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Comparison of clinical efficacy of hyperbaric ropivacaine with hyperbaric bupivacaine in spinal anesthesia for transurethral resection of prostate: A randomized and double-blind study

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ABSTRACT

Background: Ropivacaine is an ammino-amide local anesthetic agent with properties similar to bupivacaine, but its decreased lipophilicity is associated with reduced incidence of central nervous system toxicity and cardiotoxicity. This study evaluated the safety, efficacy, effects on hemodynamics and complications of spinal anesthesia using 0.5% hyperbaric bupivacaine and 0.75% hyperbaric ropivacaine in patients undergoing transurethral resection of the prostate (TURP). **Aims and Objectives:** The aim was to evaluate the safety, efficacy, hemodynamic stability, and side effects of spinal anesthesia using 0.5% hyperbaric bupivacaine and 0.75% hyperbaric ropivacaine in patients undergoing TURP. **Materials and Methods:** Sixty adult patients with physical status classes I and II, as determined by the American Society of Anesthesiologists, scheduled to undergo elective transurethral resection of prostate, were randomly allocated to receive either hyperbaric ropivacaine 0.75% 2.8 mL plus fentanyl 15 mcg or hyperbaric bupivacaine 0.5% 2.8 mL plus fentanyl 15 mcg. The parameters, such as demographic characteristics, duration of surgery, onset of sensory and motor blockade, hemodynamic stability, and complications, were compared in both groups. **Results:** Hyperbaric ropivacaine exhibited significantly slower onset times for sensory and motor blockade compared to hyperbaric bupivacaine. Patients in the ropivacaine group demonstrated better hemodynamic stability and experienced less hypotension compared to those who received bupivacaine. Moreover, the sensory and motor block lasted significantly longer in the bupivacaine group. **Conclusion:** About 0.75% hyperbaric ropivacaine is a better choice for spinal anesthesia in elderly patients undergoing TURP as compared to 0.5% hyperbaric bupivacaine.

Key words: Bupivacaine; Hemodynamic stability; Hyperbaric; Ropivacaine; Spinal anesthesia

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INTRODUCTION

Transurethral resection of the prostate (TURP) is a commonly used surgical procedure to treat benign prostatic hyperplasia (BPH). In the context of TURP, spinal anesthesia emerges as the preferred and optimal technique.[1] Spinal anesthesia helps in peripheral blood pooling, reducing the chance of circulatory overload and early detection of complications like TURP syndrome and bladder perforation. It also provides post-operative analgesia, reducing blood loss during surgery.[2,3]

Ropivacaine is a newer amino-amide local anesthetic (LA) agent similar to bupivacaine in chemical structure but 30–40% less potent. Intrathecal ropivacaine is a safe and effective option for spinal anesthesia. It has a shorter duration of action and a lower incidence of transient neurological symptoms than other LA agents. The use of

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hyperbaric LA agents for intrathecal administration has recently gained popularity due to their predictable block characteristics and reliable spinal anesthesia.[4,5]

One advantage of ropivacaine is that it has a lower risk of toxicity to the heart and nervous system compared to bupivacaine. It also has a shorter motor block time so patients can move their legs sooner after the surgery. Ropivacaine can be especially beneficial for elderly patients with BPH, who may have a higher risk of complications from long-term motor block.[6,7]

For the TURP procedure, it is essential to achieve a sensory blockade at the T10 dermatome, and the procedure typically takes 60–75 min to complete.[8] The efficacy and time of the anesthetic block crucially hinge on the choice of the LA, considering its type and concentration. Lipophilic opioids such as fentanyl are increasingly administered intrathecally as an adjunct to LAs. This practice aims to augment sensory block while avoiding an undue extension of motor recovery.

Aims and objectives

The present study evaluated the efficacy and safety of intrathecal 0.75% hyperbaric ropivacaine with 0.5% hyperbaric bupivacaine for TURP in elderly patients. The focus is on understanding how these different hyperbaric solutions impact sensory blockade, motor recovery, and overall safety parameters during and after the TURP procedure in the elderly.

