Original Article

Comparison of peritubal infiltration and single level T10 paravertebral block in percutaneous nephrolithotomy (PCNL)

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Abstract

Background and Aims: In percutaneous nephrolithotomy (PCNL), distension of renal capsule, pelvicalyceal system and nephrostomy tube causes intense postoperative pain. The present study was done to compare the efficacy of peritubal infiltration of Ropivacaine with Dexmedetomidine and ultrasound guided single level T10 paravertebral block for post-operative analgesia in patients undergoing PCNL.

Material and Methods: A prospective, double blind study was conducted on 60 American Society of Anesthesiologists (ASA) I and II patients of either gender between 18-65 years undergoing PCNL who were randomized into 3 groups. Group PV [$n = 20$] received paravertebral block at T 10 level with 20 ml of 0.25% Ropivacaine plus 0.25 mcg/kg Dexmedetomidine. Group PT [$n = 20$] received peritubal infiltration along nephrostomy tube with 20 ml of 0.25% Ropivacaine plus 0.25 mcg/kg Dexmedetomidine. Group C [$n = 20$] control group received intravenous Tramadol 1mg/kg. Postoperative pain scores, opioid consumption and side effects if any were recorded for 24 hrs. Statistical analysis was done using ANOVA test, Chi-square test. P value <0.05 was considered significant.

Results: Demographic data were comparable. Reduced dynamic VAS score was noted for first 8hrs in peritubal infiltration compared to paravertebral group. Dynamic VAS scores were significantly lower in paravertebral group at 8th, 12th and 24th hr as compared to peritubal infiltration ($P < 0.05$). During all time intervals peritubal infiltration and paravertebral group had significantly lower VAS scores as compared to control group. Opioid requirement was more in control group compared to study groups.

Conclusion: In PCNL, peritubal infiltration and single level paravertebral block produces effective postoperative analgesia without significant side effects.

Keywords: Paravertebral block, percutaneous nephrolithotomy, peritubal infiltration, post-operative analgesia

Introduction

Percutaneous nephrolithotomy (PCNL) is a minimally invasive endoscopic procedure for removal of renal calculi. Although minimally invasive, distension in renal capsule, pelvicalyceal system and the nephrostomy tube placed after surgery causes severe postoperative pain.[1] Severe post-operative pain can increase patient morbidity, delay mobilization and can increase duration of hospital stay. Multiple methods like non-steroidal anti-inflammatory drugs, opioids, neuraxial blocks are used to control postoperative pain in patients undergoing PCNL surgeries[2-5,1] and have several side effects. Infiltration of local anesthetic along the nephrostomy tube tract from the skin up to renal capsule in patient undergoing PCNL relieves initial severe postoperative pain.[6]

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Paravertebral block is a simple and effective technique used for various thoracic and abdominal procedures, provides unilateral somatosensory and sympathetic block. It can be injected at single level or multiple levels, provides effective analgesia with fewer systemic side effects (hypotension, nausea, vomiting) than an epidural block or opioids.[7-12] We hypothesized that peritubal infiltration and paravetebral block would relieve post-operative pain after PCNL. Multiple studies have been done on the analgesic efficacy of multi-level paravertebral block and peritubal infiltration at 12 'o' clock and 6 'o' clock position for PCNL surgeries. However, there are limited studies comparing analgesic efficacy of single level paravertebral block and peritubal infiltration at 4 quadrants (12, 6, 9 and 3 O clock positions). We undertook this study to assess the analgesic efficacy by comparison of VAS scores of single level T 10 paravertebral block and peritubal infiltration. Other objectives were to assess Tramadol requirement for the first 24hrs and comparison of haemodynamic parameters.

Material and Methods

A prospective randomized double blind comparative study was conducted after Institutional Ethical Committee approval, Clinical Trial Registry-India (CTRI) registration and informed written consent of the patients. The primary aim of the study was to assess the analgesic efficacy by comparison of VAS scores of single level paravertebral block and peritubal infiltration with ropivacaine and dexmedetomidine. Other objectives were to assess the Tramadol requirement for first 24hrs and comparison of haemodynamic parameters along with the safety profile of above techniques and the drugs used. Complications if any were documented and treated appropriately.

