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Effect of Intrathecal Dexmedetomidine with Hyperbaric Bupivacaine Administered as Mixture and Sequentially in Lower Abdominal Procedures

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Abstract

Objectives: To compare the effects of intrathecal dexmedetomidine given mixed or sequential with 0.5% hyperbaric bupivacaine for spinal anaesthesia. *Method:* 60 patients posted for elective lower abdominal procedures were included in this study. They were randomly divided into two groups. Group M: 30 patients received 5 µg dexmedetomidine intrathecally mixed with 0.5% hyperbaric bupivacaine & group S: 30 patients received 5 µg dexmedetomidine sequentially with 0.5% hyperbaric bupivacaine. *Results:* The age and weight distribution were comparable in the two groups. The onset of sensory and motor blockade was faster in the sequential group as compared to the mixed group. The degree of sedation was higher in the sequential group. There was a statistical significance among the two groups with respect to duration of post operative analgesia with the sequential group having the longest duration. There was a statistical significant difference in the intraoperative and post operative hemodynamics with the sequential group having a lower systolic and diastolic blood pressure and lower heart rate. There were no significant adverse effects. *Conclusion:* When dexmedetomidine is given sequentially with 0.5% hyperbaric bupivacaine for spinal anesthesia, it provides early onset of sensory and motor block and prolongs the duration of anesthesia and analgesia. It also provides sedation which is unique to alpha 2 agonists, among which dexmedetomidine provides conscious sedation, with sequential groups demonstrating lower hemodynamic parameters.

Keywords: Intrathecal Dexmedetomidine; Spinal Anesthesia; Sequential Administration; Post Operative Analgesia; Sedation.

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Introduction

Spinal anesthesia is a type of central neuraxial blockade that is indicated for lower abdominal and lower limb surgeries. It is economical, easy to administer and very effective in producing autonomic, sensory and motor blockade.

In most cases, the drug administered is hyperbaric bupivacaine (0.5%), which is a local anesthetic (LA). For years the practice was to only administer a LA, and it was effective in almost every way in terms of motor, sensory and autonomic blockade, but it does not sedate the patient. Intravenous adjuvants can sedate the patient but if the same is given

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intrathecally, more benefit is achieved in terms of prolongation of block and effective analgesia along with sedation [1].

The need for prolonging the duration of block also arose in SAB at times as duration of block/ analgesia may be shorter than what is required for surgery. We can increase the duration of the block by adding an adjuvant, especially when increasing the dose of LA would not be ideal [1,2].

Various studies have been done by mixing adjuvants, mostly opioids with local anesthetics in order to achieve better analgesia. Some adjuvants that are used are opioids like morphine, buprenorphine, fentanyl and alpha agonists like clonidine. Studies exist on the usage of all the above drugs intrathecally and their effects on the block characteristics [3,4,5].

Studies done on the comparison of various opioids and alpha agonists intrathecally have shown the superiority of dexmedetomidine in terms of sedation, analgesia and duration of block, with very minimal reversible adverse effects [4,5].

Dexmedetomidine is an alpha 2 receptor adrenoreceptor agonist, a novel sedative-analgesic. It is a short term sedative and in addition to decreasing sympathetic tone, it attenuates the hemodynamic responses to anesthesia, reduces the anesthetic and opioid requirement. It allows psychomotor functions to be preserved while letting the patient rest comfortably. It is similar to clonidine but its selectivity for alpha 2 receptors is 8 times higher than clonidine [7].

A recent study has been done that shows clonidine given intrathecally sequentially with bupivacaine is better in terms of analgesia, duration of block and hemodynamic parameters as compared to it being given mixed with bupivacaine in the same syringe [8].

Baricity of a solution is the density of a solution in comparison to the density of human CSF (cerebrospinal fluid). It is important to note that the baricity of local anesthetics and adjuvants that are normally used are different, therefore, mixing the local anesthetic with an adjuvant can alter the baricity of the two drugs, and affects the level of motor blockade, analgesia and sedation [6].

Greene NM (1985) published a paper on the distribution of local anesthetic solutions within the subarachnoid space. He mentions that the hyperbaric solutions will alter the density of the adjuvants and reduce their spread thus blunting their efficacy [9].

Abdelhamid et al. (2013) conducted a study to determine if intrathecal dexmedetomidine was useful or not. Dexmedetomidine was added to heavy bupivacaine 0.5% intrathecally for lower abdominal surgeries. They concluded that Receiving Dexmedetomidine at a dose of 5 µg provides earlier sensory and motor blockade, less postoperative analgesic requirements, less shivering among patients of lower abdominal surgery under intrathecal anaesthesia with no sedation effect or neurologic complications [10].

