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Original Article

Comparison of Intrathecal Ropivacaine and Dexmedetomidine Adjuvant to Ropivacaine in Inguinal Hernia Surgeries

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Abstract

Introduction: Adjuvants used with local anesthetic agents can improve anesthesia quality by prolonging the blockade and post-operative analgesia duration. Dexmedetomidine is a newer α2 agonist that is shown to improve the anesthetic agent's efficacy and improves post-operative pain.

Objective: The objective of the study was to compare the clinical characteristics of intrathecal anesthesia performed with ropivacaine and ropivacaine with dexmedetomidine and evaluates the synergistic effect between dexmedetomidine and ropivacaine in intrathecal anesthesia.

Materials and Methods: Forty male patients selected for elective hernia surgery were assigned into two groups, Group R, who received 0.75% Isobaric Ropivacaine 3 ml + 0.5 ml normal saline and Group RD, who received 0.75% Isobaric Ropivacaine 3 ml + 5 mcg Dexmedetomidine in 0.5 ml normal saline. Pulse rate (PR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) at baseline and after administration of the anesthetic agent were recorded, and the duration of onset of anesthesia and the total duration of the blockade were recorded.

Results: The mean age of the patients in the groups was 51.26 years and 49.48 years, respectively. The PR was significantly high in Group RD at 8 h, and significant SBP and DBP differences were observed between the two groups. The mean time of onset of sensory and motor blockade was shorter in Group RD. A prolonged duration of the block was also observed in Group RD. A decrease in the occurrence of side effects was also observed in the dexmedetomidine group.

Conclusion: Ropivacaine is a newer ideal, safe anesthetic of choice for intrathecal use in inguinal hernia surgery cases and by adding dexmedetomidine, we get prolongation of analgesia.

Key words: Dexmedetomidine, Hernioplasty, Inguinal hernia, Intrathecal ropivacaine, Ropivacaine

INTRODUCTION

Spinal anesthesia (intrathecal block), also called a subarachnoid block, is one of the most commonly used anesthetic techniques. Regional anesthesia is the priority in most procedures and the intrathecal block is preferred in lower abdominal and lower limb surgeries.[1] Bupivacaine and lignocaine have been the anesthetic agents of choice for decades, but bupivacaine's cardiotoxicity is almost impossible to treat. The prolonged motor block is another drawback associated with bupivacaine. This led to the emergence of newer anesthetic agents like ropivacaine which was released in 1996. Ropivacaine was launched recently in India and is available only as isobaric solution. Ropivacaine is effective in epidural and nerve plexus blocks and has a high therapeutic index in humans. It is also less cardiotoxic than bupivacaine.[2]

Drugs like dexmedetomidine are used for sedation and can improve the duration and quality of anesthesia. Other agents such as α2 adrenergic agonists, ketamine, midazolam, and adrenaline can be added with local

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anesthetics to potentiate the anesthetic agent's effect.[3] Animal studies have proved that dexmedetomidine can be used as adjuvants with local anesthetics, reducing the need for opioid analgesics. Dexmedetomidine is a selective α2 agonist and acts by decreasing sympathetic outflow and norepinephrine release. This produces sedative, analgesic, and hemodynamic effects.[4] Recent studies have demonstrated the synergistic interactions between dexmedetomidine and local anesthetics. The important feature of dexmedetomidine is the lack of opioid-related side effects such as respiratory depression, pruritus, nausea, and vomiting. However, it produces hypotension and bradycardia, which is manageable[5,6] comp study. When added to ropivacaine, dexmedetomidine was found to have prolonged post-operative analgesia with minimal side effects.[7,8] Systemic administration of the combination also enhanced spinal and epidural anesthesia by prolonging the duration of the blockade. Apart from this, dexmedetomidine is also shown to improve the onset of anesthesia and decrease local anesthetic dose.[9]

Very few studies have been conducted so far using dexmedetomidine as an adjuvant with ropivacaine. This prospective comparative study was conducted to explore the clinical characteristics of intrathecal anesthesia performed with ropivacaine and ropivacaine with dexmedetomidine and evaluates the synergistic effect between the combinations.