Sixty patients of either gender aged between 18-65 years with American Society of Anaesthesiologists (ASA) physical status I and II posted for unilateral PCNL surgeries under general anaesthesia were included in the study. Exclusion criteria included patients refusing to participate in the study, local anaesthetic allergy, coagulopathy, infection at the site of block, neurological deficits, uncontrolled hypertension, diabetes, cardio-respiratory disorders, neuro-psychiatric disorders, hepatic or renal dysfunction, pregnant or lactating mothers, alcoholic, allergic to study drug. Equipments, drugs for resuscitation and general anaesthesia were kept ready. Pre-anaesthetic evaluation was done and patients were explained about visual analogue scale (0 = no pain, 10 = maximum pain) used for pain assessment.

On arrival to the operation theatre intravenous line was secured. Patients were premedicated with intravenous Fentanyl 2 mcg/kg and Glycopyrolate 5 mcg/kg five minutes prior to induction and balanced general anaesthesia was given. Patient was positioned in prone position for surgery. Patients were randomly divided into three groups of 20 each using computer generated random numbers and group allocation was concealed by sealed opaque envelope method. Randomization was done by anaesthetist not involved in study. After completion of surgery prior to extubation regional block was performed by an experienced anaesthetist. Outcome measures after the block were observed by another independent anaesthesiologist. Patient and assessor of outcome measures were blinded to group allocation.

In prone position, site to be blocked was painted with 5% povidone iodine, isopropyl alcohol and draped. In group PV, linear high-frequency ultrasound probe (7–15 MHz) was placed lateral to the T 10 spinous process to identify the paravetebral space by visualizing ribs, transverse process, costotransverse ligament and pleura. Paravertebral block was given with 0.2% Ropivacaine 20mL plus 0.25 mcg/kg Dexmedetomidine as an adjuvant using 22G echogenic needle. The spread of the local anaesthetic was confirmed by anterior movement of the pleura in the paravertebral space. In group PT 22G echogenic needle was introduced under fluoroscopy guidance at 12 'o'clock, 3 'o'clock, 6 'o'clock, 9 'o'clock position and 20ml of 0.2% ropivacaine along with 0.25 mcg/kg Dexmedetomidine was injected as 5 ml at each quadrant along the nephrostomy tube up to the renal capsule. No intervention was performed in group C So1mg/kg Tramadol was given after completion of surgery pre-emptively to avoid any pain in group C.

Patient was turned to supine position, neuromuscular block was reversed with Neostigmine 0.05mg/kg and Glycopyrrolate 10mcg/kg, extubated after meeting the extubation criteria and shifted to post-anaesthesia care unit for monitoring of vital parameters. Post-operatively, visual analog scale (VAS) (0–10) was used for assessment of pain at rest and dynamic VAS (DVAS) (0–10) during coughing and deep breathing. VAS score was assessed at 0, 1, 2, 4, 8, 12 and 24thhr along with vital parameters. Intravenous Tramadol 1 mg/kg given when VAS or DVAS was ≥4, as a rescue analgesic. Total requirement of Tramadol for 1st 24hrs and any side effects were recorded. Ramsay Sedation score was used for assessment of sedation [1-completely awake to 6- asleep and no response to stimulus].

Statistical methods

Sample size of 20 patients in each group was needed to detect an intergroup difference of at least 20% difference in VAS scores with power analysis based on 95% confidence interval, beta error of 20%, alpha error 5%, power 80%.

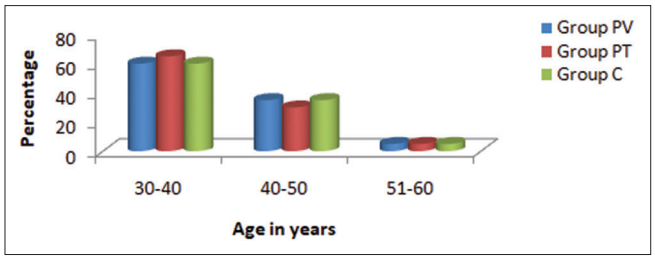

Figure 1: Comparison of age groups in all three groups

The statistical software namely SPSS 22.0, and R environment ver. 3.2.2 were used for the analysis of the data. Microsoft word and excel have been used to generate graphs, tables etc. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients. Post Hoc Tukey Test has been used to find the group wise significance. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. Non-parametric setting for Qualitative data analysis and Fisher Exact test was used when cell samples were very small. *P* value <0.05 considered as statistically significant and *P* value <0.001 as highly significant.

Results

Sixty patients were recruited and received intended treatment without any dropouts or exclusions. The demographic data of the groups, duration of surgery and anaesthesia was comparable in all 3 groups [Figures 1 and 2].

