ORIGINAL ARTICLE

Comparative study of analgesic efficacy of ropivacaine with ropivacaine plus dexmedetomidine for paravertebral block in unilateral renal surgery

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ABSTRACT

Aim: To compare the efficacy of paravertebral block with ropivacaine or ropivacaine plus dexmedetomidine for relief of post operative pain in patients undergoing unilateral renal surgeries.

Methodology: Sixty adult patients of ASA I & II, undergoing unilateral renal surgery, were included in this prospective, randomized study. After placing the catheter in T12–L1 paravertebral space, block was randomly activated either by 18 ml of ropivacaine 0.25% (Group I) or by 18 ml of ropivacaine 0.25% plus 1μg/kg dexmedetomedine (Group II). General anaesthesia was instituted in all patients using a standardised technique. After recovery from GA, pain was assessed by VAS. The patients were administered first top up dose through paravertebral route as soon as VAS score exceeded 3 and time was noted duration of analgesia. Total requirement of ropivacaine in 24 hours was also noted.

Result: Mean duration of analgesia was longer in Group II (324.4$\pm$56.35 min) as compared to Group I (149.2 $\pm$30.64 min) ($p < 0.05$). Mean total consumption of ropivacaine was 84$\pm$14.12 mg in Group II and 120$\pm$15.26 mg in Group I ($p < 0.05$).

Conclusion: Addition of dexmedetomidine to local anaesthetic agent ropivacaine significantly prolongs the duration of analgesia in paravertebral blocks.

Key Words: Paravetebral block; Ropivacaine; Dexmedetomidine; Renal surgery; Postoperative pain

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INTRODUCTION

Surgical pain is a universal phenomenon affecting all patients in the intraoperative and postoperative period. Apart from an agonizing sensory experience associated with it, acute pain has several deleterious effects on the physique and the psyche of the sufferer[1]. An anticipation of these effects combined with a humanitarian urge to relieve pain, play a pivotal role in provision and optimization of postoperative analgesia.

Patients undergoing renal surgeries often suffer from impaired renal function; which dictates judicious use of systematic analgesics in these patients. Therefore, regional nerve blocks can be a good alternative or used as a useful adjunctive in such patients. Paravertebral nerve blockade by injecting local anaesthetic solution alongside the vertebral column produces ipsilateral analgesia, and has been advocated mainly in unilateral surgeries like thoracotomy, chest wall surgery, breast surgery and renal surgery.[2]

In this study, we compared post operative analgesia after paravertebral nerve block by ropivacaine 0.25% alone with ropivacaine 0.25% plus dexmedetomidine in patients undergoing renal surgery. Total requirement of ropivacaine in first 24 hours was also compared between two groups.

METHODOLOGY

This prospective, randomized, controlled, parallel group, study was carried out at urology operating rooms of IPGME&R Kolkata. After obtaining clearance from hospital ethical committee, and informed consent from patients, study was carried out in 60 adult patients of ASA physical status I and II, aged between 30-60 years, scheduled for open unilateral renal surgeries e.g. nephrectomy, pyeloplasty, and pyelolithotomy.

Sample size calculation: A pilot study involving 20 patients (10 patients in each group) was performed to determine the standard deviation in the mean duration of effective analgesia. It was found that to detect the difference of 4 hours in the duration of effective analgesia between the two groups with a standard deviation of 4 hours, 23 subjects will be required per group, in order to detect this difference with 90%power and 5% probability of type I error. Rounding of 30 subjects was taken in each group.

Unwilling patients, patients with systemic infection, sepsis, and coagulation disorders and haemodynamically unstable one's were excluded from the study.

Table 1: Demographic profile

Parameter	Group I	Group II
Number of Patients	29	29
ASA Grade I/II	11/18	14/15
Male:Female	18:11	16:13
Age in Years (mean±SD)	41.13±11.2	36.55±12.9

Patients were randomly allocated in two groups, group I and II of 30 patients each. Randomization was done by the statistical software "Microsoft Excel XPTM (2003)".

After transferring the patients into the operating room, standard monitors (five lead ECG, SpO2, automated non-invasive arterial pressure by oscillometry) were attached and baseline parameters were noted down. Intravenous cannulation was done and infusion of lactated Ringer was started at a rate of 2 ml/kg/h. On the proposed side of operation, in sitting posture, under strict aseptic precautions and after infiltration with local anaesthetic, 2.5 cm lateral to the tip of spinous process of L1 vertebra, Tuohy needle was advanced perpendicular to the skin in all planes to contact the transverse process of the vertebra, typically at a depth of 2 to 4 cm. After the transverse process was identified, the needle was redirected cephalad and gradually advanced until loss

