

The Effect of Intravenous Dexmedetomidine Infusion on Subarachnoid Block with Bupivacaine in Inguinal Herniorrhaphies

Rakeshkumar B¹, Sunitha¹

¹Assistant Professor, Department of Anaesthesia, Mount Zion Medical college, Chayalode, Adoor, Kerala.

Abstract

Background: lumbar subarachnoid block is a technique which requires a small dose of heavy bupivacaine to provide rapid and reliable surgical anaesthesia. Duration of spinal anaesthesia may be prolonged by addition of opioids, clonidine, neostigmine, or vasoconstrictor agents to the local anesthetic drug for better post-op pain relief. This study is designed to investigate the effects of intravenous dexmedetomidine on the duration of sensory and motor blockade induced by intrathecal administration of bupivacaine, and its associated adverse events. **Aims and Objectives:** To assess the effect of Dexmedetomidine infusion on the duration of analgesia with spinal Bupivacaine for adult patients undergoing herniorrhaphy and to assess the incidence of intra operative side effects, if any. **Subjects and Methods:** This study was done under the department of Anaesthesiology, Govt. T. D. Medical College Hospital, Alappuzha, Kerala for a period of 8 months. A double blind prospective randomized control study was done. 50 adults aged 20 to 60 years scheduled for herniorrhaphies were allocated into two study groups, named A and B using computer generated randomization. **Results:** The duration of analgesia compared and Post-operative pain was evaluated by Visual Analogue Scale. Duration of analgesia is the time taken from the administration of the drug to the time when the patient complains of pain of > 50 in Visual Analogue Scale. The duration of analgesia was longest in patients received intravenous dexmedetomidine along with spinal bupivacaine. Side effect like respiratory depression not observed in either group. **Conclusion:** In conclusion, intravenous infusion of dexmedetomidine added to subarachnoid block with bupivacaine offered prolonged analgesia in adult patients undergoing herniorrhaphies, without increasing the incidence of adverse effects.

Keywords: 0.5% (H) Bupivacaine, Lumbar Subarachnoid block, Dexmedetomidine.

Corresponding Author: Dr. Sunitha, Assistant Professor, Department of Anaesthesia, Mount Zion Medical college, Chayalode, Adoor, Kerala.

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Introduction

Subarachnoid block with local anaesthetics are popular techniques of anaesthesia which have been extensively used for lower abdominal surgery. Subarachnoid block is a simple technique which requires a small dose of local anaesthetic to provide rapid and reliable surgical anaesthesia and minimal risk of drug toxicity. Bupivacaine has been used since 1963 and is now the most widely used local anaesthetic. Hyperbaric 0.5% Bupivacaine is a popularly used local anaesthetic drug for subarachnoid block. It is more potent and has a longer duration of action than lignocaine. Duration of spinal anaesthesia and analgesia may be prolonged by addition of opioids, clonidine, neostigmine, or vasoconstrictor agents to the local anesthetic drug for better postop pain relief. Intrathecal and epidural opioids provide selective analgesia without motor or sensory blockade. Intrathecal addition of a low dose of α_2 -agonist like clonidine or dexmedetomidine results in significant prolongation of the duration of the sensory and motor blockade induced by hyperbaric bupivacaine (Kanazi et al).^[1] This study is designed to investigate the effects of

intravenous dexmedetomidine on the duration of sensory and motor blockade induced by intrathecal administration of bupivacaine, and its associated adverse events.

Objectives

To determine effect of intravenous Dexmedetomidine on the duration of analgesia with spinal Bupivacaine for adult patients undergoing herniorrhaphy and to assess the incidence of intra operative side effects, if any.

Subjects and Methods

After obtaining an approval of the Institutional Ethical Committee, the present study was done under the department of Anaesthesiology, Govt.T.D. Medical College Hospital, Alappuzha, Kerala for a period of 8 months

Inclusion Criteria:

- Patients of ASA grade I and II
- Age group 20- 60 yrs.
- Weight between 65 and 75 kg.

- Height between 155cm and 175cm.
- Both sex.

Exclusion Criteria:

- Patient refusal to LSAB.
- History of drug allergy.
- Patients with coagulation disorders.
- Patient with liver disease, kidney disease, neurologic disorders, cardio vascular disease.
- Infection at the site of injection.
- Pregnancy.
- Mentally challenged patients.

