomidine or fentanyl along with ropivacaine for patients undergoing lower limb orthopaedic surgeries.

**MATERIALS AND METHODS**

A prospective, randomised, double-blinded study years was conducted at Chengalpattu Medical College, 60 patients of both gender aged 18 - 60 undergoing elective lower limb orthopaedic surgeries were selected and randomly allotted into two groups.

**RESULTS**

Group A and B were comparable with regard to their age, weight and sex. There is no statistically significant difference seen among two groups in the demographic profile. The mean time for onset of sensory block is 3.87 ± 0.681 (minutes) in Group A and 6.03 ± 1.47 (minutes) in Group B. There was significant difference among two groups in the time for onset of sensory block at T10 level, ($p < 0.05$). The mean time for complete motor block was 19 ± 3.151 (minutes) in Group A and 23.37 ± 2.58 (minutes) in Group B. There was significant difference among two groups in time for complete motor block, ($p < 0.05$). There was significant difference among two groups in sedation score, ($p < 0.05$). The mean time for first rescue analgesia was 373.67 ± 45.636 (minutes) in Group A and 314.1 ± 28.403 (minutes) in Group B. There was significant difference among two groups in time for first rescue analgesia, ($p < 0.05$). Patient in Group A had bradycardia, hypotension, dry mouth and Group B had nausea, vomiting and hypotension as main side effects. Group B patients also had shivering and pruritus as adverse effects. None of the patients had respiratory depression in both groups.

**CONCLUSION**

Dexmedetomidine seems to be a better adjuvant to epidural ropivacaine for lower limb orthopaedic surgeries.

**KEYWORDS**

Ropivacaine, Dexmedetomidine, Fentanyl, Lower Limb Orthopaedic Surgeries, Epidural Anaesthesia.

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**BACKGROUND**

Epidural anaesthesia is one of the preferred modes of regional anaesthesia for lower limb surgeries, provides not only peri-operative surgical anaesthesia but also post-operative analgesia[1,2] for lower limb orthopaedic surgeries. Epidural anaesthesia reduces physiological stress related to surgery and improves surgical outcomes, gives good post-operative pain relief.[3] Adequate post-operative pain relief is an integral part of anaesthesia, which is helpful in early ambulation of the patient as well as hospital discharge. The newer amide local anaesthetic ropivacaine has minimal cardiovascular and central nervous system toxicity as well as a lesser propensity of motor block during epidural analgesia.[4,5] Using opioid as additive to local anaesthetic provides a dose sparing effect of local anaesthetic and superior analgesia, but there is an increased chances of side effects such as nausea, vomiting, pruritus, urinary retention and respiratory depression.[6,7,8] Dexmedetomidine[8,9,10] with selective α2-adrenoceptor agonist used as adjuvant to regional anaesthesia showed analgesic, sedative, anxiolytic, sympatholytic properties and causes minimal respiratory depression. Dexmedetomidine produces manageable hypotension and bradycardia without opioid-related side effects like pruritus, urinary retention, vomiting and respiratory depression.[11,12]

This study was done to evaluate and compare the efficacy, analgesic effects, post-operative analgesia of epidurally administered dexmedetomidine or fentanyl along with ropivacaine for patients undergoing lower limb orthopaedic surgeries.

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## MATERIALS AND METHODS

A prospective, randomised, double-blinded study conducted at Chengalpattu Medical College after obtaining Ethical Committee approval; 60 patients were selected, randomly divided into two groups A and B.

