Safety and Efficacy of Spinal Anaesthesia in Percutaneous Nephrolithotomy

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ABSTRACT

Introduction: Renal stone is one of the common entities occurring in our population. There are different treatment modalities of stones; out of those percutaneous nephrolithotomy is one of the most popular and effective for the renal and upper tract stones. This study is based to compare the safety and efficacy of spinal anaesthesia and general anaesthesia in PCNL.

Methods: In a randomized prospective study 60 patients were divided in two groups; group 1 (n=30) underwent PCNL in general anaesthesia and group 2 (n=30) underwent PCNL in spinal anaesthesia in prone position with the conventional technique. Demographic, operative data, post operative complications, patients' satisfaction rate and follow up complications were recorded and analyzed between two groups.

Results: Mean age in group 1 was 39.10±12.45years and 36.10±14.18 in group 2 (P=0.100). Mean stone size in group 1 was 3.75±1.27cm and 3.23±1.36cm in group 2 (P=0.129).Similarly the operative time was 89.10 ± 49.38 min and 62.53±35.91 min in group 1 and group 2 respectively (P=0.042). There was no significant difference between the complications regarding the anaesthesia. Post operative nausea and vomiting were significantly higher in group 1 and headache in group 2 (p=<0.001). Overall patient satisfaction rate was higher in group 2 then in group 1 (p=0.01). Hospital stay in group 1 was 5.27±1.87 days and 4.53±1.88 days in group 2 (p = 0.07). Stone success rate was similar in each group (p =0.50).

Conclusions: Spinal anaesthesia is a safe and effective method in performing PCNL.

Keywords: *general anaesthesia; percutaneous nephrolithotomy; spinal anaesthesia.*

INTRODUCTION

Nowadays percutaneous nephrolithotomy (PCNL) is considered to be the gold standard treatment for renal calculi considering the size of the stone is bigger or equal to 2cm.[1] PCNL can be performed under spinal (SA), epidural (EA) or general anesthesia (GA).[2,3]

From urological perspective, the particular advantages of GA in PCNL procedure include its feasibility to control tidal volume, secure patient airway especially in prone position, and extensibility of anesthesia time.[3,4] The feasibility to control tidal volume minimizes renal mobility secondary to respiration while extensibility of anesthesia time allow surgeon to create multiple punctures with subsequent increased efficacy of the

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procedure especially in cases with large stone burden. Moreover, GA is more comfortable for the patients and the ability to carry out prolonged operation in prone position without limitation of airway is another advantage.[4,5] On the other hand, SA has some advantage over GA, such as lower postoperative pain, lower consumption of analgesic drugs and avoidance of side effects from multiple medications used in GA.[6] It is also clear that PCNL in SA is cost effective than GA.

A limited number of prospective randomized trials have been carried out to establish which one of these procedures is better in decreasing peri-operative complications.[6,7] Therefore impact of anesthesia type on efficacy of PCNL is still unclear. The aim of this study was to compare the efficacy and safety of GA versus SA in patients undergoing PCNL.

METHODS

This is a hospital based randomized control study conducted at College of medical sciences (COMS) from February 2015 to April 2016. The ethical approval was taken from the Institutional Review Board of COMS. All the cases subjected to PCNL during the study period were included in the study meeting the inclusion criteria-(1) ASA grade of I and II (2) Either sex between 20 to 80 years (3) documented sterile urine (4) patients requiring not more than two tracts (5) renal stones more than 2 cm (6) stones more than 1 cm in the lower calyx (7) stones less than 1 cm resistant to extracorporeal shock wave (8) patients not opting for extracorporeal shock wave lithotripsy were included in the study.

Patients with the features of urosepsis, coagulopathy, renal anomalies (horseshoe kidney, ectopic kidney), ASA grade more than three and person not willing to enroll in the study were excluded from the study. Similarly the patient with the local skin infection, patient who cannot sit, kyphoscoliosis, allergy to bupivacacine and fentanyl, coagulation disorders and raised intracranial pressure were also excluded from the study. Also the patient where the spinal anaesthesia was converted in general anaesthesia was also excluded from this study.