Design of Study

A double blind prospective randomized control study was done. 50 adults were allocated into two study groups, named A and B using computer generated randomization. An informed, valid, written consent was obtained for conduct of the study. All patients were kept nil by mouth from midnight before surgery and tablet alprazolam (0.01 mg/kg) was administered at bedtime the day before surgery. Intravenous access was established with an 18-gauge cannula and preloading was done with 20 ml/kg lactated Ringer's solution, 20 min before the procedure. A pulse oximeter, noninvasive blood pressure (BP), and electrocardiogram monitor were applied to each patient on arrival to the operating room and baseline parameters were recorded. All the patients were randomly allocated into two groups of 50 each by computer-generated number. The patient and the anesthesiologist were blinded to the treatment group, and all recordings were performed by an anesthesiologist, who was blinded to randomization schedule. An anesthesiologist, who was blinded to the study drug used, documented all the parameters.

Under strict aseptic conditions, subarachnoid block was performed at L3–L4 intervertebral space through midline approach using a 23 gauge Quincke spinal needle. After ensuring free flow of cerebrospinal fluid 0.5% heavy bupivacaine, 15 mg was administered intrathecally. Monitoring will be recorded at 3 minutes interval for the first 10 minutes. Thereafter every 5 minutes till the end of surgery.

Group A: received Spinal Bupivacaine 0.5% (Heavy) and intravenous Dexmedetomidine 1µg/kg bolus infusion in 20 mL (syringe) over a period of 10 minutes followed by 0.5µg/kg over a period of one hour in 50 mL (syringe).

Group B: Received Spinal Bupivacaine 0.5% (Heavy) and normal saline Infusion.

The volume of intravenous bolus dose for groups A and B was made same (20 mL). For loading dose in group A, Dexmedetomidine 1µg/kg taken, made to 20 ml with distilled water & for group B 20ml of normal saline was taken. The volume of intravenous maintenance dose for group A and B was made the same (50 mL).

For maintenance dose in groups A, Dexmedetomidine 0.5µg/kg was taken, made to 50 ml with distilled water & for group B 50ml of normal saline was taken. The investigator would administer the drugs to the patients in each group, as per the random allocation and direction of the guide. The patients in both groups were monitored for the onset of

sensory blockade, motor block, and duration of analgesia and for any intra operative side effects.

Assessment:

Time of onset of sensory blockade.

Time to achieve maximum sensory blockade.

Time at which patient complaints of pain.

Onset of sensory block was evaluated by pin prick method at every 3 minutes along mid-clavicular line bilaterally till adequate analgesia was attained. Duration of analgesia was recorded every half hour, then every one hour till occurrence of breakthrough pain.

Results

Data were analyzed using computer software, Statistical Package for Social Sciences (SPSS) version 10. Data were expressed in its frequency and percentage as well as mean, median and standard deviation. To elucidate the associations and comparisons between different parameters, Chi square (χ^2) test was used as nonparametric test. Student's t test was used as parametric test to compare mean values between two groups. Mann Whitney U test was employed as non-parametric test to compare pain score. For all statistical evaluations, a two-tailed probability of value, < 0.05 was considered significant.

Age group >50 years dominated in both the groups. Gender distribution in the study population. Female patients were only 8% in group A and 4% in group B.

The mean ages in both the groups were comparable and group A registered 51.36 years where as in group B, mean age was 50.96 years. Mean body weight in group A was 68.12 kg and in group B 68.4 kg.

Mean duration of surgery among group A was 54.4 minutes and in group B 55 minutes. In order to find out the equality of mean age, mean weight and mean duration of surgery

Mean systolic blood pressure (SBP) in group A is 108 mmHg and for group B it is 112.56 mmHg. Mean heart rate in group A is 70.40/mt and for group B it is 74.24/mt. It is not statistically significant with p value > 0.05.

Mean time of onset of sensory blockade in group A is 3.48 mt and in group B is 3.48. It is not statistically significant with p value > 0.05.

Mean time to achieve maximum sensory blockade in group A is 11.96 mt and in group B is 11.52mts. It is not statistically significant with p value > 0.05.