The purpose of this study is to compare two different methods of administering dexmedetomidine with respect to onset and duration of sensory and motor blockade, duration of post operative analgesia, sedation and adverse effects to find a safe and more effective method of administration of dexmedetomidine.

Material and Methods

Sources of data collection

The study group comprised of patients admitted to Father Muller Medical College Hospital, Mangalore, Karnataka, for elective lower abdominal surgeries from January 2015 to June 2016.

Inclusion criteria

1. Men and women between the ages of 18-60.
2. ASA I-II
3. Scheduled for elective lower abdominal procedures.

Exclusion criteria

1. Patients with height <140 cm
2. Patients with weight >90 kgs.
3. Pregnant women
4. Patients with bradycardia (HR<50 bpm)
5. Patients with relative or absolute contraindications to spinal anesthesia
6. Emergency procedures.

Study design

A prospective, interventional randomized controlled double blinded clinical study

Sample size and sampling procedure

Sample size of 60, with sample comprising men and women in more or less equal proportion, the sampling procedure being

Group M: 30 patients receiving 5 µg dexmedetomidine (0.5 ml) + 0.5% hyperbaric bupivacaine 12.5 mg (2.5 ml) as a mixture in a single syringe.

Group S: 30 patients receiving 5 µg dexmedetomidine (0.5 ml) + 0.5% hyperbaric bupivacaine 12.5 mg (2.5 ml) sequentially in two separate syringes

Study Procedure

Patients were randomly allotted into two groups -Randomization was done using sealed envelope technique. The two drugs were sourced from the same company to avoid manufacturing differences

Pre operatively-

A baseline recording of the hematological parameters – non invasive blood pressure (NIBP), Heart rate (HR) was taken at the time of pre-anesthetic evaluation and patients were familiarized with the visual analogue scale (VAS) for pain assessment (0 being no pain and 10 being the worst possible pain). They were asked to stay nil per oral (NPO) from 12 midnight, Ranitidine 150 mg at night and the next morning (minimum 2 hrs before the surgery) was administered by the nurse in charge.

Intraoperatively-

On the day of the surgery, – non invasive blood pressure (NIBP), Heart rate (HR)- Electrocardiography, Oxygensaturation using standard pulse oximeter (SpO_2) baseline recording was taken.

After securing an 18 gauge cannula, and ensuring free flow of fluid through the vein, patients were preloaded with 15 ml/kg of either Ringer Lactate (RL) or Normal Saline (NS) depending on the diabetic status, before sub-arachnoid block (SAB).

Under strict aseptic precautions, Using a 23 gauge Quincke Babcock spinal needle through midline approach, in the lateral decubitus position, SAB was given according to the group that the patient was randomly allotted to. To maintain the same standard, the same position was also used when the two drugs were given as a mixture.

The intrathecal drugs were given in the L3-L4 subarachnoid space within 30 seconds, (including time taken for change of syringe in sequential administration) when not possible, then the L2-L3 space was used. Patients were put in supine position immediately after administration. Oxygen mask was placed on the patient, delivering oxygen at 5 L/min. Anesthesiologist other than investigator injected the drugs.

Investigator was blinded in regard to which group the patient has been allotted and the data was entered after complete evaluation in the proforma.

NIBP, HR, SpO_2 was constantly monitored throughout the surgical procedure. NIBP checked every minute for the first 5 minutes, every 2 minutes for the next 15 minutes and every 3 minutes for the next 15 minutes and every 5 minutes for the next 15 min and every 15 minutes thereafter till the end of the surgical procedure .

Sensory block assessment- pin prick with a blunt needle along the bilateral mid-clavicular line Time taken to reach T 10 dermatome was recorded (onset)

Motor block assessment- for this purpose we used the modified Bromage scale [11]. Assessment for repeated every minute till complete block-bromage 0

For sedation assessment- Modified Ramsay sedation score (RSS) [12]

Hypotension (>30% of baseline fall or <90 mmhg SBP) was treated with 6 mg of mephenteramine with co loading of IV fluids. Dosing was repeated if required. Bradycardia (HR<50 bpm) was treated with IV atropine 0.3-0.6 mg. this was repeated if required. Desaturation (SpO_2 <95%) was dealt with by supplementing oxygen and ensuring free airway.

Post operatively-

After the patient was shifted to the post operative ward, the NIBP, HR, SpO_2, Ramsey Sedation score and VAS was recorded at 15 min, 30 min, 60 min and every hour till 6 hours post spinal block (follow up). Time taken to reach S1 dermatome was recorded (sensory block regression). Time taken for motor block to regress to modified Bromage 0 also was noted. Time for first analgesic request also was noted.

Patients complaining of nausea or vomiting were given injection ondansetron 0.15 mg/kg i.v. In case of complaints of pain; IV tramadol 100 mg rescue doses was given.