Table 2: Comparison of haemodynamic parameters between the group

Time Point	SBP		DBP		PR	
	Group I	Group II	Group I	Group II	Group I	Group II
Baseline	128.2069	129.0690	72.6207	70.0345	**72.6207**	**70.0345***
At skin incision	**136.0714**	**124.8148***	73.04	70.2500	**94.0741**	**72.1071***
Immediate Post-op	118.1379	120.0714	70.17	70.2500	71.75	71.79
1 Hr Post -op	118.6897	120.8571	71.4483	70.14	70.62	71.75
2 Hr Post -op	**123.9310**	**115.2143***	70.74	69.75	70.25	71.25
4 Hr Post -op	121.8621	119.2500	69.00	72.28	68.1724	70.71
8 Hr Post -op	121.4483	123.0000	71.8276	71.69	69.5172	70.57
16 Hr Post -op	125.8621	120.7241	68.6207	68.07	69.5862	68.86
24 Hr Post -op	123.1014	115.0690	72.34	70.09	69.24	66.07

** Figures with statistically significant difference*

of resistance was felt 1 to 1.5 cm distal to its superior edge. Through the needle a multiorifice 18G epidural catheter was placed 3 cm inside T12–L1 paravertebral space. After negative aspiration for blood, CSF and air, test dose of 2% lignocaine (3 ml) with 1:2,00,000 adrenaline was administered through the epidural catheter. Patients were put back to horizontal supine position and, block was activated either by 18 ml of 0.25% ropivacaine[3] (Group I) or by 18 ml of ropivacaine (0.25%) and 1μg/Kgdexmedetomidine[4,19](Group II). Patients were induced with injection propofol and endotracheal intubation was facilitated by injection rocuronium bromide, 90 μg/Kg body weight. Anaesthesia was maintained with O_2, N_2O and 1 MAC of Isoflurane.

Table 3: Comparison of postoperative VAS scores in two groups

Time	Group I	Group II	p value
Immediate Postop Period	1.45	2.03	0.7374
After 1 hour	4.75	2.96	.0000
After 2 hour	2.55	3.82	.0324
After 4 hour	5.03	2.67	.0004
After 8 hour	5.34	3.24	.0001
After 16 hour	4.79	3.0	.0000

Patients were observed for haemodynamic response to skin incision. If the change in pulse rate or blood pressure was more than 20% of the baseline value, the patient was excluded from the study and intravenous fentanyl citrate (2 μg/Kg) was administered. At the end of surgery residual neuromuscular blockade was reversed with 50 µg/Kg neostigmine with 10 µg/Kg glycopyrrolate.

In PACU, patients were assessed for severity of pain using VAS. When VAS score exceeded 3, the time was noted and top up doses of 0.25% ropivacaine (6ml) (Group I) or ropivacaine (6ml) and dexmedetomidine (0.25 μg/Kg) (Group II) were administered. Total requirement of ropivacaine in the first 24 hrs was noted in both the groups.

Statistical analysis: Statistica version 6 [Tulsa, Oklahoma: StatSoft Inc., 2001] and MedCalc version 11.6 [Mariakerke, Belgium: MedCalc Software 11.6] was used to analyse the data. Comparison of numerical variables between the groups was done by Student's unpaired t test and Mann-Whitney U test was used to analyse the numerical variable. Comparison of categorical variables between groups was done by Fischer's exact test. Repeated measures ANOVA with post-hoc Tukey's test used for change of haemodynamics within groups and Friedman's ANOVA with post-hoc Dunn's test used to see the changes of VAS over time.

Results: One patient in group I had failure of paravertebral block, another patient had vascular puncture during the procedure in group II. Both the patients were excluded from the study and final tabulation was done on 29 patients in each group. There was no statistically significant difference among all four groups in terms of demographic data ($p > 0.05$) (Table I).

Table 4: Comparison of duration of analgesia and total ropivacaine consumption in 24 hours

Parameter	Group I (mean±SD)	Group II (mean±SD)	P value
Duration of analgesia (minutes)	149.21±30.64	324.48±56.35	< 0.0001
Ropivacaine consumption in 24hrs	120.52±15.26	84.31±14.12	

Table 2 compares the haemodynamics changes between the groups at various time points. The baseline systolic and diastolic blood pressures and the pulse rates were comparable ($p > 0.05$) between Group I and II and showed no significant differences. Mean SBP (baseline) in group I was 128.21 mm Hg and in group II 130.07 mm Hg and mean pulse rate (baseline) in Group I was 76 bpm and in Group II 80 bpm. The change in systolic blood pressure and pulse rate at the time of skin incision was significantly less in dexmedetomidine group i.e Group II ($P < 0.02$) where as diastolic blood pressure was comparable. The readings again became comparable in the immediate postoperative period, 1st, 4th, 8th, 16th and 24th hours postoperatively in both the groups ($p > 0.05$). However significant fall in SBP was observed at 2nd hour of postoperative period.