### Methodology and Study Design

Preoperative evaluation including detailed medical and surgical history, drug intake history, clinical evaluation, airway assessment and investigations were done. Visual Analogue Scale (VAS) was explained in detail to the patients in the preoperative period. Intradermal test dose was given with 0.1 mL of 2% lignocaine. Patient was shifted inside the operation theatre, IV line secured with 18-G cannula, premedication with injection ranitidine 50 mg IV, injection glycopyrrolate 0.2 mg IV given. Patients were connected to multipara monitor showing electrocardiogram, pulse rate, non-invasive blood pressure and oxygen saturation and basal readings were recorded. All patients received Ringer's lactate solution 10 mL/kg as preloading solution. Under strict aseptic precautions, lumbar epidural anaesthesia was performed using 17-G Touhy needle with patients in the sitting position in L3-L4 interspace and location of epidural space was confirmed by loss of resistance technique. Epidural catheter (19-G) advanced cephalad 3 - 5 cm into the epidural space. A test dose of 3 mL of 2% lignocaine with adrenaline was administered into epidural space and thereafter epidural catheter was secured and patients were placed supine. The following solutions were randomly administered: 15 mL of 0.5% ropivacaine with 1 μg/kg of dexmedetomidine in Group A (n= 30) and 1 μg/kg of fentanyl in Group B (n= 30). Supplemental oxygen was provided during surgery.

### Inclusion Criteria

1. ASA grade I and II status.
2. 18 - 60 years of age.
3. Patients giving informed written consent.
4. Patients scheduled to undergoing elective lower limb orthopaedic surgery.

### Exclusion Criteria

1. SHT.
2. Hypotension.
3. Patients allergic to drugs.
4. Arrhythmias.

### Sample Size

Subjects were randomised into two groups based on block randomisation technique. Random allocation software, Version 1.0 was used to generate the random sequence taking into consideration block size of 6 and total blocks of 10. An external person who was not involved in the study generated the sequence and it was given to the investigator in sealed, consecutively numbered opaque envelope.

The sample size was calculated to be 58, rounding up the figure we are taking 60 patients (30 in each group). This was calculated using open Epi software Version 3.01 taking into an account of mean onset time of sensory block at T10 mins of 7.12 ± 2.44 in Ropivacaine + Dexmedetomidine (RD group and 9.14 ± 2.94 in Ropivacaine + Fentanyl (RF) group done by Sukhminder Jit Singh Bajwa et al (Reference no. 15) with 95% confidence interval and 80% power.

### Randomisation

In this study, subjects are allocated into two groups using block randomisation. The number of participants assigned to each treatment group will be equal and all the blocks are the same size and the overall study sample size is a multiple of the block size.

### Statistical Analysis

Continuous variables like patient's age, weight, time of first rescue analgesia, sedation score, time to complete motor block and time of sensory onset at T10 are expressed as mean and standard deviation and two sides independent student 't' test was used to find out the association between two groups. Nominal variables like sex are analysed using Chi-square test and $P < 0.05$ was considered as statistically significant.

Group A (n= 30) received 15 mL of 0.5% Ropivacaine with 1 μg/kg of dexmedetomidine epidurally Group B (n= 30) received 15 mL of 0.5%. Complete motor blockade, sedation score, total duration of analgesia, time of first rescue Inj. Ropivacaine, 15 mL of 0.5% was administered epidurally in both the groups with addition of 1 μg/kg of dexmedetomidine in Group A and 1 μg/kg of fentanyl in Group B.

Time of onset of sensory block at T10, time taken for analgesia, haemodynamic parameters and side effects were observed. At the end of study, data was analysed statistically using two-sided independent student's 't' test and Mann-Whitney U test for parametric data and chi-square test for non-parametric data. Value of $P < 0.05$ is considered as statistically significant. Results: The demographic profile of patients was comparable in both the groups. Onset of sensory analgesia at T10 is 3.87 ± 0.681 vs. 6.03 ± 1.47 (mins) p= 0.0001 and attainment of complete motor blockade is 19 ± 3.151 vs. 23.37 ± 2.58 (mins) p = 0.0001 was significantly earlier in Group A. The mean time for first rescue analgesia was prolonged significantly in Group A, 373.67 ± 45.636 vs. 314.1 ± 28.403, p= 0.0001. Sedation scores were much better in Group A ($p < 0.05$); 5% Ropivacaine with 1 μg/kg of fentanyl epidurally.

## RESULTS

The following parameters were observed following the block.
Time of onset of analgesia at T10,
Time taken for complete motor blockade.
Sedation score.
Time of first rescue analgesia.
Haemodynamic parameters.