Observations and Results

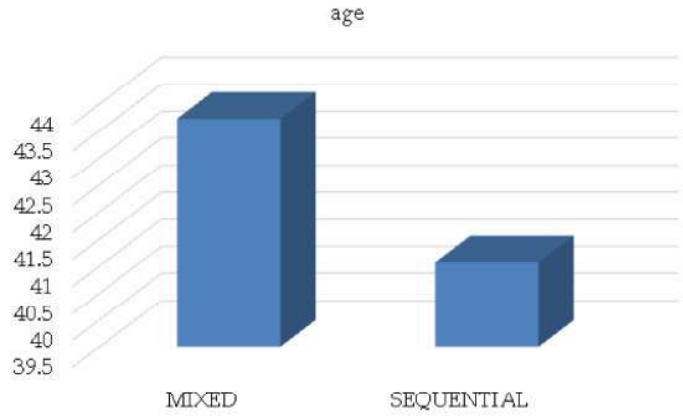
Statistical analysis

Power analysis from similar studies suggest that a sample size of 30 patients/group is required to get the power of study to 80%, with 0.05 level of significance. All the data was fed into the IBM SPSS software, mean and standard deviation was used for continuous data and median for non parametric

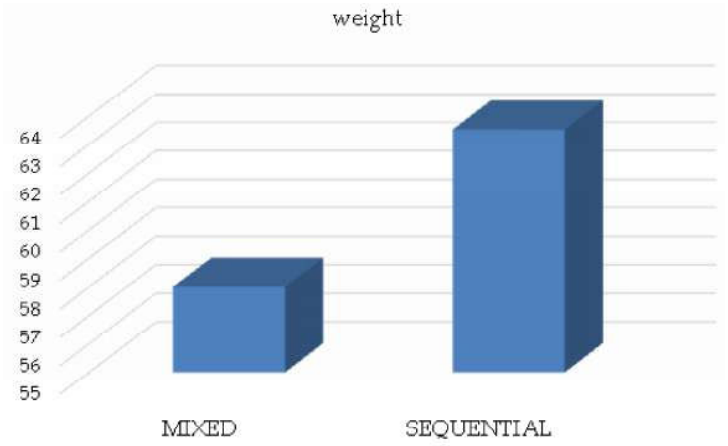
data. The two groups were compared using paired t test in terms of hemodynamics. Level of block achieved was calculated using chi-square test. The sedation was compared with the help of chi square test. Age and weight compared using independent t test. p values of < 0.05 and Confidence intervals of >95 if achieved was considered significant.

Results

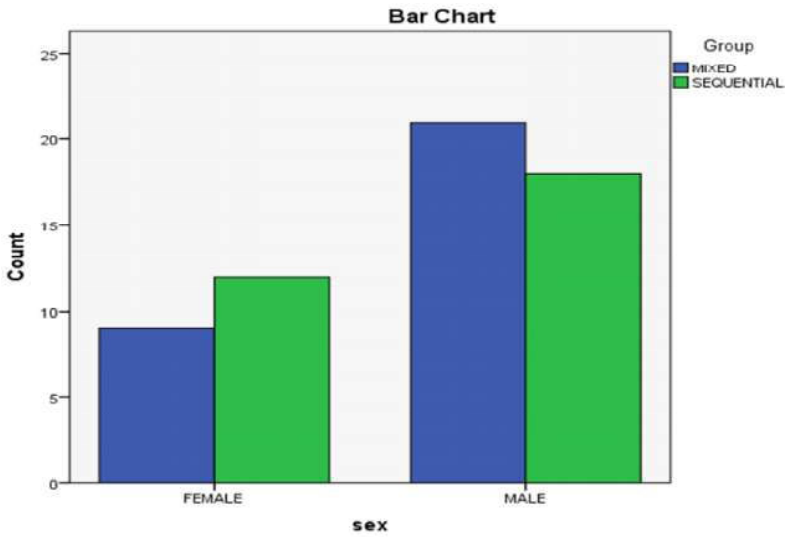
- The demographic profile was comparable in both groups.
- Earliest onset of sensory blockade was observed in the sequential group within 1 min as compared for mixed 1-1.5 mins.
- Onset of motor blockade was observed earliest in the sequential group within 1-1.8 mins, followed by mixed group which took 1.7-2 mins.
- Maximum level of sensory block reached (T8) was higher in sequential group.
- Regression of sensory blockade took longer in sequential group with a mean of 12623 min followed by mixed group which took 104.83 min.
- Regression of motor blockade took longer in sequential group which was 138.33 min followed by mixed group which was 133.87 min on an average.
- Highest degree of sedation was seen in sequential group.
- Intraoperative hemodynamics were lower in sequential group.
- Post operative hemodynamics were lower in sequential group.
- Duration of analgesia was longer in sequential group.
- VAS was lower in sequential group.
- Incidence and severity of bradycardia was higher in sequential group, but not deleterious.
- No significant adverse effects.