Objective

The objective of the study was to compare the clinical characteristics of intrathecal anesthesia performed with ropivacaine and ropivacaine with dexmedetomidine and evaluates the synergistic effect between dexmedetomidine and ropivacaine in intrathecal anesthesia.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Anesthesia, — Government Medical College, Pudukkottai. The study included 40 male patients who were undergoing surgery for inguinal hernia. The study procedure was explained in detail to the patients, and they were allocated into two groups of 20 each. Group R (n = 20) included patients administered with intrathecal ropivacaine alone, and Group RD (n = 20) included patients administered with intrathecal ropivacaine and dexmedetomidine. Only male patients between the age group of 30–60 years, with weight 40–65 kg, and with American Society of Anesthesiologists (ASA) I and ASA II physical status scheduled for elective inguinal hernioplasty under intrathecal anesthesia were included in the study. Patients with ASA III or greater physical status, age >60 years, allergy to local anesthetic agents, patients with comorbid conditions such as hypertension, hepatic or renal impairment and cardiac diseases, coagulopathy, those on β-blockers, long-term analgesic therapy, and patients on drugs which are known to interact with study drugs were excluded from the study.

Spinal Administration of Drug Mixture

Group R patients were administered with 0.75% Isobaric Ropivacaine 3 ml + 0.5 ml normal saline, and Group RD patients were administered with 0.75% Isobaric Ropivacaine 3 ml + 5 mcg dexmedetomidine in 0.5 ml normal saline.

RESULTS

The 40 study patients were randomly allotted to Group R and Group RD, consisting of 20 patients in each group. All the 40 patients were males, and 34 patients belonged to ASA I physical status while six patients belonged to ASA II. The patients' mean age was 51.26 ± 3.48 years in Group R and 49.48 ± 4.21 years in Group RD, respectively [Figure 1].

Pulse rate (PR) variables at baseline in both the groups were not statistically significant (P = 0.663). The mean PR in Group R was 82.23/min, and in Group RD was 81.24/min. No statistically significant changes were observed in the systolic blood pressure (SBP) and diastolic blood pressure (DBP) between the two groups at baseline. The mean SBP in Group R was 119.2mm/Hg, and in Group RD was 118.24 mm/Hg with a P = 0.696. The mean DBP was 75.24 in Group R and 76.21 in Group RD with a P = 0.448, which is statistically insignificant [Figure 2].

There were no changes in PR until 15 min, after which a slight fall in PR was observed in Group RD, which was statistically insignificant. After 4 h, a significant reduction in PR and bradycardia was observed in Group RD patients with $P < 0.0001$. A significant increase in PR was observed

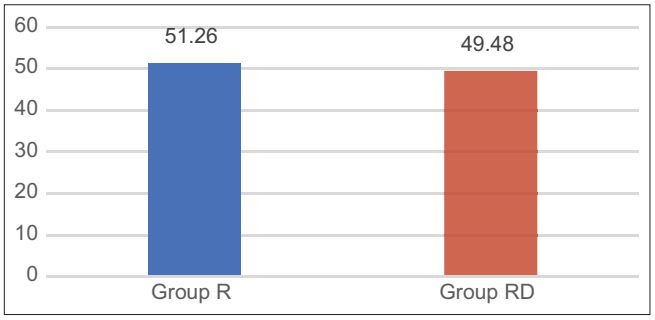

Figure 1: Mean age of patients in both the groups

after 8 h in the RD group, which could be explained due to the effect of dexmedetomidine [Figure 3].

Similarly, significant changes in SBP and DBP were also observed after 4 h in Group RD patients. The SBP was significantly high in the RD group at 4 h ($P < 0.0001$) and 8 h ($P < 0.05$), and the DBP was also significantly high in the RD group at 4 h ($P < 0.001$) and after 8 h ($P < 0.05$) of anesthesia administration [Figures 4 and 5].

