Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/3mxf6y69

COMPARATIVE EVALUATION OF THREE DEXMEDETOMIDINE DOSES COMBINED WITH LOW-DOSE 0.5% HYPERBARIC BUPIVACAINE FOR SPINAL ANESTHESIA DURING TURP: A RANDOMIZED, DOUBLE-BLIND CLINICAL STUDY

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Abstract

Background: The talking anesthesia technique has been the choice of conducting transurethral resection of the prostate (TURP), partly because it is safe and effective. Hyperbaric bupivacaine has slowly assumed the role of preference since older agents such as cinchocaine, despite their usefulness, are not as long-lasting as their counterparts, and highly expensive and restricted to a patient position.

Study design: Randomized double-blind

Duration and place of study: this study was conducted in Liaquat National Hospital and Medical College Karachi from January 2024 to January 2025

Objectives: This study aims at the evaluation as well as the comparison of the clinical effects of three different doses of intrathecal dexmedetomidine when combined with 0.5% hyperbaric bupivacaine in patients undergoing TURP.

Methods: This study is a randomised, double-blind clinical trial involving 120 male subjects of age 55-70 years who were about to undergo elective TURP. Random selection of three equal groups was received by the participants. Group A was given 0.5% hyperbaric bupivacaine 1.5 ml (7.5 mg) and dexmedetomidine 6 mcg. Group C was given 10 mcg dexmedetomidine along with bupivacaine and Group B was given 8 mcg dexmedetomidine with the same amount of bupivacaine. Researchers

observed the time and duration to occurrence of sensory and motor block. Pain relief after operations involved morphine. The Numeric Rating Scale (NRS) of pain, total morphine use, and time until first rescue analgesia were recorded at 6, 8, and 12 hours.

Results: There is no statistically significant difference between the sensory and motor block length and onset of Groups A and B. In comparison with A and B, the Group C showed a significantly faster onset of block ($P < 0.05$). Also, the time whose first analgesic need occurred was considerably longer in Group C in comparison with Groups A and B, and it was longer in Group B in comparison with the group A ($P < 0.05$). Also, the total consumption of morphine during the study, as well as the NRS scores, were the lowest in the Group C at every registered point subsequent to the Group B and the highest in the Group A ($P < 0.05$).

Conclusion: The addition of 10 mcg of dexmedetomidine to 0.5 percent hyperbaric bupivacaine mixture has a drastic effect on the quality and the duration of spinal anesthesia used in TURP surgery with a high degree of analgesia and low opioid demand. In increasing the doses, the efficacy rises but the incidence of adverse effects does not improve with high doses in comparison with low ones.

Keywords: Dexmedetomidine, Hyperbaric Bupivacaine. Spinal Anesthesia, TURP

Introduction

The prevalent urological disorder known as benign prostatic hyperplasia (BPH) primarily affects older men. For moderate to severe lower urinary tract symptoms that do not improve with medication, transurethral resection of the prostate (TURP) remains the recommended surgical procedure [1,2]. Because of its favourable safety profile, lower incidence of postoperative sequelae, and decreased blood loss, spinal anaesthesia is commonly chosen over general anaesthesia for TURP, which is routinely performed in older patients with numerous comorbidities [3–5].

Long-acting amide local anesthetic Bupivacaine stands out as an agent of choice in spinal blocks. Nonetheless, the standard doses have been described to come along with severe hypotension, especially among aged patients receiving TURP [6]. In order to reduce these cardiovascular perturbations, a significant number of anesthesiologists have endeavored to administer half dose of hyperbaric bupivacaine, which sufficient anaesthesia with relatively stable cardio-vascular parameters [7,8]. However, reduction in the dose can act as a disservice to the block duration and quality, and that is why using intrathecal adjuvant becomes of interest in providing a better result in anesthesia.

Dexmedetomidine a highly selective agonist at the alpha-2 adrenergic receptor has proven very promising as an intrathecal adjuvant. It is helpful in enhancing spinal anaesthesia due to its ability to maintain hemodynamic stability, extend sensory and motor block as well as increase postoperative analgesia [9 10 11]. When compared to other such opioids, dexmedetomidine has been associated with fewer adverse effects which include itching, nausea and respiratory depression [12].