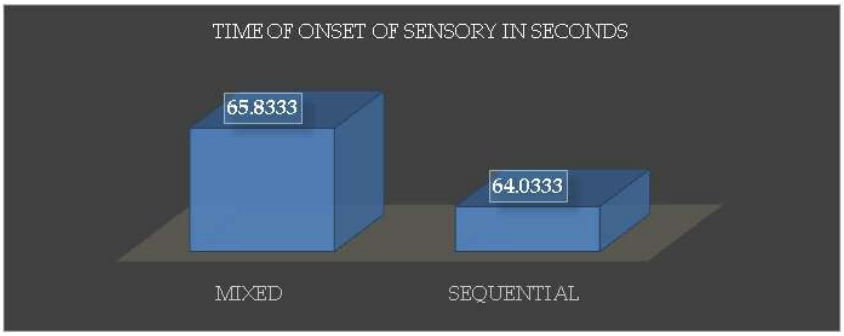
Graph 1: Bar Chart representing the distribution of age in both groups



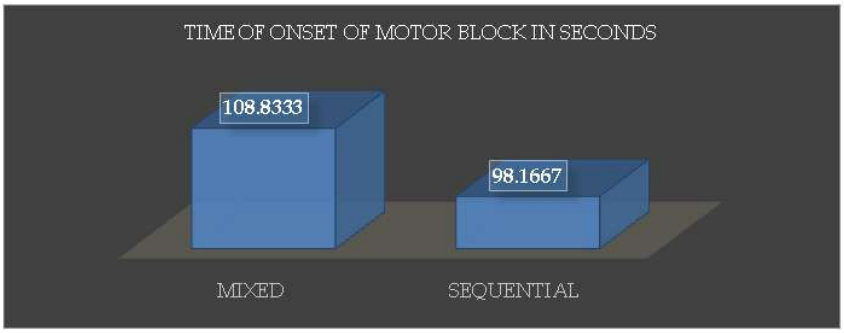
Graph 2: Histogram representing the distribution of weight in both groups



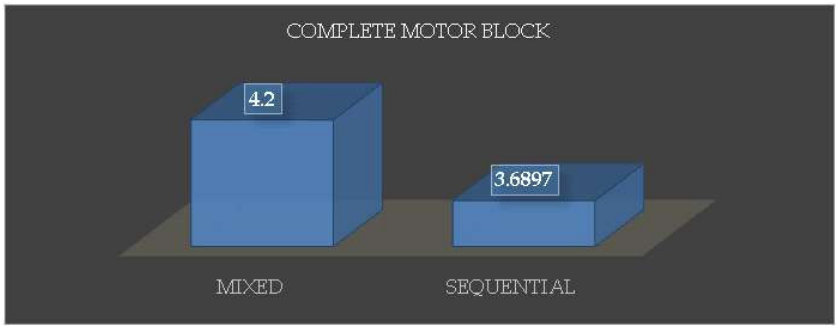
Graph 3: Gender distribution among the two groups



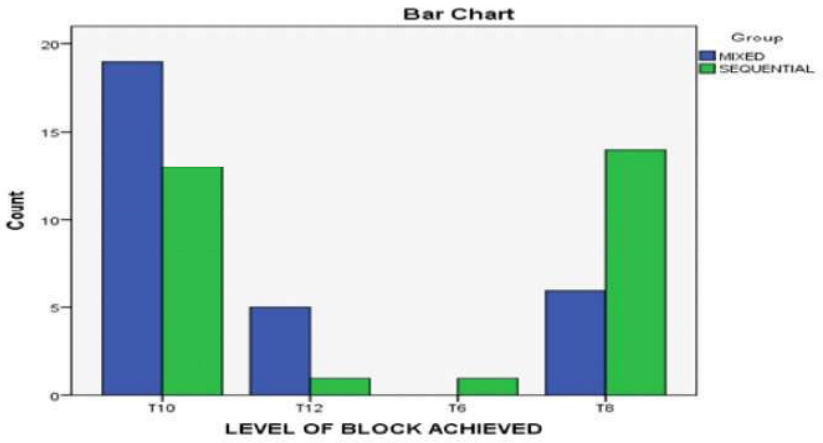
Graph 4: Time of onset of sensory in seconds