MATERIALS AND METHODS

The study was a double-blind, randomized interventional study conducted in a tertiary care hospital between May 2022 and October 2022. After obtaining institutional ethics committee permission (GIMS IEC/HR/2022/02 dated April 28, 2022), the trial was registered in the Clinical Trial Registry of India (CTRI/2022/06/043065). After taking written informed consent, 60 patients aged between 55 and 80 years of American Society of Anesthesiologist physical status I, II having a prostatic volume of 30–80 cc with approximate operation time of 60–90 min scheduled for TURP were selected for our study. A computer-generated randomization table (Microsoft® Excel 2016 [v16.0] software, Microsoft Corp., Redmond, WA) was used to assign each patient to either Group "R" (patients receiving ropivacaine) or Group "B" (patients receiving bupivacaine) and allotted into the groups through sealed opaque envelopes. Group R (n=30) were patients proposed to undergo TURP under spinal anesthesia using hyperbaric ropivacaine (Ropin 0.75% heavy Neon) 0.75% 2.8 mL plus fentanyl 15 mcg and Group B (n=30) using hyperbaric bupivacaine (Anawin 0.5% heavy Neon) 0.5% 2.8 mL plus fentanyl 15 mcg. Considering the results of a previous study based on motor blocks with an alpha error of 1% and a power of 90%, we calculated that the sample size should be at least 30 patients per group.[9] Patients with significant cardiovascular disease, hypertension, renal failure, hepatic dysfunction, chronic pulmonary disease, neuromuscular disorder, morbid obesity, bleeding disorder, and infection at the local site were excluded from the study. All equipment and drugs essential for resuscitation were ready in the operation theatre. On arrival at the operation theatre, an electrocardiogram (ECG), pulse oximeter, and non-invasive blood pressure monitors were attached. The baseline blood pressure and heart rate (HR) were recorded. The intravenous line was secured, and patients were preloaded with Ringer Lactate solution 10 mL/kg before initiating the procedure.

Before the initiation of anesthesia, patients were instructed in sensory and motor assessment techniques. The respective drug was loaded by another anesthesiologist under strict aseptic precautions based on group allocation and handed the syringe to the anesthesiologist performing the block so that she was blinded to the drug. Spinal anesthesia was performed under aseptic precautions in a sitting position with 26G Quincke's needle at L3-L4 interspace by the attending anesthesiologist, who was not involved in the study. Once free flow of clear cerebrospinal fluid was obtained, the study drug was given over 15–20 s, and the time at which the drug was given was noted. The patient was then placed in the supine position. Then, the observations and patient assessments were done by the chief investigator, who was blinded to the drugs given. When complete motor blockade and sensory block up to T10 dermatome were achieved, the patient was placed in the lithotomy position, and the surgeon was allowed to proceed. After spinal anesthesia, the patient was given 5 L of oxygen per minute through a simple oxygen mask. HR, ECG, blood pressure, breathing rate, SPO_2, nausea and vomiting, chills, and pruritus were recorded before anesthesia and every 2 min for the first 20 min after anesthesia, then recorded, every 5 min until the end of the surgery, at the recovery room to monitor every 30 min and every 3 h when transferred to the ward until 24 h after spinal anesthesia.

The onset of sensory blockade was defined as the time interval between intrathecal administration of the drug and the time of attaining sensory block at T10. The sensory block was assessed by pinprick using a sterile 26 G needle at the midclavicular line anteriorly every minute till the T10 dermatome was reached. Time for 2-segment regression was defined as the time interval between intrathecal administration of the study drug and time to regression of

sensory block by two segments from the maximum block height. It is evaluated by pinprick at the midclavicular line anteriorly every 15 min after the first 20 min in the intra-operative period. Duration of sensory block was defined as the time interval from intrathecal administration of the study drug to the point of complete resolution of sensory block (time of appearance of pain sensation at S2 dermatome). The duration of the sensory block was assessed by pinprick using a hypodermic needle at the lateral side of a foot every 30 min in the post-operative period till the appearance of pain sensation at that site.