[Tables 1 and 2]. Pain scores (VAS) were analysed at rest and during coughing, deep breathing [dynamic VAS]. Reduced VAS scores were noted for the initial 8 hours (resting VAS), 4 hours (dynamic VAS) with peritubal infiltration group compared to paravertebral group subsequently VAS scores were significantly lower in group PV than group PT. Control group had higher VAS scores at all time intervals compared to group PV and group PT. This shows that pain relief was better with peritubal infiltration group in the initial 8 hours after which paravertebral group had better pain relief [Tables 3 and 4].

Postoperative Tramadol consumption was recorded at 0-4 hrs, 4-8th hr, and 8-24th hr ranges. Tramadol consumption was significantly lower in group PV compared to group C at all time intervals. Group PT had no significant difference in Tramadol consumption for initial 8 hours compared to group PV but significantly higher at 8-24hr compared to group PV. In control group, Tramadol consumption was higher at all time intervals compared to group PV and group PT [Table 5 and Figure 3].

We observed calm and cooperative patients in the study group compared to control group [Figure 4]. All three groups were haemodynamically [Figures 5 and 6] stable. Side effects like nausea, vomiting due to Tramadol was experienced by few patients which was treated with intravenous ondansetron [Table 6 and Figure 7]. No serious complications in all three groups.

Discussion

We observed that reduced VAS scores in group PT than group PV in VAS scores at rest for initial 8 hours and 4 hours for dynamic VAS after which VAS scores were significantly lower in group PV than group PT which implies that pain relief in the initial few hours was better with peritubal infiltration group but subsequently pain relief was better with paravertebral block group. Control group had higher VAS scores at all time intervals compared to group PV and group PT. Consumption of Tramadol for 1st 24hrs was significantly reduced in both the study groups compared to control group.

Percutaneous nephrolithotomy (PCNL) is a minimally invasive technique for removal of staghorn stones, stones which are more than 2 cm and multiple kidney stones, which has several advantages over open surgery. It improves the quality of life in the post-operative period and decreases the duration of hospital stay[13] as compared to open surgery.

Tissue trauma, distension in renal capsule and pelvicalyceal system, nephrostomy tube placed after surgery causes post-operative pain which is substantial. Several modalities like non-steroidal anti-inflammatory drugs, opioids, central neuraxial blocks, peripheral nerve blocks, adjunctive techniques like transcutaneous electrical nerve stimulation and physical therapy have been used to relieve this pain; all techniques have some inherent disadvantages.

The effectiveness of paravertebral block for urological procedures have been demonstrated.[14-16] Previous studies have demonstrated paravertebral block by multi-level injections, blind/neurostimulatory technique and obtained reduced VAS scores and opioid consumption in the post-operative period. Recent studies showed a single local anesthetic injection of 15–20 ml or 0.3 ml/kg led to a unilateral blockade including four or five thoracic dermatomes.[17,18] This led us to use a single level ultrasound guided lower thoracic (T10) paravertebral block.

Peritubal infiltration of local anaesthetics can inhibit inflammatory and local sensitizing responses by directly suppressing some phases of inflammation and inflammation

Table 1: Demographic Characteristics

Variables	Group PV	Group PT	Group C	Total
Age in years	39.85±5.65	40.05±5.52	39.60±5.47	39.83±5.46
Gender (Male/Female)	10/10	11/9	10/10	
Weight (kg)	52.70±3.16	53.10±4.20	52.05±3.85	52.62±3.72
Height (cm)	152.10±4.97	151.70±5.11	152.00±4.61	151.93±4.82

Table 2: Duration of Surgery and Anaesthesia (in minutes)

Variables	Group PV	Group PT	Group C	Total	*P*
Duration of Anesthesia	126.30±17.86	124.40±15.59	124.80±14.06	125.17±15.66	0.924
Duration of Surgery	98.15±19.35	102.65±18.41	98.70±17.71	99.83±18.30	0.705

Table 3: VAS Score at Rest

VAS at Rest	Group Wise Significance					
	Group PV	Group PT	Group C	Group PV vs Group PT	Group PV vs Group C	Group PT vs Group C
1 h	1.70±0.47	1.45±0.60	2.80±1.01	0.528	<0.001**	<0.001**
2 h	1.80±0.41	1.55±0.69	2.65±1.09	0.572	<0.001**	<0.001**
4 h	2.05±0.22	2.2±0.52	3.00±1.17	0.803	0.004*	0.001**
8 h	2.75±0.79	2.45±1.00	3.70±0.86	0.537	<0.001**	0.004*
12 h	2.25±0.44	2.85±0.81	5.75±0.64	0.014*	<0.001**	<0.001**
24 h	2.40±0.60	3.95±1.05	6.05±0.94	<0.001**	<0.001**	<0.001**