Randomization was carried out by restricted block method with allocation ratio of 1:1. The block size comprises of ten participants of every ten consecutively enrolled participants. The patients were asked to open the sealed envelope at the operating theater at the time of surgery. The day before surgery, the study protocol of spinal and general anesthesia procedures were explained to each patient. All patients received 10 mg diazepam orally at the night of surgery. All patients received intravenous 3rd generation cephalosporin, 2 h before surgery and for next 1 day thereafter.

All patients underwent pre-operative evaluation which include a detailed history, physical examination, urine analysis, urine culture and sensitivity, complete blood count, serum creatinine, sodium and potassium, random blood sugar, bleeding time, clotting time, prothrombin time, international normalize ratio (INR), chest X-ray (PA view) and electrocardiography (ECG). For the evaluation of stones preliminary ultrasonography followed by intravenous urography or contrast / non contrast CT pyelogram were carried.

Intervention: In treatment group, i.e., patient receiving spinal anaesthesia, were preloaded with 10 ml/kg of intravenous fluid. Under aseptic precautions 25 gauge spinal needle was inserted at L3-L4 space and after the confirmation of free flow of cerebrospinal fluid 3 ml of 0.5% bupivacaine along with 0.5 ml fentanyl (25 mcg) was injected. After confirmation of sensory level at T6 patients were positioned in prone position. Spinal blockade induced hypotension and bradycardia were managed appropriately with intravenous fluid bolus, injection mephenteramine and injection atropine. Intraoperative pain or discomfort was managed with inj. Ketamine 1 mg/kg intravenous bolus and top up dose of 0.5 mg/kg was used when required. Patients who had severe pain and discomfort were repositioned supine and were managed with general anaesthesia.

In control group, i.e., patient receiving general anaesthesia were pre-oxygenated with 100% oxygen for 3-5 minutes and induced with inj. midazolam 40 mcg/kg, inj. fentanyl 2 mcg/kg, inj. propofol 2 mg/kg and inj. vecuronium 0.1 mg/kg. Three minutes after injection of vecuronium patients underwent laryngoscopy and intubation with appropriate sized tube. Anaesthesia was maintained with isoflurane along with intravenous infusion of fentanyl 1 mcg/kg/hr and vecuronium 0.01 mg/kg/hr, which were titrated according to requirement to blunt sympathetic response during the procedure. Neuromuscular block was antagonized with neostigmine 0.05 mg/kg and glycopyrrolate 0.2 mg/mg of neostigmine at the end of surgery.In both the groups, patients were monitored continuously and non invasive blood pressure, heart rate and oxygen saturation (SPO2) were recorded every 5 minutes.

PCNL procedure: After anaesthesia the patients were kept in modified lithotomy position, a 5-6 Frenchopen tip ureteric catheter was inserted in the desired ureter up to the level of pelvis by using 19-ch. cystoscope. Then the patient was catheterized with 14/16thfrench Foleys catheter and the patient was positioned in prone position with well padded cushion at the pressure site. Under fluoroscopy guided, renal punctures were created at time of surgery in all patients in seldinger method by serial dilators up to 26 to 30 french. A 26 french nephroscope was used to visualize the stones and

pneumatic lithotripter was used to pulverize the stones. The stones were extracted with the forceps. Injection normal saline was used for irrigation throughout the operation. At the completion of the procedure a 6 french double J stent was stented antegradly with or without a nephrostomy tube. All the surgeries were performed by a single urologist. The patients were shifted to the recovery room and then to ward.

Measurable outcome: Pre-operative parameters included patients' demographics, ASA status, stone size, laterality, stone number, costal approach, calyceal puncture, number of drain, operative time, hospital stay, co-morbidity, post operative blood transfusion, pre and post operative haemoglobin, post operative complications, nephrostomy leakage, hematuria, status of the contralateral kidney, post operative nausea and vomiting, headache, over all patients' satisfaction, removal of foley's catheter, previous renal surgery, stone free rate, stone success rate, reoperation and follow-up complications.