The Modified Bromage Scale assessed the degree of motor blockade. The onset of motor block was defined as the interval between intrathecal administration of the study drug and complete motor block (Bromage 3) of the lower limbs. The onset of the motor block was assessed every minute till an entire motor block was attained. Duration of motor block was defined as the time interval from intrathecal administration of the study drug till full motor recovery (the point at which Bromage score is back to zero). It is evaluated every 30 min in the post-operative period till complete recovery of motor block. Duration of surgery was taken from the time of introduction of resectoscope till the end of surgery (time of removal of resectoscope). Evaluate thermal sensation closure with a 100 mL sodium chloride bottle refrigerated in the refrigerator after anesthesia every 2 min for the first 20 min, at the end of the surgery, and every 10 min in the recovery room. Evaluate movement block after anesthesia using the Bromage scale every 2 min for the first 20 min, at the end of surgery, and every 10 min in the recovery room. Evaluate pain level using a numerical rating scale in the wake-up room every 30 min and every 3 h when transferred to 24 h after spinal anesthesia. Hypotension was diagnosed when systolic blood pressure is decreased by more than 20% compared with baseline or systolic blood pressure. The time for the patient's first request for analgesia was noted in the postoperative period. It was managed with intravenous injection of Tramadol 2 mg/kg. Patients were closely observed postoperatively for 24 h for complications like bradycardia (HR <50/min), hypotension (mean average precision [MAP] <20% from baseline), post-spinal headache, and transient neurological symptoms. They were subsequently managed as per standard institution protocols.

Data collected were entered into a computer-based spreadsheet for analysis using SPSS statistical software (version 28) (IBM Corp., NY, USA). The statistical tests were applied, including proportions, Student's t-test, and Chi-square tests for the significance of associations. A probability value P<0.05 was considered statistically significant.

RESULTS

The groups were comparable concerning age, weight, BMI, and ASA status (Table 1). The mean time to onset of sensory and motor block in Group R was significantly slower than in Group B (P<0.001). The total sensory and motor block duration was considerably greater in Group B (P<0.001). Patients in Group B experienced a more extended period of analgesia than patients in Group R, which was not significant. The onset and duration of the sensory and motor block with time to first rescue analgesic are shown in Table 2.

Figure 1 shows a statistically significant difference in mean arterial pressure at different time points during the evaluation period. There was more fall in HR after

Table 1: Comparison of demographic data between the two groups

Parameter	Group R (n=30)	Group B (n=30)	P-value
Age (years)±SD	71.46±13.24	69.62±14.44	0.60*
Weight (kg)±SD	66.86±10.80	67.64±12.26	0.79*
BMI (kg/cm^2)±SD	27.48±8.68	27.07±9.02	0.85*
ASA score (I/II)	9/21	10/20	0.78ł
Surgery duration (min)±SD	50.12±10.72	49.14±14.83	0.77*

Group R- hyperbaric ropivacaine 0.75% 2.8 mL plus fentanyl 15 mcg. Group B - hyperbaric bupivacaine 0.5% 2.8 mL plus fentanyl 15 mcg. SD: Standard deviation, min: Minutes, cm: Centimeter, Kg: Kilogram, *: t-student test, ł: Pearson's Chi-square test ; *, ł P<0.05 Statistically significant

Table 2: Onset and duration of sensory and motor block with time to first rescue analgesic

Parameter	Group R (n=30)	Group B (n=30)	P*
Onset of sensory block (min)	5.38±0.62	3.94±0.76	0.0001
Onset of motor block (min)	7.51±1.43	5.65±0.82	0.0001
Duration of sensory block (min)	160.46±11.24	209.28±8.72	0.0001
Duration of motor block (min)	124.32±10.68	195.26±9.25	0.0001
Time to first rescue analgesic (min)	178.64±8.84	183.32±9.44	0.052
Bromage grade 3 (n, %)	20 (66.67)	26 (86.67)	0.034
Bromage grade 2 (n, %)	7 (23.33)	4 (13.33)	0.158
Bromage grade 1 (n, %)	1 (3.33)	0	0.0001
Bromage grade 0 (n, %)	0	0	NS
Complications (%)			
Hypotension	4 (13.3)	11 (36.6)	0.01
Bradycardia	2 (6.6)	3 (10)	0.31
Nausea and vomiting	2 (6.6)	2 (6.6)	0
Shivering	5 (16.6)	6 (20)	0.36