Studies on the application of dexmedetomidine combined with spinal bupivacaine have been explored but no conclusion has been reached on the best dose to be used on efficacy and safety [13,14]. On the one hand, increasing doses can deepen the block and prolong it, but on the other, they can provoke an increase in the risk of bradycardia and hypotension. In contrast, a small dose may be less dangerous yet inadequate to give long-lasting pain relief [15]. It is even more important that such a fragile balance replays specifically during TURP procedures, when an unnoticeable change in hemodynamics is a clinically significant issue.

In order to deal with this clinical uncertainty, the current randomized, double-blind trial was planned to examine the effects of three doses of intrathecal dexmedetomidine with low dose of 0.5% hyperbaric bupivacaine in patients subjected to TURP. We mainly wanted to evaluate the quality and duration of spinal anesthesia, but additional goals were the hemodynamic stability, the level of sedation, and adverse effects. We believe that determination of the most efficient and safest

combination of doses (of the anesthetics) will provide significant data about how to proceed with anesthetizing geriatric patients undergoing urologic surgeries.

Methodology

In this study, a total of 120 male patients aged 55-70 years, elective TURP was proposed under the spinal anesthesia. The patients were ASA physical status I and II. Patients who had contraindications to the use of spinal anesthesia, had a known hypersensitivity to the study medication, had severe cardiovascular or neurological conditions, chronic opioid use, or who refused in the study were excluded. All the participants were asked for a written informed consent.

Patients were randomly allocated in three equal groups of 40 using the computer generated list of randomization. The allocation was hidden in closed opaque envelopes. The anesthesiologists in charge of administering the spinal block and the observer used in recording the perioperative data was blinded to the group assignment.

Standard monitors including non-invasive blood pressure, ECG and pulse oximetry were attached to all patients immediately after admission to the operating room. Baseline measurements of vital indicators were made. Before the spinal block, the patients were injected with 500 mL of a lactated Ringer solution I/V.

100 mcg (1 ml) dexmedetomidine was filled in a 100-unit (1 ml) insulin syringe which constitute 1 mcg of dexmedetomidine per unit of syringe. Group A and Group B received six and eight micrograms of dexmedetomidine, respectively, and group C had ten micrograms of the drug along with 1.5 ml of 0.5% hyperbaric Bupivacaine in each group. 0.9% saline was added to make total volume of 2 ml in each 5 ml syringe. The patient was seated; aseptic administration of spinal anaesthesia was done in the L3-L4 or L4-L5 interspace using a 25-gauge Quincke needle. All the patients were put in supine position immediately after the injection. Further administration of sedatives and analgesics was made not without medical reasons.

The sensory block level was measured every 2 minutes in the first 10 minutes and every 5 minutes thereafter with the help of pinprick technique using a blunt 22-gauge needle. Motor block was determined with the modified Bromage scale. Sensory block to the L1 dermatome, duration of sensory and motor block, maximum sensory block and time of onset were also noted. Some of the hemodynamic parameters that were continuously monitored and noted after every five minutes included heart rate, oxygen saturation, and mean arterial pressure. Hypotension was treated with intravenous ephedrine, which was defined as a drop of more than 20 percent in the baseline mean arterial pressure. Bradycardia which is defined as a heart rate projected less than 50 beats per minute was treated using intravenous administration of atropine.

Intravenous morphine used as a postoperative analgesic as and when the patients scored 4 or higher on the Numeric Rating Scale (NRS). The pain scores were measured in 6, 8 and 12 hours after the surgical operation. First analgesic order and morphine use over the initial 12 hours were recorded. Ramsay Sedation Scale was also used to observe the levels of sedation. Any undesired events were mentioned and accordingly treated.

Data analysis was done by means of SPSS software. Continuous variables were presented as mean and standard deviation and compared by means of analysis of variance (ANOVA) and post hoc Tukey tests. Chi-square or Fisher exact test were also done on categorical variables as necessary. The statistical significance of a p-value corresponding to a level less that 0.05 was regarded.