Figure 6 shows the sensory level in Group R and Group RD patients. Decreased pain and temperature sensations below the T 7 level was observed in five patients in Group R and 8 patients in Group RD. However, this difference is not statistically significant ($P = 0.311$).

The mean time required for the onset of sensory and motor blocks is shown in Figure 7. The onset of sensory block in Group R was 7.64 min and in Group RD was 5.41 min with $P = 0.005$, which is significant. The mean time required for the onset of motor block is 9.28 min in Group R and 4.96 min in Group RD with $P = 0.001$, which is also statistically significant. This shows that ropivacaine with dexmedetomidine are associated with faster onset of anesthesia.

Group R patients required rescue analgesia after 228.4 min of surgery, while Group RD patients required rescue analgesia after 412.2 min post surgically. $P < 0.0001$ is highly significant. Ropivacaine with dexmedetomidine combination is associated with significant long lasting post-operative anesthetic effect [Figure 8].

The duration of sensory and motor blocks was also significantly high in the RD group with a $P < 0.0001$,

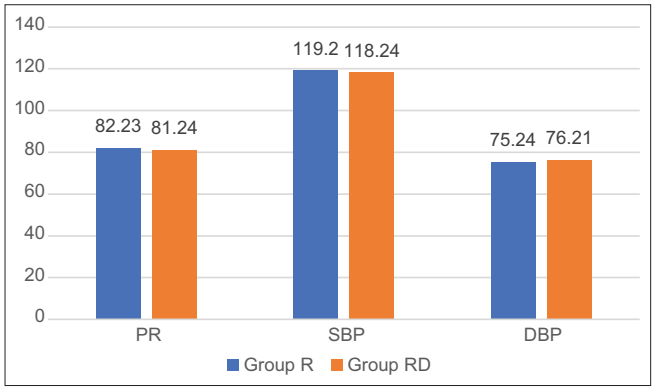

Figure 2: Baseline mean pulse rate, systolic and diastolic blood pressure in Group R and Group RD