*P<0.05 statistically significant difference between groups

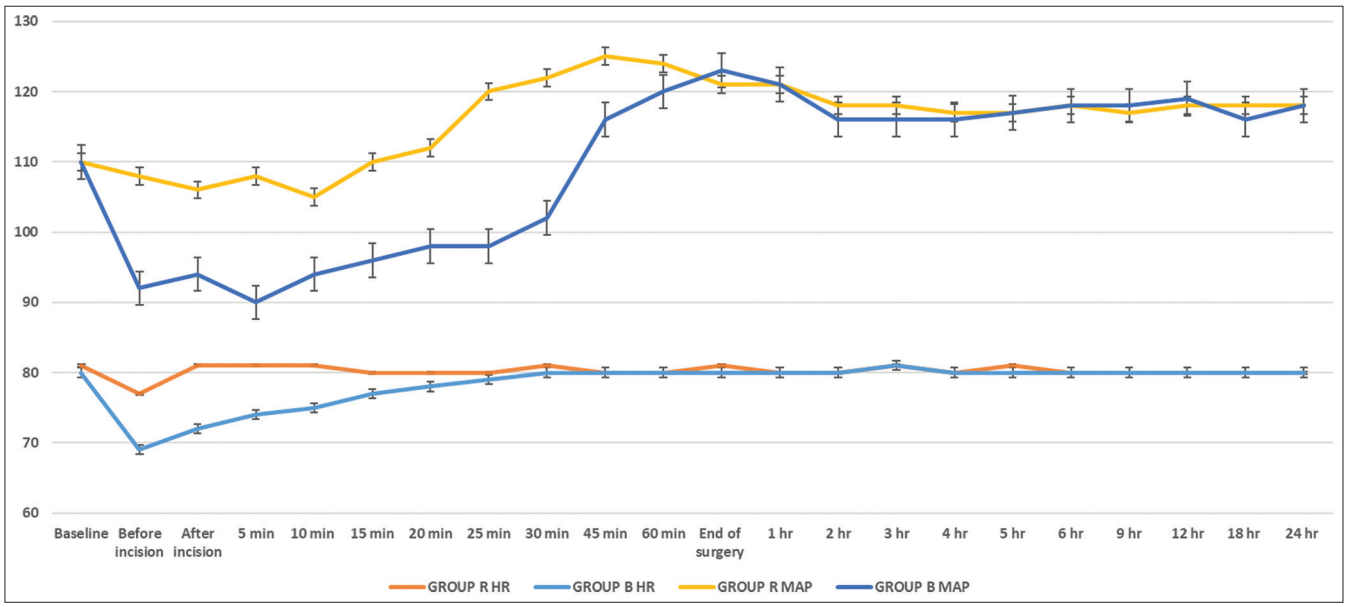

Figure 1: Haemodynamic parameters - trends of heart rate (bpm) and mean blood pressure (mmHg) in both groups at different time intervals. Group R- hyperbaric ropivacaine 0.75% 2.8 mL plus fentanyl 15 mcg; Group B -hyperbaric bupivacaine 0.5% 2.8 mL plus fentanyl 15 mcg; Data are presented as mean±standard deviation

the administration of spinal anesthesia, with Group B recording a lesser value of HR at 10, 15, and 20 min, but it was statistically insignificant.

Fall in MAP in Group B was also significantly more compared to group R (P<0.001). Thus, the patients in the ropivacaine group showed minimal variation of hemodynamic parameters from the baseline values, which is desirable in elderly patients. None of the patients from either group experienced any adverse events.

No statistically significant side effects such as shivering, nausea, and vomiting were noted in either group of our study population. Moreover, no patients have complained of post-dural puncture headaches.

DISCUSSION

The present study focused on determining the potential of 0.75% hyperbaric ropivacaine in replacing 0.5% hyperbaric bupivacaine as a safer intrathecal anesthetic for geriatric patients. Spinal anesthesia is presently acknowledged as a more effective and secure alternative to general anesthesia across various surgical procedures, with TURP being a prominent example within urological surgeries. Since hyperbaric ropivacaine was not available commercially till recently, extreme antiseptic care is required to prepare the hyperbaric solution with an autoclaved dextrose ampoule. In an Indian context, it is noteworthy that commercial hyperbaric ropivacaine represents a recent addition to the repertoire of drugs employed for anesthesia. Limited research has been conducted on its efficacy and safety, especially compared to well-established anesthetic drugs.