Results

All 120 patients completed the study without any protocol deviations or dropouts. The demographic and baseline hemodynamic parameters were comparable across all three groups, with no statistically significant differences observed (Table 1).

Table 1: Demographic and Baseline Characteristics

Parameter	Group A (6 µg)	Group B (8 µg)	Group C (10 µg)	*p*-value
Age (years)	63.4 ± 4.2	64.1 ± 5.1	63.7 ± 4.5	0.72
Weight (kg)	68.2 ± 6.5	69.0 ± 5.9	68.5 ± 6.1	0.81
ASA I/II (n)	18/22	17/23	19/21	0.89
Baseline MAP (mmHg)	92.3 ± 7.8	91.7 ± 6.5	92.0 ± 7.2	0.93
Baseline HR (bpm)	78.6 ± 5.9	77.8 ± 6.1	78.1 ± 5.6	0.88

The onset of sensory block was fastest in Group C, followed by Group B and then Group A. Sensory and motor block durations were also significantly prolonged in Group C compared to the other groups. Regression to L1 took longest in Group C as well (Table 2).

Table 2: Block Characteristics

Parameter	Group A (6 µg)	Group B (8 µg)	Group C (10 µg)	*p*-value
Sensory block onset time (min)	4.8 ± 1.2	4.2 ± 1.0	3.6 ± 0.9	<0.01
Time to peak sensory block (min)	9.1 ± 2.0	8.5 ± 1.8	7.3 ± 1.5	<0.01
Duration of sensory block (min)	151.3 ± 14.5	174.5 ± 15.2	202.6 ± 16.1	<0.001
Duration of motor block (min)	131.7 ± 13.2	156.2 ± 12.4	181.4 ± 15.6	<0.001
Regression to L1 dermatome (min)	136.5 ± 11.8	158.9 ± 13.1	187.1 ± 14.7	<0.001

In terms of postoperative analgesia, the time to first rescue morphine was significantly delayed in Group C. Total morphine consumption over 12 hours was lowest in Group C, indicating superior analgesic efficacy. Pain scores on the Numeric Rating Scale (NRS) at 6, 8, and 12 hours were also significantly lower in the higher dexmedetomidine groups (Table 3).

Table 3: Postoperative Analgesia and Pain Scores

Parameter	Group A (6 µg)	Group B (8 µg)	Group C (10 µg)	*p*-value
Time to first analgesic (min)	157.2 ± 15.4	182.3 ± 17.8	214.9 ± 19.1	<0.001
Total morphine used (mg)	6.8 ± 1.2	5.4 ± 1.1	4.1 ± 1.0	<0.001
NRS score at 6 hours	3.6 ± 0.8	2.8 ± 0.7	2.1 ± 0.6	<0.01
NRS score at 8 hours	4.2 ± 0.9	3.1 ± 0.8	2.3 ± 0.6	<0.001
NRS score at 12 hours	3.7 ± 1.0	2.9 ± 0.9	2.2 ± 0.7	<0.01

Sedation scores were higher in Group C but remained within safe limits. No episodes of respiratory depression were recorded. Mild bradycardia occurred more frequently in Group C but was managed easily with atropine. Hypotension requiring treatment was infrequent and similarly distributed among all groups. Other minor side effects were observed sporadically, without significant intergroup differences.

Discussion

This study set out to explore how different doses of intrathecal dexmedetomidine impact the characteristics and clinical outcomes of spinal anesthesia when paired with a low dose of 0.5% hyperbaric bupivacaine in patients undergoing TURP. The findings clearly indicate that increasing the dexmedetomidine dose prolongs both sensory and motor block durations, delays the need for rescue analgesia, and reduces postoperative morphine requirements, all without a marked increase in adverse effects.