Intra group comparison of haemodynamics showed no significant difference across time in group I. In Group II Systolic blood pressure (mean difference of SBP at reversal and after 1 hour was -13.036 with a confidence interval -23.807 to -2.265, P value < 0.0069) and pulse rate (mean difference of PR at reversal and after 1 hour -9.286, P value < 0.0126) decreased significantly across time whereas DBP did not.

VAS were comparable in the immediate post operative period but after that it became significantly higher VAS in Group I on all the post operative recordings also in

the group significant change occurred across time.

A statistically significant ($p < 0.05$) increase in the mean and maximum duration of analgesia was found in Group II [324 and 480 min] in comparison to Group I [149 and 210 min] (Table 4).

Requirement of ropivacaine in the first 24 hours of post operative period was significantly less in Group II (84 mg) as compared to Group I (105 mg) (P value 0.001) as shown in Table 4.

DISCUSSION

α_2 adrenoceptor agonists are now being used with great interest in anaesthesia practice for their sympatholytic, sedative, analgesic, and anaesthetic-sparing effects.[5,6] Clonidine has been used extensively for this purpose. Dexmedetomidine is a more selective α_2 agonist with a greater selectivity for the α_2 receptors than the α_1 receptors[7]. It was introduced in clinical practice in the United States in 1999 and approved by the FDA only as a short-term (<24 hours) sedative[8,9] Dexmedetomidine is shorter acting drug than clonidine and has a reversal drug, Atipamezole, for its sedative effect.

The analgesic action of intrathecal or epidural clonidine was first demonstrated clinically in 1984. Dexmedetomidine has also been reported to enhance central and peripheral neural blockades by local anesthetics[7,10,11].

At the spinal cord level, stimulation of alpha$_2$ receptors at the substantia gelatinosa of the dorsal horn leads to inhibition of the firing of nociceptive neurons and inhibition of the release of substance P.[12] Alpha2-adrenoceptors located at the nerve endings have a possible role in the analgesic mechanisms by preventing Norepinephrine release. The spinal mechanism is the principal mechanism for the analgesic action of dexmedetomidine even though there is a clear evidence for both a supraspinal and peripheral sites of action.[13]

Paula F SalQado et al[14] found a clear synergism between epidural dexmedetomidine and ropivacaine. Dexmedetomidine increases sensory and motor block duration during epidural anaesthesia with ropivacaine, prolongs postoperative analgesia and does not cause hemodynamic instability. [14-16] But the literature related to paravertebral block for post operative analgesia with ropivacaine and dexmedetomidine is silent.

Paravertebral nerve blockade produces reliable level of analgesia and without additional nursing skills or monitoring in the postoperative period.[17] Side effects of this procedure are hypotension, vascular puncture, pleural puncture, and pneumothorax, which can easily be detected and managed by closed monitoring. It provides high quality analgesia with very little cost in terms of side effects and complications.It has been used successfully for analgesia after thoracotomy, rib fractures and breast surgeries. But there are not many reported cases of its use in renal surgery. So in our study we evaluated the effectiveness of paravertebral blockade for this particular set of patients, and tried to find out whether dexmedetomidine prolongs the duration of ropivacaine in paravertebral block.

In our study, we found that dexmedetomidine enhanced the local anesthetic action of ropivacaine when administered in paravertebral space. Aliye Esmaoglu et al[18] studied the effect of addition of dexmedetomidine to levobupivacaine in axillary brachial plexus block and they found shortening of onset of time of levobupivacaine and prolongation of duration of block and post operative analgesia. A.M El-Hennawy et al[4]in a study in 2009 used dexmedetomedine 2 μg/Kg through caudal route. Bajwa et al [19] used 1.5 μg/kg of dexmedetomedine in epidural route. Based on these observations, we administered 1 μg/Kg of dexmeditomedine initially, to be followed by top up dosage of 12.5 μg, along with ropivacaine as an adjuvant.

Dexmedetomidine causes bradycardia, so the pulse rate in patients of dexmedetomidine group decreased significantly over time but inter group variation was not significant. Also SBP in dexmedetomidine group decreased significantly over time but DBP did not. However, clinically,there was no significant haemodynamic instability and none of the patients required any active intervention.Paula F Salgado et al[20] reported that when dexmedetomidine was added to ropivacaine for epidural anaesthesia, it prolonged postoperative analgesia without significant haemodynamic instability. The total requirement of ropivacaine in first 24 hours decreased significantly in the dexmedetomidine group. This is of utmost importance in patients with a compromised renal status. Ropivacaine is mainly metabolized by liver, but metabolites are excreted by kidney. So the use of a low dose is beneficial in a nephrectomised patient who is single kidney dependent.

CONCLUSION

Paravertebral administration of ropivacaine along with Dexmedetomidine provides prolonged post operative analgesia without causing significant haemodynamic

instability. Also co administration of dexmedetomidine leads to decreased total consumption of ropivacaine which is very beneficial for renal compromised patients.

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