### Side Effects

Time of onset of analgesia at T10: Time interval between the end of administration of drug and the onset of sensory block at T10 level will be evaluated using midline loss of cold sensation every minute till complete sensory block at T10, at which point surgery will be proceeded. Maximum sensory level achieved: Assessed by loss of cold sensation with cotton soaked in isopropyl alcohol (spirit). Time to complete motor blockade: Degree of motor block was assessed after complete sensory block was achieved at T10 level using modified Bromage scale for every 5 minutes.

Sedation scores were recorded every 15 minutes till 60 mins and then every hourly upto 180 minutes. Level of sedation will be assessed using observer's assessment of alertness/ sedation scale.

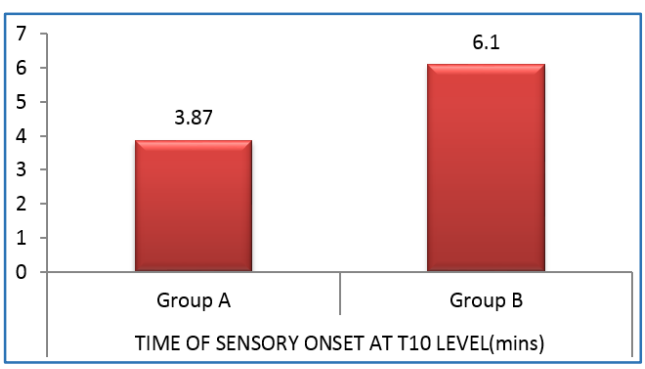
**Time of First Rescue Analgesia**

Time interval from the completion of anaesthesia to the time the patient experiences pain of verbal analogue score > 4. Epidural tramadol 50 mg was given as rescue analgesia, when patient experiences pain of verbal analogue score > 4. Haemodynamic parameters: Baseline pulse rate, oxygen saturation, non-invasive blood pressure were recorded. Above mentioned parameters were monitored continuously and recordings were made every 5 mins until 30 mins and at 15 mins interval upto 90 minutes and finally at 30 mins upto 180 mins. Incidence of bradycardia (heart rate < 60 beats per minute) was treated with 0.6 mg of injection atropine and hypotension (20% reduction in baseline blood pressure) was treated with injection ephedrine 6 mg IV bolus. During surgical procedure side effects like nausea, vomiting, anxiety, dry mouth, dizziness, headache, pruritus, shivering and respiratory depression were recorded. The above parameters were observed and data were collected.

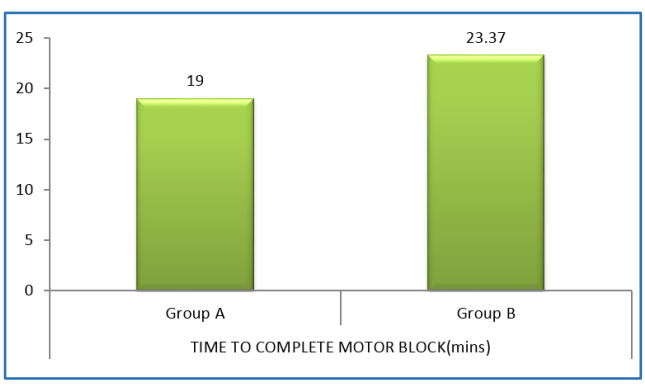
**Statistical Analysis**

Appropriate statistical analysis of data were done using following tests-

1. Two-sided independent student's 't' test and Mann-Whitney U test for parametric data.
2. Chi-square test for non-parametric data; P < 0.05 was considered as statistically significant.