Intra-operative parameters included recording of pulse, blood pressure at basal level and every 15 min till the end of procedure. Hypotension was defined when systolic blood pressure was <90 mm Hg. Bradycardia was defined when pulse <60 beat/min. Any conversion from spinal to general anesthesia was documented and the patient was excluded from the study. Operative time was calculated starting from onset of cystoscopic fixation of ureteric catheter till end of PCNL. After patients were transferred to post-anesthesia care unit, meticulous recording of vital parameters continued every 15 min. Adverse effects including pain, nausea, vomiting, shivering or pruritus were recorded up to 24 h postoperatively. Intraveinous tramadol 50–100 mg was given to control the pain. If the pain was not control by tramadol then inj. Pethidine was topped over. At the end of the study period, Satisfaction Visual Analog Scale system was used to evaluate patients satisfaction whether they were highly satisfied, satisfied or not satisfied.

Early hospital discharge was defined as when the patient was discharged on the 3rd or less post operative day.

Statistical analysis: Data were analyzed using the SPSS software version 20 (the statistical package for the social sciences, Chicago, Illinois, USA). All quantitative data were measure in as mean ± SD and qualitative data in number (%). For comparing the categorical variables chi-square test was applied. To test the normality; Kolmogorov-Smirnov test was applied and p value less than 0.05 was considered as significant where Mann-Whitney-U test was applied. For all tests, statistical significance was considered when $p< 0.05$.

RESULTS

Total of 60 patients, were included in the study. Thirty patients received general anaesthesia in control group and 30 patients receivedspinal anesthesia in treatment group. Mean age ±SD at the time of presentation was 39.13±12.45 years in GA group VS 36.10±14.18 years in SA group. Mean stone burden was similar between both groups. No significant difference was found between both groups regarding patients' demographics characteristics (Table 1).

Table 1. Patients' profile.

Sex		GA (n=30)	SA (n=30)	P value
	Male	19 (63.3%)	13 (43.3%)	0.190
	Female	11 (36.7%)	17 (56.7%)	
Age (yrs)		39.13±12.45	36.10±14.18	0.100

Table 2. Stone characteristics and approach.

Side		GA (n=30)	SA (n=30)	P-value
	Right	15 (50%)	16 (53.3%)	0.833
	Left	13 (43.3%)	13 (43.3%)	
	Bilateral	2 (6.7%)	1 (3.3%)	
Stone Size(cm)				
	< 2	3 (10%)	7 (23.3%)	0.299
	≥ 2	27 (90%)	23 (76.7%)	
Mean stone size		3.75±1.27cm	3.23±1.36cm	0.129
Stone Number				
one stone		8 (26.7%)	20 (66.7%)	0.006
two stones		8 (26.7%)	5 (16.7%)	
multiple stones		14 (46.7%)	5 (16.7%)	
Costal approach				
Infracostal		18 (60%)	26 (86.66%)	0.065
Supracostal		9 (30%)	3 (10%)	
	Both	3 (10%)	1 (3.33%)	
Calyceal Puncture				
	L	2 (6.7%)	8 (26.7%)	0.060
	M	22 (73.3%)	20 (66.7%)	
	ML	3 (10%)	1 (3.3%)	
	SM	3 (10%)	0	
	SML	0	1 (3.3%)	

L = Lower; M = middle; S = superior:

The stone mean size in group 1 and group 2 was 3.75 ± 1.27cm and 3.23 ± 1.36cm respectively with no significant p difference. A few number of cases were operated less than 2cm which were lower calyceal stones or patient opted themselves for the operation. With a significant value most of the multiples stones were operated under GA. Stones were approached mostly by middle calyceal and a few of them bilaterally with no significant p value. Most of them had a single tract as shown in the table 2.

In GA 13 (43.3%) and in SA 19 (65.3%) were done as a tubeless PCNL with no significant p-value. The mean operative time was 89.10 ± 49.38 min and 62.53 ± 35.91 min in group 1 and group 2 with a significant p-value. In group 1, 5 (16.7%) and 14 (46.7%) of cases were discharged less than 3rd post operative days which in our set up is considered as a early discharge with no significant p-value as shown in table no. 3.

Table 3. Tube versus tubeless, operative time and hospital stay.