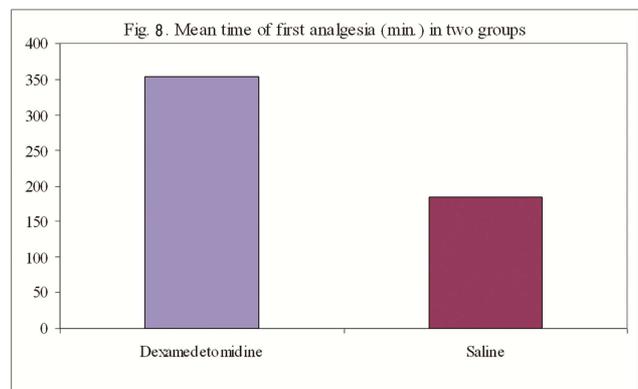
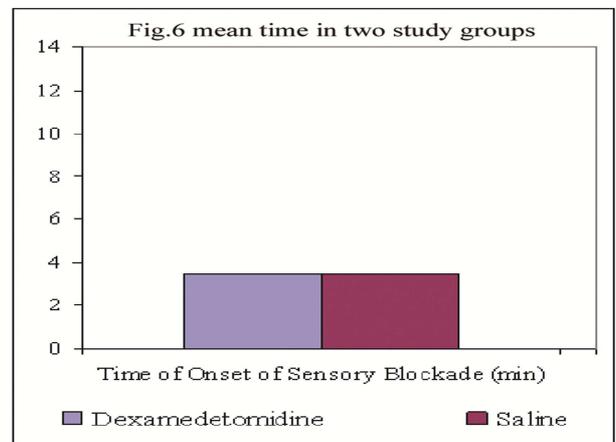
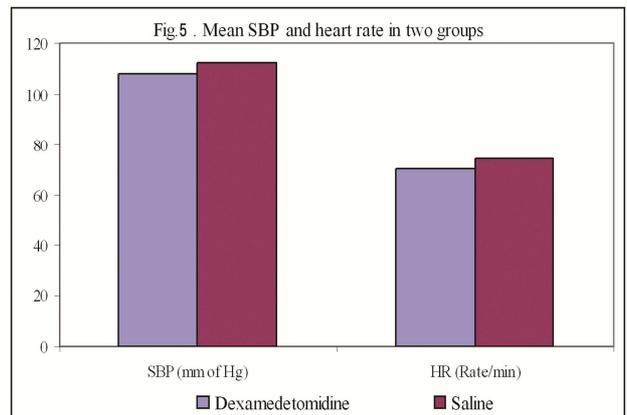
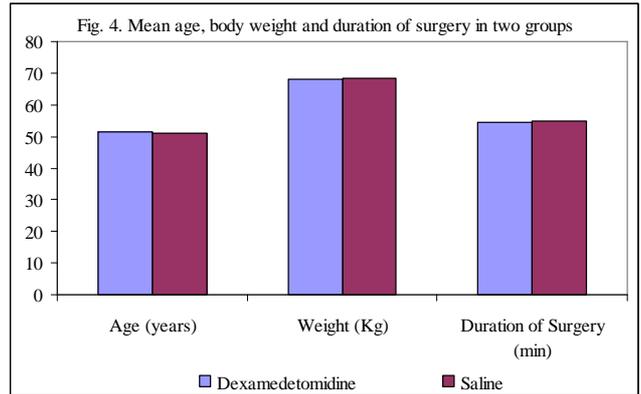
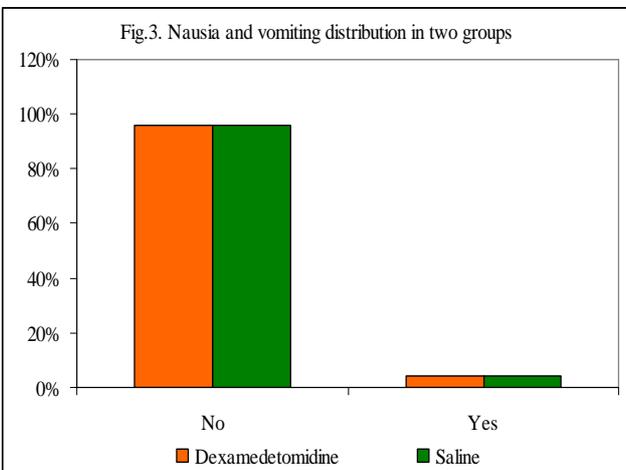
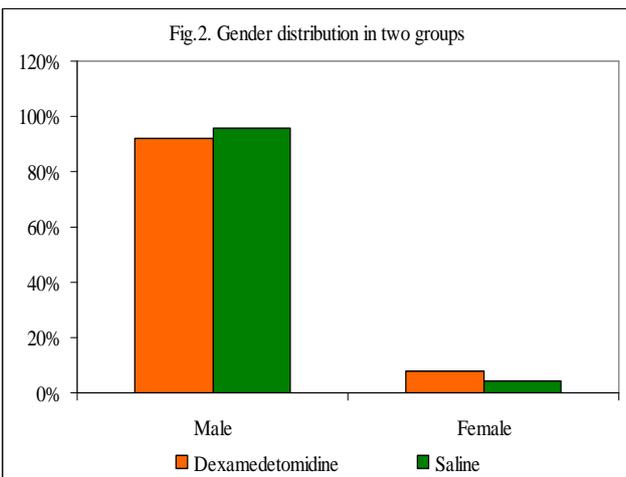
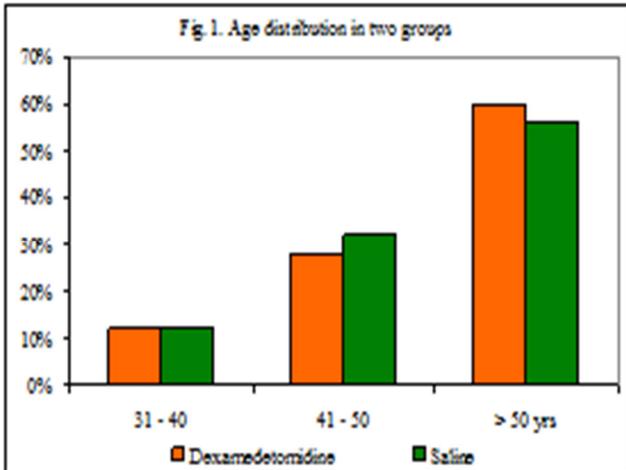
Mean Time of first Analgesia is compared in two groups. Time of first analgesia in group A is 352.4 mts and for group B IS 184.28mts. It is statistically significant with p value < 0.001.