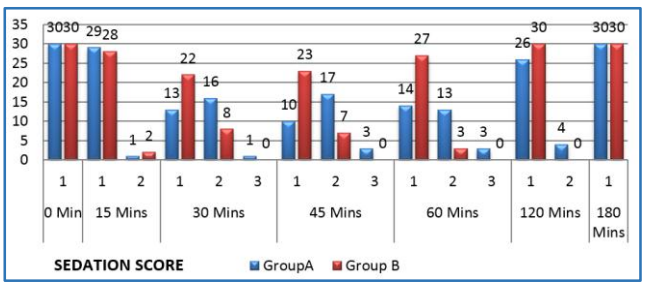

| | Mean (min) | S.D | P value |
|---|---|---|---|
| Group A | 3.87 | 0.681 | 0.0001 |
| Group B | 6.03 | 1.47 | |
| ***Table 1. Time of Sensory Onset at T10*** | | | |




| Group | Mean (min) | S.D | P value |
|---|---|---|---|
| Group A | 19 | 3.151 | 0.0001 |
| Group B | 23.37 | 2.58 | |
| ***Table 2. Time to Complete Motor Block*** | | | |

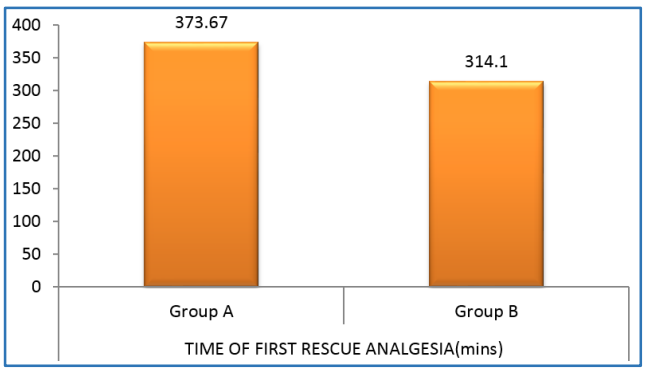
In our study, complete motor block was achieved earlier in Group A than Group B. The study had shown that addition of 1 µg/ kg of dexmedetomidine to 15 mL of 0.5% ropivacaine in Group A with time for complete motor block was 19 ± 3.151 minutes earlier when compared to Group B addition of 1 µg/ kg of fentanyl of 0.5% to 15 mL of ropivacaine with time for complete motor block of 23.37 ± 2.58 minutes.

**These Results were Correlated with following**




| | Group 1 | Group 2 | P value |
|---|---|---|---|
| MIN 0 | 1.00 | 1.00 | 1.000 |
| MIN 15 | 1.03 | 1.07 | **0.557** |
| MIN 30 | 1.60 | 1.27 | **0.017** |
| MIN 45 | 1.77 | 1.23 | **0.001** |
| MIN 60 | 1.63 | 1.10 | **0.000** |
| MIN 120 | 1.13 | 1.00 | **0.040** |
| MIN 180 | 1.00 | 1.00 | 1.000 |
| ***Table 3. Sedation Score*** | | | |

Sukhminder Jit Singh Bajwa, et al[13] where they had shown that addition of 1 µg/kg of dexmedetomidine to 15 mL of 0.75% ropivacaine in Group RD with earlier achievement of complete motor blockade (18.16 ± 4.52) than in Group RF (22.98 ± 4.78) who had received 1 µg/ kg of fentanyl to 0.75% of 15 mL of ropivacaine. Rashpal Singh Gill et al observed that attainment of complete motor block was significantly faster in Group RD (dexmedetomidine 1 µg/kg + 0.75% ropivacaine) when compared with Group RF (fentanyl 1 µg/kg + 0.75% ropivacaine). (Group RD vs RF 19.86 ± 1.66 vs 27.72 ± 1.21) (P= 0.003). Kumkum Gupta et al,[14] this study aimed to compare the effects of adding Dexmedetomidine and fentanyl with levobupivacaine for epidural anaesthesia. They concluded that time to attain complete motor blockade (19.27 ± 4.7 versus 22.78 ± 5.57 mins) was significantly earlier in Group LD (dexmedetomidine with levobupivacaine group) than Group LF (Fentanyl with levobupivacaine).




| Group | Mean (min) | S.D | P value |
|---|---|---|---|
| Group A | 373.67 | 45.636 | 0.0001 |
| Group B | 314.1 | 28.403 | |