Nephrostomy drain	GA (n = 30)	SA (n = 30)	P value
Tubeless	13 (43.3%)	19 (63.3%)	0.121
Tubed	17 (56.7%)	11 (36.7%)	
Operative time (min)			
	89.10 ± 49.38	62.53 ± 35.91	0.042
Hospital stay (days)			
	5.27 ± 1.87	4.53 ± 1.88	0.071
≤ POD 3	5 (16.7%)	14 (46.7%)	0.012
≥ POD 4	25 (83.3%)	16 (53.3%)	

POD = post operative days:

The patient's co-morbidity, post operative blood transfusion, pre and post operative haemoglobin, complications, nephrostomy leakage, hematuria, status of Contralateral kidney, removal of Foley's catheter in consecutive days and previous renal surgery are shown in table no. 4 with no significant p-value. The post operative nausea and vomiting were more common in GA group and the headache was common in SA group with a significant p-value. Similarly the patients' were more satisfied in SA than GA group.

Table 4. Co-morbidity, blood transfusion, haemoglobin changes, post operative complications, nephrostomy leakage, post operative hematuria, and status of contralateral kidney.

Co-morbidity	GA (n = 30)	SA (n = 30)	P value
Present	5 (16.7%)	4 (13.3%)	1.000
Absent	25 (83.3%)	26 (86.7%)	
none	25 (83.3%)	26 (86.7%)	
DM	1 (3.3%)	-	
HTN	3 (10%)	4 (13.3%)	
COPD	1 (3.3%)	-	
Post-op BT			
No BT	25 (83.3%)	27 (90%)	0.706
BT	5 (16.7%)	3 (10%)	
no BT	25 (83.3%)	27 (90%)	0.737
one pint	2 (6.7%)	1 (3.3%)	
two pint	3 (10%)	2 (6.7%)	
Pre operative haemoglobin(gm%)			
	12.53 ± 1.59	12.69 ± 1.72	0.704
Post operative haemoglobin (gm%)			
	11.48 ± 1.98	11.84 ± 1.85	0.500
Post-operative Complications			
Absent	25 (83.3%)	26 (86.7%)	1.000
Present	5 (16.7%)	4 (13.3%)	
No complications	25 (83.3%)	26 (86.7%)	
Fever	4 (13.3%)	4 (13.3%)	
UTI	1 (3.3%)	-	
Post-operative nephrostomy leakage			
no leakage	17 (56.7%)	22 (73.3%)	0.279
minor leakage	13 (43.3%)	8 (26.7%)	
Post-operative hematuria			
no hematuria	7 (23.3%)	14 (46.7%)	0.103
minor hematuria	23 (76.7%)	16 (53.3%)	
status of contralateral kidney			
Normal	21 (70%)	25 (83.3%)	0.360
not normal	9 (30%)	5 (16.7%)	
PONV			
absent	1 (3.3%)	29 (96.7%)	<0.001
present	29 (96.7%)	1 (3.3%)	
post-operative headache			
absent	28 (93.3%)	5 (16.7%)	<0.001
present	2 (6.7%)	25 (83.3%)	
overall patients' satisfaction			
highly satisfied	21 (70%)	11 (36.7%)	<0.001
satisfied	8 (26.7%)	6 (20%)	
not satisfied	1 (3.3%)	13 (43.3%)	
removal of Foley's catheter (days)			
POD 1	11 (36.7%)	17 (56.7%)	0.195
POD2 & after	19 (63.3%)	13 (43.3%)	
	1.97 ± 0.92 days	1.63 ± 1.03days	0.074
previous renal surgery			
no	26 (86.7%)	28 (93.3%)	0.671
yes	4 (13.3%)	2 (6.7%)	

DM = diabetes mellitus; HTN = hypertension; COPD = chronic obstructive airway disease; BT = blood transfusion; UTI = urinary tract infections; PONV = post operative nausea and vomiting; POD = post operative day:

The success rate in GA group was 28 (93.3%) and in SA group was 29 (96.7%) with no significant p-value (Table 5). All the follow up complications were of minor types which include fever and UTI. No procedures in SA were accomplished without need to conversion to GA.

Table 5. Stone free rate, stone success rate, re-operation and follow up complications.