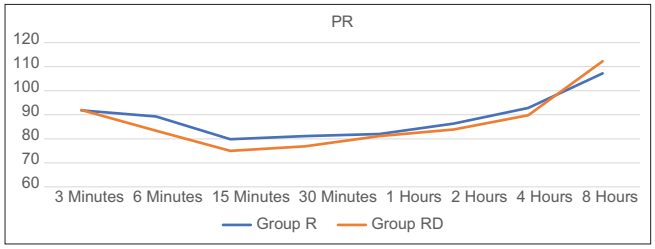

Figure 3: The pulse rate of patients in Group R and Group RD

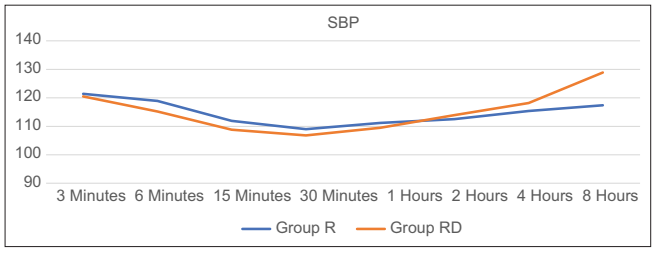

Figure 4: The systolic blood pressure of patients in both the groups

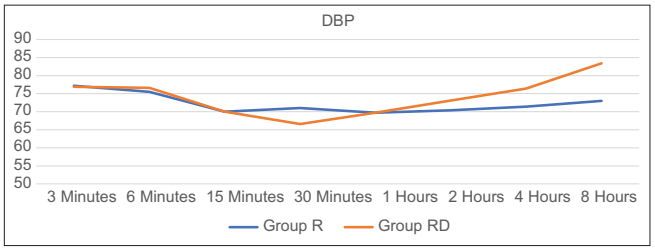

Figure 5: The diastolic blood pressure of patients in both the groups

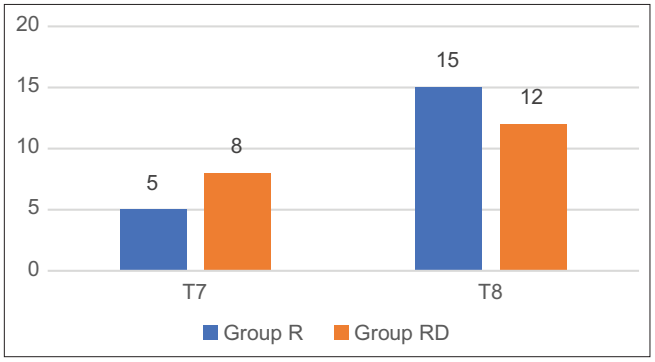

Figure 6: Sensory level in both the study groups

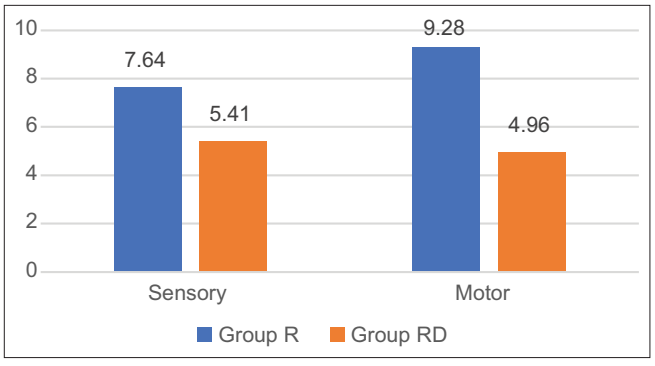

Figure 7: Mean time of onsets of sensory and motor blocks in both the groups

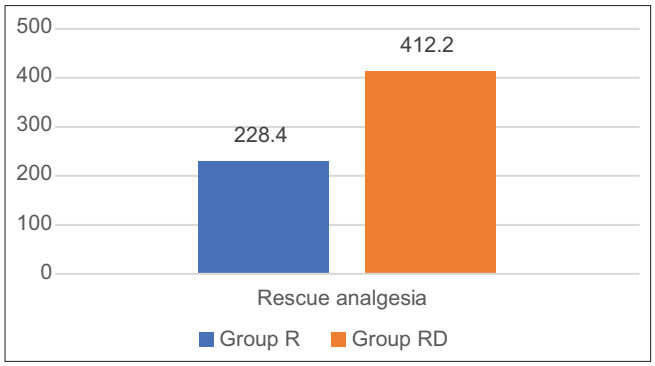

Figure 8: Rescue analgesia

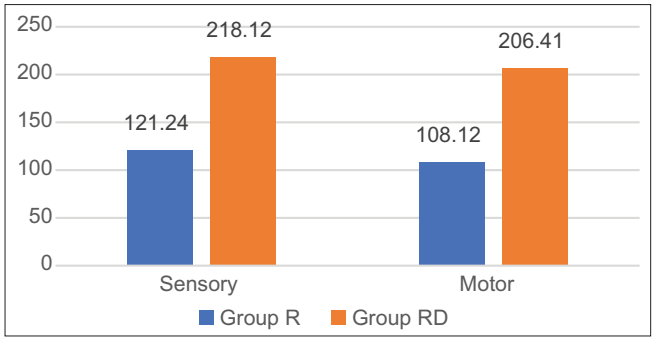

Figure 9: Block duration in minutes

showing that ropivacaine with dexmedetomidine is superior to ropivacaine alone [Figure 9].

Not much adverse effects were observed except for one case each of nausea, vomiting in both the groups and one case of hypotension and dry mouth in Group R.