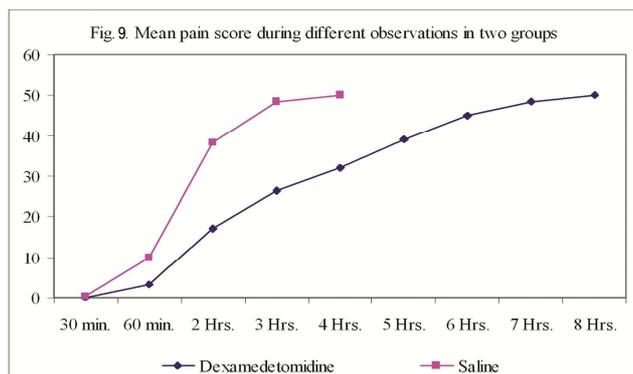
Post-operative pain was evaluated by Visual Analogue Scale. The pain score was assessed using visual analogue scale every 30 minutes initially then hourly till the pain score reached a score > 50. For the first 30 minutes none of the cases in both the groups showed any sign of pain.

Whereas mean pain score at 60mt, 2hr, 3hr, 4hr, 5hr in group A is 3.2, 17.2, 26.4, 32.17, 39.09 and for group B is 10, 38.4, 48.57, 50. At 60 minutes the mean pain score for group A was 3.2 and for group B was 10 which was again showed significant difference between two groups.

All the patients in group B showed a pain score of >50

before 4hr and received rescue analgesia. At 4hr the mean pain score in group A was only 32.17. At 60mt, 2hr, 3hr, 4hr, 5hr, 6hr, 7hr, 8hr mean pain score in group A is increased from 3.2, 17.2, 26.4, 32.17, 39.09, 45, 48.57, 50. This observed difference among the groups were statistically significant and that of group A continues to be a superior drug when mean pain scores were compared, than the other group.





Discussion

The intrathecal 0.5% hyperbaric bupivacaine is the drug of choice for surgeries lasting for about 120 min. To prolong the duration of spinal anesthesia, various drugs such as magnesium sulfate, neostigmine, midazolam, fentanyl, and clonidine have been used through intrathecal route as adjuvant to local anesthetic. Opioids have attained an integral role as a spinal anesthetic adjuvant, but its addition to local anesthetic solution may lead to pruritus and respiratory depression.