Stone Free Rate	GA (n = 30)	SA (n = 30)	P value
no stones	25 (83.3%)	28 (93.3%)	0.472
< 4mm	3 (10%)	1 (3.3%)	
> 4mm	2 (6.7%)	1 (3.3%)	
stone success rate			
success	28 (93.3%)	29 (96.7%)	1.000
not success	2 (6.7%)	1 (3.3%)	
redo operation			
no operation	28 (93.3%)	29 (90%)	1.000
operation	2 (6.7%)	1 (3.3%)	
follow-up complications			
no complications	27 (90%)	27 (90%)	1.000
minor complications	3 (6.7%)	3 (6.7%)	

DISCUSSION

Many studies conducted comparison between GA and SA in PCNL procedure with conflicting results. It seems that SA is safe and efficient in performing PCNL in selected cases. Although GA is preferred in many centers because of its feasibility to control the tidal volume, securing airway in prone position and extensibility of anaesthesia time.[3,4]Therefore many urosurgeons would still like to perform PCNL in GA in case of staghorn calculi. But it will still be challenging in chronic obstructive airway diseases, cardiovascular disorders and morbid obese patients where SA will be preferred over the GA.[8-13]

In several studies efficacy of SA in selected cases or critically ill patients had been addressed.[1,9,14]

Using SA in PCNL surgery is acceptable and more secure. By faster discharge and reduced recovery time the patients' quality of life can be improved.[8]

Kuzgunbay et al found no difference regarding operative time, post operative haemoglobin level, hospital stay, success rate and post operative complications.[13] However more patients' satisfaction was reported with the spinal block[3,15] which resembles with my study.

In my study, operative time in SA group was less than GA group, may be because of the surgeon's mind to finish the case in time. The operative duration was higher in a study done by Cicek et al.[16] In McClain et al study, SA could reduce the length of operative time and other side effects which is similar to my study.[17]

Regarding the hospital stay it did not show the significant value in both groups may be because in our set up the patient is reluctant to go to home in 2nd post operative even though the surgeon requests to discharge. So early discharge was considered when ≤3rd post operative day. Viewing this in mind there was significant p-value.

Tetzlaff et al have also shown that SA was a better choice of anaesthesia compare to GA in terms of side effects.[18] Regarding post operative haemoglobin and amount of haemoglobin reduction that is the reflection of bleeding, there was no significant difference between two groups.

Mehrabi et al in their study, 6 patients developed mild to moderate headache and low back pain,10 patients (6.3%) receive blood transfusion.[9] In my study, Post operative nausea and vomiting was more common in GA group and headache in SA group with a significant p-value which resembles with the study of Karacalar et al.[15]

SA is associated with hypotension resulting from sympathetic block especially after changing the posture from supine to prone position.[9,19,20] None of the patients' were recorded to have hypotension in our series probably because our anesthetic used pre-load with intravenous fluid prior to spinal anaesthesia.

In a recent study that involved 1004 patients, complications were graded according to modified clavien classification and found to have more complications in GA group than in the SA group however not all the complications were directly related with the anesthesia.[16]

Despite the general opinion that SA will not be suitable for staghorn calculi and upper ureteric stones in my study it was well tolerated by the patients with comparable complications with the GA group. But a well designated study is required with a bigger sample size to prove whether SA is safe and efficient in staghorn calculi.

CONCLUSIONS

Both GA and SA are safe and effective for PCNL. SA has comparable complications as GA but operation time is less in SA group. Similarly patients' satisfactions were more in SA group.

Conflict of Interest: None.