There were marked differences in cardiovascular responses were observed between the two groups. Only 13.3% of patients in the ropivacaine group experienced hypotension, contrasting with 36.6% of patients in the bupivacaine group (P=0.01). This finding aligns with a study conducted by Whiteside et al., 70% of patients in the bupivacaine group necessitated ephedrine due to a per-protocol reduction in systolic pressure, while only 15% of patients in the ropivacaine group exhibited the exact requirement (P=0.001).[10] However, a similar study by Patil et al., reported a high degree of cardiovascular stability with intrathecal ropivacaine, showing a low incidence of bradycardia and hypotension compared to bupivacaine, although the difference was not statistically significant.[11]

Our observation that ropivacaine has weaker motor activity and greater sensorimotor separation than bupivacaine but produces reliable spinal anesthesia is supported by similar observations from other studies.[12,13] The findings were comparable to the survey carried out by Whiteside et al., who observed a mean onset time of motor blockade of 15 min and 10 min and a total duration of around 90 min and 180 min with a similar dose of hyperbaric ropivacaine and bupivacaine respectively.[10] Similarly, in the study by Luck et al., they reported a reduced intensity and duration of motor blockade with a lower occurrence of Bromage score III, which denotes a complete motor block, in 63% of cases with hyperbaric ropivacaine compared to 90% with bupivacaine.[14] Moreover, we observed a Bromage score

of Grade III in 66.67% and 86.67% of patients receiving intrathecal hyperbaric ropivacaine and bupivacaine, respectively. In a study by Lee et al., studied intrathecal isobaric ropivacaine in different concentrations (2, 4, 7, 10, and 14 mg) for lower limb surgeries and found 100% successful anesthesia with 14 mg of ropivacaine dose.[15]

We also noted that the ropivacaine group had a positive response, a positive sensory/motor improvement curve, and a shorter time to first voiding in the ropivacaine group compared to bupivacaine. These features of ropivacaine help with ambulatory surgery. Hyperbaric lignocaine 5% has been used as a short-acting agent for ambulatory spinal anesthesia, but currently, its use is limited due to a high incidence of TNS.[16,17]

We found no evidence of any late sequelae, such as back pain or other sequelae. Therefore, ropivacaine can be a safer alternative for ambulatory surgeries.

Shivering was a side effect in 16.6 % and 20% of cases in hyperbaric ropivacaine and hyperbaric bupivacaine, respectively, which was non-significant (P=0.36). As seen in a study by Gupta et al., in the present study, only 3.3% of the patients in both groups suffered from nausea or vomiting, which was non-significant.[18]

Limitations of the study

Limitation of the study was that we did not standardize the dose of the drugs based on age, height and weight.

CONCLUSION

Elderly patients require evidence-based strategies to reduce potential complications of TURP surgery, and there is limited geriatric-specific data to direct care of elderly patients. The intrathecal 0.75% isobaric ropivacaine with 15 μg fentanyl has provided clinically effective surgical anesthesia for TURP, with rapid return of motor function and less hemodynamic alterations in comparison to 0.5% heavy bupivacaine with fentanyl. Early mobilization has accelerated the post-operative recovery.