Dexmedetomidine, is pharmacologically related to clonidine, has 8 times more affinity for α_2 receptors than does clonidine. It shows a high ratio of specificity for the α_2 receptor (α_2/α_1 1600 :1) compared with clonidine (α_2/α_1 200 : 1). It produces sedation and anxiolysis by binding to α_2 receptors in the locus ceruleus, which diminishes the release of norepinephrine and inhibits sympathetic activity, thus decreasing heart rate and blood pressure. Dexmedetomidine has an inhibitory effect on the locus ceruleus (A6 group) located at the brain stem. This supraspinal action could explain the prolongation of spinal anesthesia after intravenous administration of dexmedetomidine. The noradrenergic innervation of the spinal cord arises from the noradrenergic nuclei in the brain stem including the locus ceruleus, the A5, and the A7 noradrenergic nuclei. Neurons in the locus ceruleus are connected to the noradrenergic nuclei in the brain stem. Axon terminals of the noradrenergic nuclei reach lamina VII and VIII of the ventral horns of the spinal cord. The activity of the noradrenergic neurons is decreased by agonists acting at α_2 -adrenergic receptors on the locus ceruleus cell bodies. Therefore, inhibition of the locus ceruleus results in disinhibition of the noradrenergic nuclei and exerted descending inhibitory effect on nociception in the spinal cord. These pharmacokinetic parameters apparently are unaltered by age or weight or renal failure, but clearance is a function of height.^[3] Dexmedetomidine is now being used off-label outside of the ICU in various settings, including sedation and adjunct analgesia in the operating room, sedation in diagnostic and procedure units, and for other applications such as withdrawal/detoxification amelioration in adult and pediatric patients.^[4] The α_2 agonists produce their sedative-hypnotic effect by an action on α_2 receptors in the locus caeruleus and an analgesic action at α_2 receptors within the locus caeruleus and within the spinal cord.^[5] The α_2 agonists have the advantage that their effects are readily reversible by α_2 -

adrenergic antagonists (e.g., atipamezole).^[6] The primary site of analgesic action is thought to be the spinal cord.^[7]

Side effects of dexmedetomidine such as hypotension and bradycardia, are dose dependent. Infusion of loading dose over 10 min and then infusing the maintenance dose decreases the incidence of those side effects. The addition of dexmedetomidine as an intravenous adjuvant along with local anaesthetic for achieving the same level of anaesthesia but with a prolonged duration of analgesia which increases the margin of safety and reduces the incidence of unwanted motor blockade. This study was conducted keeping these facts in mind. Patients receiving dexmedetomidine seemed to have greater recall of their stay in the ICU, but all described this as pleasant overall.^[8]

Al-Mustafa MM et al, in 2011 conducted a study in 48 patients.^[9] The aim of this study was to evaluate the prolongation of spinal analgesia by intravenous dexmedetomidine administration after the spinal block and to assess the haemodynamic changes and the level of sedation. They concluded that supplementation of spinal anesthesia with intravenous dexmedetomidine loading dose of 1 $\mu\text{g}/\text{kg}/\text{hour}$ over 10 minutes and a maintenance dose of 0.5 $\mu\text{g}/\text{kg}/\text{hour}$ till the end of surgery, produced significantly longer sensory and motor block than spinal anesthesia alone. All patients reached good sedation levels that enabled their cooperation and better operating conditions for the surgeons without significant respiratory depression.

In this study mean pain score at 30 mt in group A is 0 and for group B is 0.4. It is not statistically significant. whereas mean pain score at 60mt, 2hr, 3hr, 4hr, 5hr in group A is 3.2, 17.2, 26.4, 32.17, 39.09 and for group B is 10, 38.4, 48.57, 50. Pain score at these interval is clinically and statistically significant with p value <0.001.

In this study mean time of onset of sensory blockade, mean time to achieve maximum sensory blockade in group A is 3.48 mt, 11.96 mt respectively and in group B it is 3.48, 11.52mts. It is not statistically significant with p value >0.05.

In this study mean systolic blood pressure (SBP) in group A is 108 mmHg and for group B it is 112.56 mmHg. No further decreases in SBP occur after infusing dexmedetomidine. It is not statistically and clinically significant with p value > 0.05. Incidence of bradycardia after spinal anaesthesia has been reported to be 12-15 %. In this study mean heart rate in group A is 70.40/mt and for group B it is 74.24/mt. No further decrease clinically significant in heart rate occurred after infusing dexmedetomidine. None of the patients in both study groups received intravenous atropine. It is not statistically and clinically significant with p value > 0.05.

Incidence of nausea and vomiting is 3 to 17 %. In this study incidence is 4% in group A and also 4% in group B. P value is >0.05. It is not statistically and clinically significant.

Conclusion

Intravenous infusion of dexmedetomidine added to subarachnoid block with bupivacaine shows prolonged analgesia in adult patients, without increasing the incidence of unwanted effects.

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