REFERENCES

1. Aravantinos E, Karatzas A, Gravas S, Tzortzis V, Melekos M. Feasibility of percutaneous nephrolithotomy under assisted local anaesthesia: a prospective study on selected patients with upper urinary tract obstruction. Eur Urol. 2007;51(1):224-7.
2. Elbealy M, Rashwan D, Kassim SA, Abbas S. A comparision of the effects of epidural anaesthesia,lumbar paravertebral block and general anaesthsia in percutaneous nephrolihotomy. J Med Sci. 2008;8(2):170-6.
3. Tangpaitoon T, Nisoog C, Lojanapiwat B. Eficacy and safety of percutaneous nephrolithotomy (PCNL): a prospective and randomised study comparing regional epidural anaesthesia. Int Braz J Urol. 2012;38(4):504-11.
4. Prakash R, Kushwaha B, Shasibhusan, Bhatia V, Chandra G, Singh B. A comparative study of bupivacaine 0.25% alone and with fentanyl or dexmedetomidine for percutaneous nephrolithotomy (PCNL) under epidural anaesthesia. Indian J Sci Res. 2014;5(1):39-46.
5. Attari M, Mirhosseini S, Honarmand A, Safavi M. Spinal anaesthesia versus genearal anaesthesia for elective lumbar spine surgery:a randomised clinical trial. J Res Med Sci. 2011;16(4):524-9.
6. Singh V, Sinha R, Sankhwar S, Malik A. A prospective randomised study comparing percutaneous nephrolithotomy under combined spinal-epidural anaesthesia with percutaneous nephrolithotomy under general anaesthesia. Urol Int. 2011;87:293-8.
7. Kim SS, Jeong WL, Yu JH, Sung LH, Chung JY, Noh CH. Percutaneous nephrolithotomy: comparision of the efficacies and feasibilities of regional and general aneshesia. Korean J Urol. 2013;54:846-50.
8. 8.Rozentsveig V, Neulander E, Roussabrov E, Schwartz A, Lismer L, Gurevich B, et al. Anaesthetic considerations during percutaneous nephrolithotomy. J Clin Anesth. 2007;19(5):351-5.
9. Mehrabi S, Karimzadeh Shirazi K. Results and complications of spinal anaesthesia in percutaneous nephrolithotomy. Urol J. 2010;7(1):22-5.
10. Stoller M, Wolf J, Lezin M. Estimated blood loss and transfusion rate associated with percutaneous nephrolithotomy. J Urol. 1994;152:1977-81.
11. Trivedi N, Robalino J, Shevde K. Interpleral block: a new technique for regional anaesthesia during percutaneous nephrostomy and nephrolithotomy. Can J Anesth. 1990;37:479-81.
12. El-Husseiny T, Moraitis K, Maan Z, Papatsoris A, Saunders P, Golden B, et al. Percutaneous endourologic procedures in high-risk patients in the lateral decubitus position under general anaesthesia. J Endorol. 2009(23):1603-6.
13. Kuzgunbay B, Turunc T, Akin S, Ergenoglu P, Aribogan A, Ozkardes H. Percutaneous nephrolithotomy under general versus combined spinal-epidural anaesthesia. J Endorol. 2009;23:1835-8.
14. Kanaroglou A, Razvi H. Percutaneous nephrolithotomy under consious sedation in morbidly obese patients. Can J Urol. 2006;13:3153-5.
15. Karacalar S, Bilen C, Sarihasan B, Sarikaya S. Spinal epidural anaesthesia versus general anaesthesia in the management of percutaneous nephrolithotomy. J Endorol. 2009;23:1835-8.
16. Cicek T, Gonulalan U, Dogan R, Kosan M, Istanbulluoglu O, Gonen M, et al. Spinal anesthsia is an efficient and safe anesthetic method for percutaneous nephrolithotoy. Urology. 2014;83(1):50-5.
17. Taghipour Anvari Z, Afshar-Fereydouniyan N, Imani F, Sakhaei M, Alijani B, Mohseni M. Effect of clonidine premedication on blood loss in spine surgery. Anesth Pain. 2011;1(4):252-6.
18. Tetzlaff J, Dilger J, Kodsy M, Al-Bataineh J, Yoon H, Bell G. Spinal anaesthesia for elective lumbar spine surgery. J Clin Anesth. 1998;10(8):666-9.
19. Sunana G, Rahul G, Nandita M, Arti M, Sidhartha V, Rajesh M. Percutaneous nephrolithotomy under spinal anesthesia and the efficacy of adding adjuvant clonidine to intrathecal hyperbaric bupivacaine: a comparative study. Internet J Anesthesiol. 2014;33(1).
20. Movasseghi G, Hassani V, Mohaghegh M, Safaeian R, Safari S, Zamani M, et al. Comparision between spinal and general anesthesia in percutaneous nephrolithotomy. Anesth Pain Med. 2014;4(1):e1387.