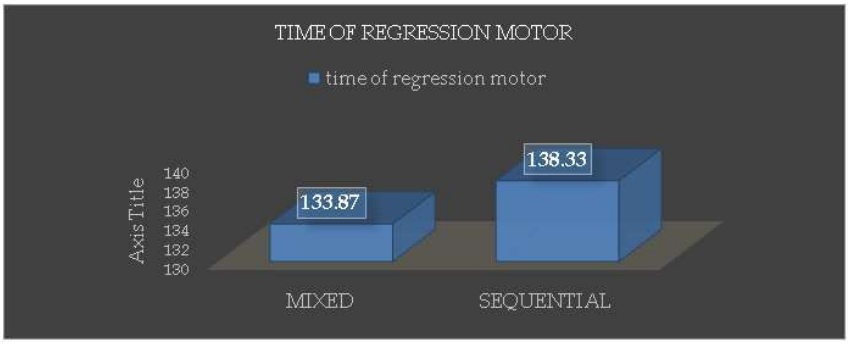
Graph 5: Time of onset of motor block in seconds



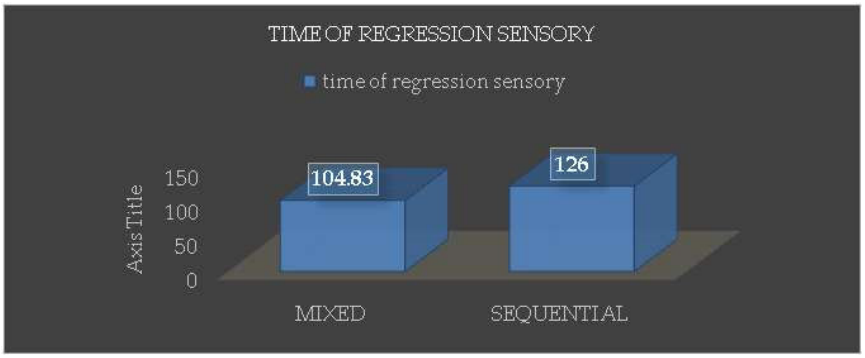
Graph 6: Complete motor Block



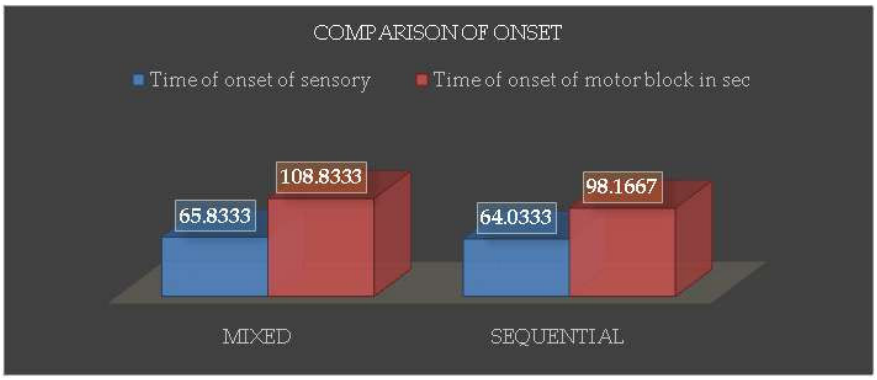
Graph 7: Bar chart representing the level of block achieved