***Table 4. Time of First Rescue Analgesia***

## DISCUSSION

Epidural anaesthesia is used as a sole anaesthetic technique for lower orthopaedic surgeries to provide post-operative analgesia and for the early ambulation.[15] Adjuvant drugs used along with the epidural anaesthesia can modify local anaesthetics effects. They reduce latency, prolongs the duration and improves quality of anaesthesia. Opioids, Adrenergic stimulator, GABA receptor agonists, NMDA receptor antagonist and cholinesterase inhibitor are used as neuraxial adjuvants and reviews of various studies are available.[16] In our study, 5 mL of 0.5% ropivacaine with 1 µg/kg of Dexmedetomidine or 15 mL of 0.5% ropivacaine with 1 µg/kg of fentanyl was used. The efficacy and analgesic effects of dexmedetomidine and fentanyl with epidurally administered ropivacaine was studied in 30 patients in each group for patients undergoing lower limb orthopaedic surgeries. The patients in both groups did not show any statistically significant difference with respect to age, weight and sex. In our study, an addition of 1 µg/kg of dexmedetomidine to 15 mL of 0.5% ropivacaine in Group A reduced the onset time for sensory block when compared to 0.5% ropivacaine with 1 µg/kg of fentanyl in Group A. The mean time for onset of sensory block at T10 is 3.87 ± 0.681 (minutes) in Group A and 6.03 ± 1.47 (minutes) in Group B. Early sensory onset time was observed in Group A. The study of Sukhminder Jit Singh Bajwa et al,[13] Rashpal Singh Gill et al and Kumkum Gupta et al[14] and Bhawana Rastogi et al[17] were also correlated with the same results when dexmedetomidine was used as an adjuvant to Ropivacaine.

In our study, sedation score was assessed by observer's assessment of alertness/ sedation score. Results showing that 60% of patients in dexmedetomidine and ropivacaine group with better and easily arousable sedation when compared to fentanyl and ropivacaine group was only 10%. This result was also concurrent with studies of Sukhminder Jit Singh Bajwa et al,[13] Rashpal Singh Gill et al and Kumkum Gupta et al.[14]

Our study showed that addition of dexmedetomidine to ropivacaine in Group A prolongs the duration of analgesia and prolongs the patient's first analgesic request 373.67 ± 45.636 minutes when compared to addition of fentanyl to ropivacaine in Group B 314.1 ± 28.403, dexmedetomidine group and was 242.16 ± 23.86 minutes in ropivacaine fentanyl group (P < 0.0001).

This result also correlated with the study of Rashpal Singh Gill et al, where they concluded that adding dexmedetomidine to epidural ropivacaine increases the time to first analgesic use and also in studies conducted by Sarabjit Kaur et al,[18] Salgado PF et al[19] and Bhawana Rastogi et al.[17]

Heart rate remained stable in the range of 56 to 88/min in Group A and in range of 62 to 90/min. Mean arterial pressure (MAP) decreased from the baseline in both groups, but never went below 65 mmHg. Significant hypotension and bradycardia were observed in Group A (dexmedetomidine with ropivacaine), but manageable with intravenous atropine and ephedrine and this result was correlated with the study of Sukhminder Jit Singh Bajwa, et al.[13]

In our study dry mouth, bradycardia and hypotension was observed more in Group A. Nausea and vomiting were side effects observed in Group B. None of the patients in both groups had respiratory depression and these observations were also found in studies of Sukhminder Jit Singh Bajwa, et al[13] and Rashpal Singh Gill et al.

### Limitations of the Study

- Patients belong to ASA I/II.
- Since blood loss varies with different types of orthopaedic surgeries and haemodynamic parameters which also depends on blood loss, hence comparison of haemodynamic changes was less reliable.
- As the patients were undergoing lower limb orthopaedic surgery, patients were immobile and the measurements of body weight was impossible. Hence, a nomogram was used to calculate the body weight.

## CONCLUSION

To conclude, dexmedetomidine seems to be a better adjuvant to epidural ropivacaine for lower limb orthopaedic surgeries in the onset time of sensory and motor block, increasing the duration of analgesia, providing better sedation and prolonging postoperative analgesia when compared to epidural fentanyl with minimal side effect.

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