**Significant (P<0.05), **Highly significant (P<0.001)*

Table 4: Dynamic VAS

Dynamic VAS	Group Wise Significance					
	Group PV	Group PT	Group C	Group PV vs Group PT	Group PV vs Group C	Group PT vs Group C
1 h	1.80±0.41	1.55±0.69	4.15±1.09	0.572	<0.001**	<0.001**
2 h	2.35±0.75	2.15±0.88	3.80±1.11	0.772	<0.001**	<0.001**
4 h	2.70±0.57	2.60±0.99	4.25±1.65	0.960	<0.001**	<0.001**
8 h	3.15±1.31	4.50±1.36	6.55±1.15	0.004*	<0.001**	<0.001**
12 h	3.40±0.60	4.45±1.36	6.95±1.00	0.006*	<0.001**	<0.001**
24 h	2.90±0.79	5.70±1.72	7.30±0.86	<0.001**	<0.001**	<0.001**

**Significant (P<0.05), **Highly significant (P<0.001)*

Table 5: Tramadol Requirement (mg)

Tramadol Consumption	Group PV (*n*=20)	Group PT (*n*=20)	Group C (*n*=20)	Total (*n*=60)	*P*
0-4 h	63.33±10.41	55.00±8.66	56.25±7.76	56.92±8.13	0.352
4-8 h	63.33±10.41	58.13±8.89	56.25±7.76	57.42±8.25	0.381
8-24 h	75,00±38.19	105.25±28.90	138.00±34.65	112.33±40.12	<0.001**
Total 24 h	113.00±98.88	133.50±61.02	250.54±45.07	176.20±88.55	<0.001**

***Highly significant (P<0.001)*

Table 6: Tramadol Related Side Effects

Opioid related side effects	Group PV (*n*=20)	Group PT (*n*=20)	Group C (*n*=20)	Total (*n*=60)	*P*
Nausea	3 (15%)	8 (40%)	12 (60%)	23 (38.3%)	0.014*
Vomiting	1 (5%)	3 (15%)	4 (20%)	8 (13.3%)	0.505
Itching	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1.000
Constipation	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1.000
Urinary retention	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1.000
Additional analgesic	3 (15%)	4 (20%)	13 (65%)	20 (33.3%)	0.001**