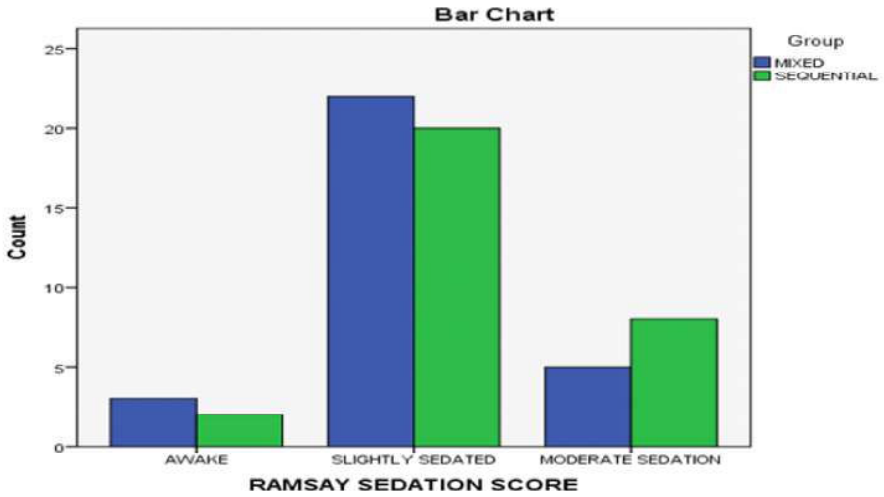
Graph 8: Time of Regression Motor



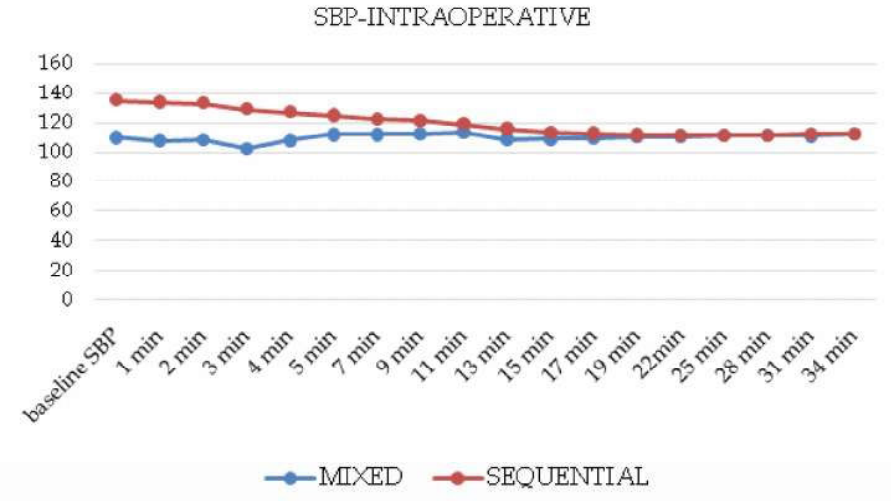
Graph 9: Time of Regression Sensory



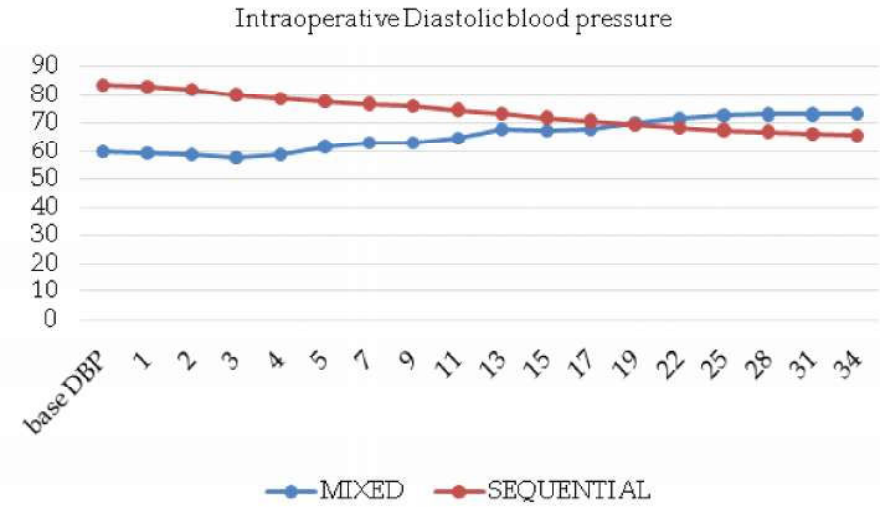
Graph 10: Comparison of onset



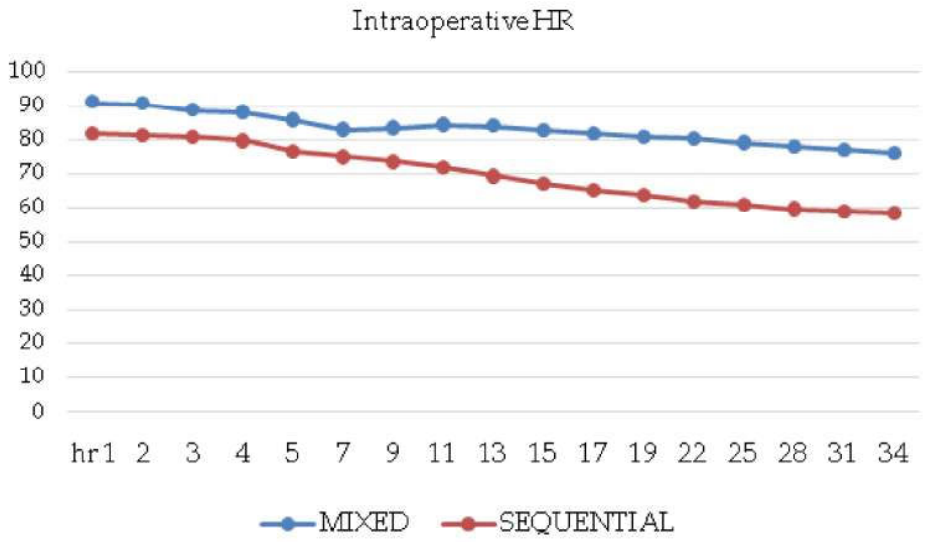
Graph 11: Bar chart representing the levels of sedation among the two groups