DISCUSSION

An intrathecal block is an effective and frequently used technique that provides effective anesthesia to the lower limbs and lower abdomen. Inguinal hernioplasty is associated with increased post-operative pain and discomfort that may increase hospital stay and complications. An effective anesthesia and analgesia are therefore imperative to overcome this situation.[5] Increased use of opioid analgesics and NSAIDs is also associated with risk of gastrointestinal complications and sedation. An ideal anesthetic agent that serves as analgesic and prolonged anesthetic does not exist, but the addition of certain drugs can synergize the effect of a local anesthetic agent. Dexmedetomidine is one such agent, which when used in combination with ropivacaine is found to prolong the anesthesia duration and reduce the need for additional analgesics.[6]

In this study, we attempted to evaluate the clinical effects of intrathecal administration of dexmedetomidine with ropivacaine and found that there exists some synergistic interaction between the two drugs. Dexmedetomidine is also devoid of opioid side effects but may produce sedation, bradycardia, and hypotension, which was also confirmed by our study. The hemodynamic parameters were comparable between the two groups in our study. There were no significant associations between the PR, SBP, and DBP at baseline. After anesthetic administration, no significant changes were observed in PR until 15 min in both the groups, after which a fall in PR was observed in Group RD. At 4 h, a significant reduction in PR was seen in the RD group with $P < 0.0001$. The mean SBP and DBP were significantly higher in the RD group when compared with the R group in our study at the 4th h, but the levels were not above the baseline values and did not require any active treatment. Kalso *et al.* also studied the synergistic effect of dexmedetomidine with ropivacaine and found no hemodynamic instability due to drug association.[10]

A maximum sensory level of T7-T8 was observed in both the groups in our study, and there was no statistically significant difference between the two groups. Pratibha *et al.* observed the highest level of sensory block achieved was T5-T6 in the dexmedetomidine group.[11] The mean time of onset of sensory block in Group R was 7.64 min, and in Group RD was 5.41 min with $P = 0.005$, which is significant. The mean time required for the onset of motor block is 9.28 min in Group R and 4.96 min in Group RD with $P = 0.001$, which is also statistically significant. This shows that ropivacaine with dexmedetomidine combination is associated with faster onset of anesthesia. Our results regarding the onset of sensory block are similar with the reports made by Hogue *et al.*[12]

These results are consistent with the study findings of Thimmappa *et al.* who also observed that the mean time to onset of sensory block to T10 dermatome was 8.90 ± 0.99 min in dexmedetomidine group and 12.33 ± 1.56 min in ropivacaine group ($P < 0.001$).[13]

The duration of the sensory and motor blocks was also significantly high in the RD group (Sensory-218.12 min and motor-206.41 min) with $P < 0.0001$ in this study. This finding is supported by Fukushima K *et al*, who also found that the post-operative analgesia was increased when adding dexmedetomidine 2 μg/kg with 0.5% bupivacaine for epidural anesthesia in patients undergoing a hysterectomy.[14] Kaur *et al.* observed in his study that the total duration of sensory block in dexmedetomidine group (535.18 ± 19.85 min) was significantly prolonged as compared to ropivacaine group (375.20 ± 15.97 min, $P = 0.000$).[15] Brown *et al.* also obtained a total duration of sensory block of 333 ± 54 min, using 20 ml of 0.5% ropivacaine which is comparable with the findings of the present study. The

Table 1: Adverse effects

Adverse effects	Group R	Group RD
Nausea vomiting	1	1
Hypotension	1	0
Dry mouth	1	0

need for rescue analgesia was also prolonged in the RD group (412.2 min) when compared to that of the R group (228.4 min). The prolongation of motor block may be the result of binding α2-adrenergic agonists to the motor neurons in the spinal dorsal horn, resulting in profound analgesic properties.[16]

The incidence of adverse effects was also less in the RD group in our study, Table 1. Like any other study, our study also has its limitations. The pain assessment based on VAS was not done and hence patient perspective of pain is unknown. The level of sedation was also not assessed in our study which limits its findings. The small sample size is another study limitation. Further studies addressing these limitations must be conducted to assess the analgesic effects of dexmedetomidine in extensive surgeries.

CONCLUSION

Ropivacaine is a newer ideal, safe anesthetic of choice for intrathecal use in inguinal hernia surgery cases and by adding dexmedetomidine we get prolongation of analgesia. Ropivacaine with dexmedetomidine also causes quick onset of sensory and motor blockade and prolongs the need for rescue anesthesia without altering the hemodynamic variables.

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