**Significant (P<0.05), **Highly significant (P<0.001)*

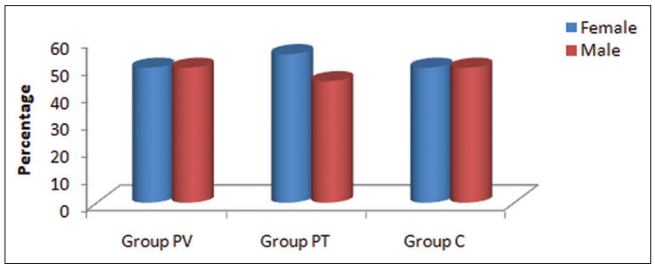

Figure 2: Gender distribution between the groups

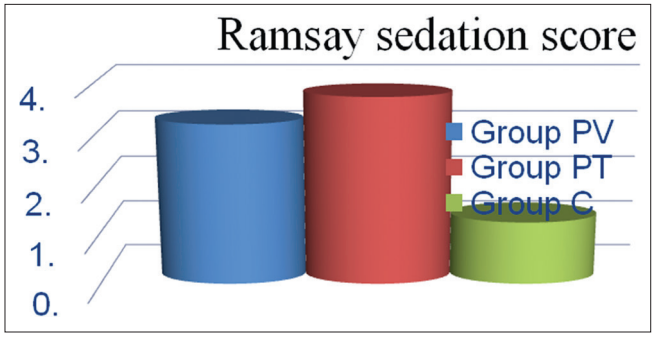

Figure 4: Comparison of sedation scores among the study groups

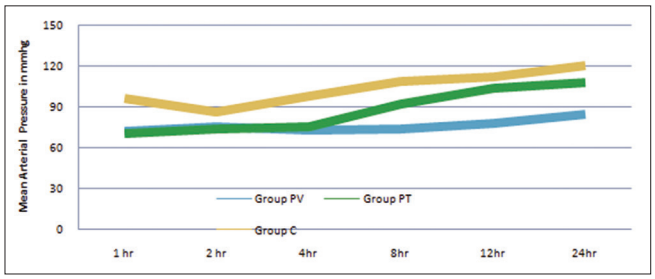

Figure 6: Comparison of Mean arterial pressure among the study groups

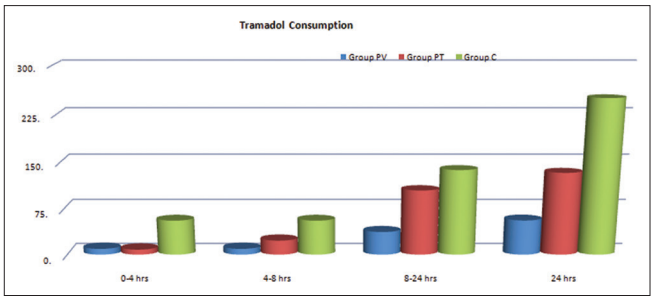

Figure 3: Comparison of tramadol consumption in all three groups

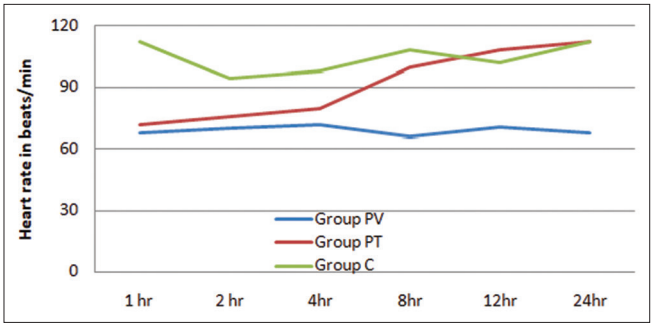

Figure 5: Comparison of heart rate among the study groups

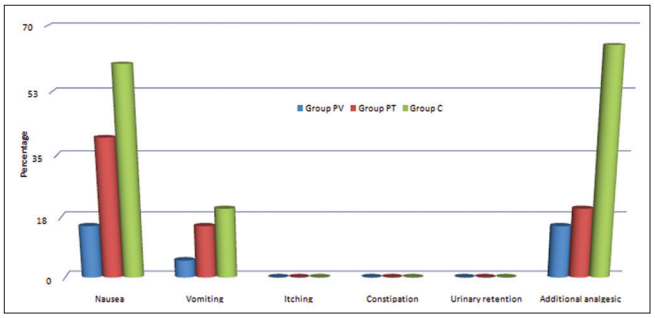

Figure 7: Comparison of opioid related side effects among the study groups

induced neuronal pathways. It is usually carried out with long acting local anesthetics or as an adjuvant[19,4,20] along with other modalities of analgesia. These studies demonstrated that peritubal infiltration reduced post-operative opioid usage and VAS scores and prolonged the first analgesic time.

In 2009, Jonnavithula *et al*. obtained reduced VAS scores and prolonged duration of analgesia by Bupivacaine infiltration beside the nephrostomy tube under fluoroscope guidance. In our study, Ropivacaine was chosen due to better pharmacological profile than Bupivacaine.[21]

In 2019, Soni *et al*. conducted a study using Fentanyl and Dexmedetomidine as an adjuvant to Ropivacaine for peritubal infiltration in PCNL surgeries and concluded that Dexmedetomidine significantly prolonged the duration of analgesia compared to fentanyl. Hence in our study Dexmedetomidine, an alpha 2 adrenergic agonist was used as an adjuvant with Ropivacaine to prolong the duration of analgesia.[22]

In 2018, Yayik *et al.*[10] conducted USG guided lower thoracic paravertebral block using 20 ml of 0.25% Bupivacaine in PCNL surgeries comparing with peritubal infiltration and control group and observed that there was no statistical significant difference in VAS scores at rest between group PV and group PT. 1st and 2nd hour dynamic VAS scores were lower in group PV than group PT.

One of the limitations of our study was no sensory testing was performed to detect the dermatomal distribution of the block.

Conclusion

Peritubal infiltration in PCNL surgeries is easy to administer and it achieves effective analgesia, especially in the early postoperative period. Paravertebral block achieved more effective analgesia compared to peritubal infiltration group in later part of post-operative period.

Future scope

Further studies are required to ratify widespread use of combination of peritubal infiltration and ultrasound guided paravertebral block for achieving early and prolonged effective post-operative analgesia in patients undergoing PCNL surgeries.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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