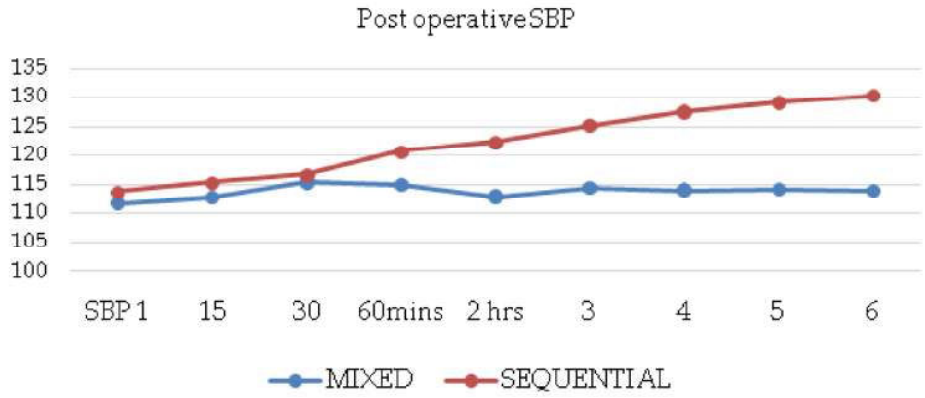
Graph 12: Intraoperative SBP among the two groups



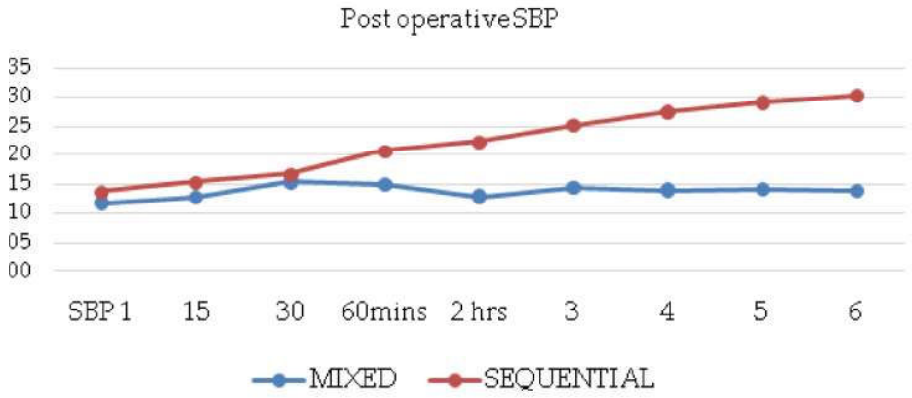
Graph 13: Comparision of the intraoperative Diastolic blood pressure



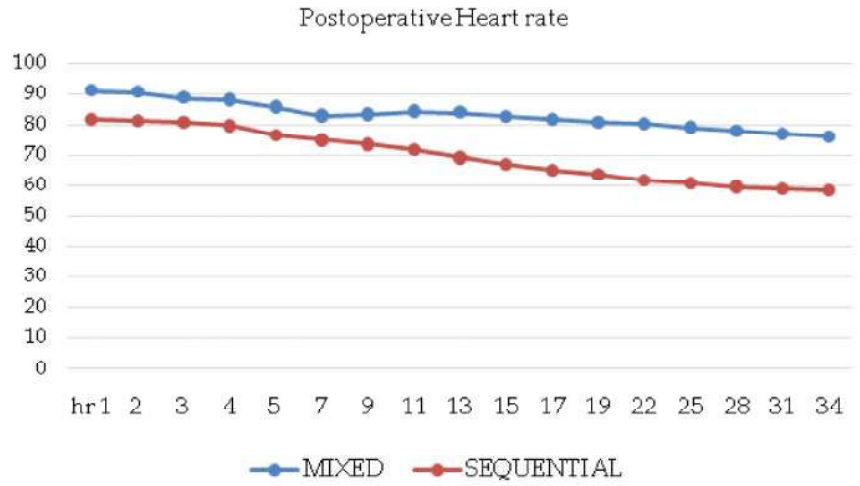
Graph 14: Comparison of Intraoperative heart rate