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REFERENCES

1. Ul Hassan J, Zafar E, Ameer K, Akram M, Saleem MA and Sami A. Comparison of low dose ropivacaine plus dexmedetomidine vs. bupivacaine for spinal anesthesia in transurethral resection of prostate. Anaesth Pain Intensive Care. 2023;27(5):535-538. https://doi.org/10.35975/apic.v27i5.2309
2. Shahid N, Iqbal MW, Haque SN, Rashid AM and Shaukat S. Effectiveness of saddle block vs spinal anaesthesia in turp: An open label randomized control trial. J Ayub Med Coll Abbottabad. 2023;35(1):127-132. https://doi.org/10.55519/JAMC-01-11451
3. Agrawal MS and Mishra DK. Transurethral resection of prostate. J Endourol. 2022;36(S2):S29-S34. https://doi.org/10.1089/end.2022.0305
4. Shashikala TK, Sagar SS, Ramaliswamy P and Hudgi VV. Comparing effects of intrathecal adjuvants fentanyl and dexmedetomidine with hyperbaric ropivacaine in patients undergoing elective infraumbilical surgeries: A prospective, double-blind, clinical study. Anesth Essays Res. 2019;13(4):654-662. https://doi.org/10.4103/aer.AER_183_18
5. Sethi D. Randomised control trial comparing plain levobupivacaine and ropivacaine with hyperbaric bupivacaine in caesarean deliveries. Turk J Anaesthesiol Reanim. 2019;47(6):471-479. https://doi.org/10.5152/TJAR.2019.50465
6. Nguyen QT, Hoa NH and Chinh NV. Comparison of intrathecal ropivacaine-fentanyl and bupivacaine-fentanyl in transurethral resection of the prostate of the benign prostatic hyperplasia surgeries. J Anesthesiol Clin Sci. 2021;10(2):54-59. https://doi.org/10.7243/2049-9752-10-1
7. Koo CH and Ryu JH. Anesthetic considerations for urologic surgeries. Korean J Anesthesiol. 2020;73(2):92-102. https://doi.org/10.4097/kja.19437
8. Wang WB, Sun AJ, Yu HP, Dong JC and Xu H. Dural sac cross-sectional area is a highly effective parameter for spinal anesthesia in geriatric patients undergoing transurethral resection of the prostate: A prospective, double blinded, randomized study. BMC Anesthesiol. 2020;20(1):139. https://doi.org/10.1186/s12871-020-01059-x
9. Erturk E, Tutuncu C, Eroglu A and Gokben M. Clinical comparison of 12 mg ropivacaine and 8 mg bupivacaine, both with 20 μg fentanyl, in spinal anesthesia for major orthopedic surgery in geriatric patients. Med Princ Pract. 2010;19(2):142-147. https://doi.org/10.1159/000249581
10. Whiteside JB, Burke D and Wildsmith JA. Comparison of ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia for elective surgery. Br J Anaesth. 2003;90(3):304-308. https://doi.org/10.1093/bja/aeg077
11. Patil P, Dhulkhed PV and Dhulkhed VK. Isobaric forms of ropivacaine vs. Bupivacaine in lower abdominal surgeries: A hospital-based, prospective, comparative study. Med Gas Res. 2023;13(3):123-127. https://doi.org/10.10.4103/2045-9912.359678
12. Kulkarni KR, Deshpande S, Namazi I, Singh SK and Kondilya K. A comparative evaluation of hyperbaric ropivacaine versus hyperbaric bupivacaine for elective surgery under spinal anesthesia. J Anaesthesiol Clin Pharmacol. 2014;30(2):238-242. https://doi.org/10.4103/0970-9185.130031
13. Olapour A, Akhondzadeh R, Rashidi M, Gousheh M and Homayoon R. Comparing the effect of bupivacaine and ropivacaine in cesarean delivery with spinal anaesthesia. Anesth Pain Med. 2020;10(1):e94155. https://doi.org/10.5812/aapm.94155
14. Luck JF, Fettes PD and Wildsmith JA. Spinal anaesthesia for elective surgery: A comparison of hyperbaric solutions of

racemic bupivacaine, levobupivacaine, and ropivacaine. Br J Anaesth. 2008;101(5):705-710.

https://doi.org/10.1093/bja/aen250

15. Lee YY, Ngan Kee WD, Chang HK, So CL and Gin T. Spinal ropivacaine for lower limb surgery: A dose response study. Anesth Analg. 2007;105(2):520-523.

https://doi.org/10.1213/01.ane.0000267523.66285.57

16. Suljević I, Šurković I, Turan M, Bajraktarević A, Mušija E and Suljević O. Clinical effects of hyperbaric lidocaine and bupivacaine in spinal anesthesia - our experience. Acta Clin Croat. 2022;61(Suppl 2):22-27.

https://doi.org/10.20471/acc.2022.61.s2.03

17. Koo CH, Shin HJ, Han SH and Ryu JH. Lidocaine vs. Other local anesthetics in the development of transient neurologic symptoms (TNS) following spinal anesthesia: A meta-analysis of randomized controlled trials. J Clin Med. 2020;9(2):493.

https://doi.org/10.3390/jcm9020493

18. Gupta K, Singhal AB, Gupta PK, Sharma D, Pandey MN and Singh I. Ropivacaine: Anesthetic consideration in elderly patients for transurethral resection of prostrate a clinical trial. Anesth Essays Res. 2013;7(2):178-182.

https://doi.org/10.4103/0259-1162.118950

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