These results are well-aligned with the growing body of literature supporting dexmedetomidine as a potent intrathecal adjuvant. In a study by Shaikh and colleagues, 10 µg dexmedetomidine significantly prolonged sensory and motor blockade when combined with 7.5 mg bupivacaine, compared to fentanyl as an additive, without causing major hemodynamic instability [16]. Similar to our findings, the prolonged block translated into improved postoperative analgesia, highlighting dexmedetomidine's dual role in anesthesia and pain control.

Interestingly, our results also resonate with those of Al-Ghanem et al., who observed that 10 µg dexmedetomidine added to bupivacaine produced a significantly extended time to first analgesic request and reduced postoperative opioid consumption in lower limb orthopedic surgeries [17]. Although their study population differed, the consistency of these analgesic benefits across surgical types further reinforces dexmedetomidine's analgesic value.

A recent randomized trial by Tekin et al. involving elderly patients undergoing urological procedures compared 5 µg and 10 µg dexmedetomidine with 0.5% bupivacaine. Their results showed a longer sensory block and greater patient satisfaction in the 10 µg group, with no significant increase in hypotension or bradycardia [18]. These observations mirror our own data, where the 10 µg group achieved the most extended duration of anesthesia and required the least postoperative morphine.

Moreover, in a study by Harsoor et al., which focused on infraumbilical surgeries, the addition of dexmedetomidine led to significantly higher sedation scores and prolonged block duration compared to clonidine [19]. While deeper sedation may be a concern in some settings, the patients in our study remained arousable and did not experience respiratory compromise, confirming that these doses are both effective and safe when properly monitored.

A dose-finding study by Subramanian et al. is particularly noteworthy. They demonstrated that although higher doses (up to 10 µg) of intrathecal dexmedetomidine provided better analgesia and longer anesthesia duration, the optimal balance between efficacy and safety was achieved at 8 µg, especially in geriatric patients [20]. Our study supports this conclusion as well, while the 10 µg group offered the best clinical outcomes, the 8 µg dose (Group B) provided an excellent middle ground with fewer side effects than the highest dose.

In contrast, Chinnappa et al. reported that even 5 µg dexmedetomidine significantly enhanced bupivacaine-induced spinal anesthesia without causing notable sedation or hemodynamic changes [21]. Although their dose was lower than in our highest group, their findings confirm that dexmedetomidine remains effective even at modest doses. This aligns with our results in Group B, where 8 µg proved to be both efficient and safe.

Taken together, these studies and our current findings suggest that intrathecal dexmedetomidine exhibits a clear dose-response relationship in terms of block quality and duration. While 10 µg appears to deliver the most robust anesthetic and analgesic effects, 8 µg offers a highly favorable balance, particularly in elderly surgical populations, where avoiding bradycardia and hypotension is critical. Importantly, no patient in our study experienced respiratory depression, and all cardiovascular side effects were mild and easily managed.

Given the consistency of results across different clinical contexts, it's reasonable to suggest that 8–10 µg dexmedetomidine may be considered an optimal range when used as an adjuvant to low-dose hyperbaric bupivacaine for spinal anesthesia in TURP. However, it remains essential for anesthesiologists to tailor the dose based on individual patient profiles, particularly in those with cardiovascular vulnerabilities.

Conclusion

This study clearly demonstrates that adding dexmedetomidine to low-dose 0.5% hyperbaric bupivacaine significantly enhances the quality of spinal anesthesia in patients undergoing TURP. Among the three doses evaluated, 10 µg provided the longest sensory and motor block durations, superior postoperative pain control, and the least requirement for rescue analgesia, all without introducing serious side effects. However, the 8 µg dose also offered a clinically effective profile

with fewer hemodynamic fluctuations, making it a suitable alternative for elderly or high-risk patients. These findings support the growing consensus that dexmedetomidine is a reliable and dose-sensitive intrathecal adjuvant. An optimal balance between anesthesia efficacy and patient safety may be achieved at doses between 8–10 µg. Nevertheless, careful monitoring remains essential, especially in vulnerable populations. Further large-scale, multicenter studies would be beneficial to validate these findings and refine dosing strategies across a wider spectrum of surgical contexts.

Funding Source
None

Permission granted
Ethical approval granted

Conflict in Interest
None

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