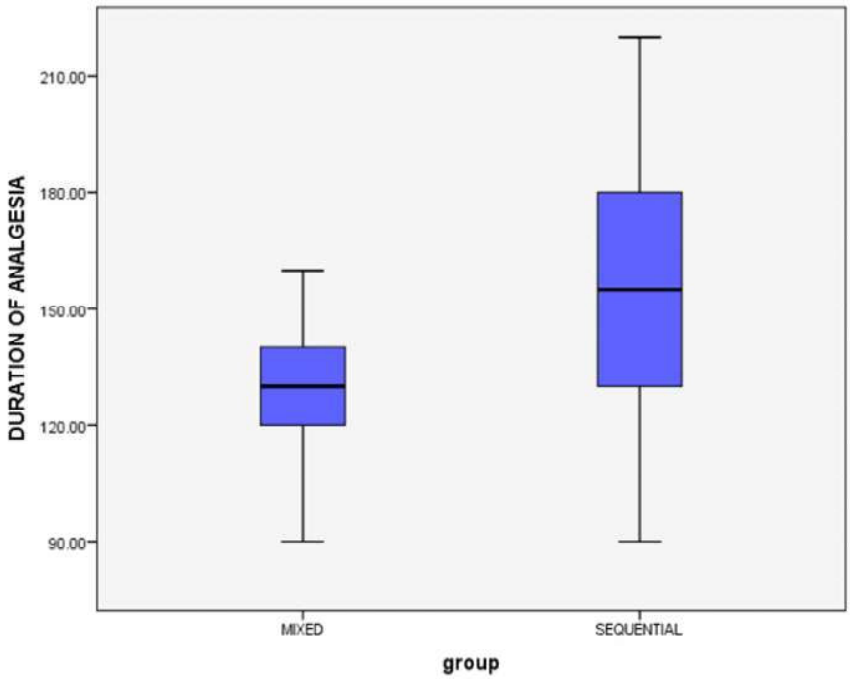
Graph 15: Mean Post-operative Diastolic blood pressure



Graph 16: Comparison of Postoperative DBP



Graph 17: Postoperative Heart rate



Graph 18: Box Plot showing Mean duration of post operative analgesia

Discussion

The dosage of intrathecal dexmedetomidine was decided after careful review of the various studies which use different doses of dexmedetomidine and the effects of the different doses.

It was observed that 5 of intrathecal dexmedetomidine produced effective sensory block and duration of anesthesia, along with sedation and lesser incidence of adverse effects like bradycardia and hypotension.

Comparison of the age and weight between the two groups shows that the groups were comparable, hence giving leverage to study findings.

The onset of sensory block was studied among the two groups, The test showed that the time of onset of sensory block is faster in sequential group. This shows that dexmedetomidine causes early onset of sensory block.

Comparison of the Time of onset of motor block and Complete Blockin sec between the two groups shows that Time of onset of motor block in seconds is faster in sequential group.

Comparison of the time of regression of motor

block between the two groups shows that time of regression of motor block is higher in sequential group shows that the time for regression is delayed while using dexmedetomidine in either mixed or sequential form.

Comparison of the time of regression sensory between the two groups shows that time of regression sensory is higher in sequential. This proves that dexmedetomidine does prolong the duration of sensory blockade which is statistically significant, especially when given sequentially.

In the mixed group, 10% of patients were awake, 73.3% were slightly sedated and 16.7% were moderately sedated.

In the Sequential group, 6.7% were awake, 66.7% were slightly sedated and 26.7% were deeply sedated.

This shows that there was significant amount of sedation in both groups with higher level of sedation seen in the sequential group.

The mean systolic blood pressure among the two groups was compared and was found that the sequential group had a higher SBP which was statistically significant.

By 30 minutes of the procedure, the two groups SBP was comparable.

The mean diastolic blood pressure was higher in the sequential groups, which was statistically significant.

The intra operative heart rate was higher in the mixed group compared to sequential group which was statistically significant.

The systolic blood pressure (SBP) and DBP in the post operative period was comparable till 30 minutes post operatively. And thereafter the BP was higher in sequential group which was statistically significant. This shows that giving DXM mixed potentiates the fall in SBP seen with local anesthetics, whereas given sequentially increases duration of analgesia without much fall in systolic blood pressure.

The post operative heart rate was higher in the mixed group when compared with the sequential group which was statistically significant, in other words, sequential administration of DXM causes more bradycardia.

The median duration of analgesia is higher in the sequential group with 155 min average. This was an important part of the study. This is significantly higher when compared to the other studies control group with an average of 125 min.

All the 60 patients showed VAS < 4 in the first 120 minutes. At the 180th time interval, 2 patients from mixed group and 1 patient from sequential group experienced VAS > 4 and were administered the rescue analgesic. This corresponds with good postoperative pain relief.

The incidence of nausea and vomiting were not significant in either group. No other adverse effects were seen except for two patients who had a heart rate of 39 and dropping, who needed Inj. Atropine 0.6 mg in the post operative ward.

Conclusion

Based on the findings of the study, we can conclude that for elective lower abdominal procedures, intrathecal dexmedetomidine 5, given sequentially with 0.5% hyperbaric bupivacaine provides faster onset of sensory and motor blockade, longer duration of anesthesia and analgesia along with sedation, when compared to the mixed group. Significant bradycardia was observed, that was not deleterious to the patient, there were no other significant side effects.

Abbreviations

DXM- Dexmedetomidine

DBP- DiastolicBlood Pressure

SBP- Systolic blood pressure

VAS- Visual Analogue scale

LA- Local Anesthetic

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