



# Comparison of Surgical Outcome and Complications Between Spinal and General Anaesthesia for Patients Undergoing Percutaneous Nephrolithotomy

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**Abstract:** Background: Percutaneous nephrolithotomy (PCNL) now a days is the treatment of choice for most renal stones, staghorn calculi and stones resistant to shock wave lithotripsy. Mostly PCNL is done under general anesthesia. However, it can be done under spinal anaesthesia which can have advantages like easier technique, faster discharge, reduced cost and recovery time and most important patient satisfaction. Aim: Unfortunately, few research studies have been conducted to compare regional and general anesthesia with respect to operative parameters. In the present study, we compared surgical outcomes and complications between percutaneous nephrolithotomy under spinal and general anesthesia. Materials and Method: 60 patients were divided into two groups of 30 each (GA/SA), who were undergone percutaneous nephrolithotomy under spinal and general anaesthesia. Patient's general characteristics, stone features, surgical outcomes, and complications were compared between the two groups. All qualitative data and quantitative data were analyzed by chi square and student's t test respectively. P value <0.05 was considered statistically significant. Result: The two groups were similar in terms of mean age and stone size, number, and type. Furthermore, they did not differ significantly in terms of general characteristics, treatment outcomes or complications excluding postoperative fever. However, mean hospital stay was significantly shorter in the regional anesthesia group than in the general anesthesia group ( $8.2 \pm 1.6$  days vs.  $12.5 \pm 2.8$  days, respectively, ( $p=0.0001$ )). Also, the postoperative fever rate was significantly higher in the general anesthesia group (82.5% vs 50%) respectively. ( $p=0.012$ ). The treatment cost was 30\$ in GA group and 10 \$ in spinal group which was statistically significant. Also analgesia requirement on day 1 was more in GA group than SA group which was statistically significant. Conclusion: Regional anaesthesia is as effective as general anaesthesia during percutaneous nephrolithotomy and is associated with shorter hospital stays, lower rates of postoperative fever, lower analgesic requirement and treatment cost.

**Keywords:** Anaesthesia, Complications, Percutaneous Nephrolithotomy

## 1. Introduction

Percutaneous nephrolithotomy (PCNL) is now the treatment of choice for kidney stones greater than 2 cm to 3 cm in diameter, multiple kidney calculi, staghorn calculi, and in cases of failed shock wave lithotripsy. European urology guideline on urolithiasis recommended (PCNL) as first line treatment modality for renal stones over 300 mm [1]. Anaesthesia for percutaneous nephrolithotomy can be general or regional. Most urologists prefer general anaesthesia for percutaneous nephrolithotomy owing to the high level of

anesthesia achieved, the ability to control the patient's breathing. [2] However, general anaesthesia is more likely to cause severe morbidities, such as drug-induced anaphylaxis, complications associated with endotracheal tube insertion, and cardiovascular, pulmonary, and neurological complications than regional anaesthesia. [3] Regional anaesthesia like spinal, epidural and intrapleural anaesthesia has the advantage over general anaesthesia in many urogenital surgeries. Also spinal anaesthesia can be used in patients who are at high risk for surgery under general anaesthesia. [4] Unfortunately, few research studies have been conducted to compare regional and general anaesthesia with

respect to operative parameters. In the present study, we compared surgical outcomes and complications to determine whether percutaneous nephrolithotomy under regional anaesthesia is better over general anaesthesia.

## 2. Materials and Methods

This study was a prospective, randomized clinical study which was carried out from Feb 2013 to Dec 2013 on 60 patients, older than 18 years, with renal stones larger than 15 mm. A written informed consent was obtained from the patient and they were randomly allocated to two groups (n=30 each) by a computer generated randomization program.

Patients having horseshoe or ectopic kidney, any cardiovascular, pulmonary or coagulation disorder, ASA class 3 or 4, or any contraindication for spinal or general anaesthesia, and failure of spinal anaesthesia were excluded from the study.

Besides proper history taking and physical examination, preoperative laboratory tests like complete blood count (CBC), serum sodium, potassium, urea, creatinine, coagulation tests and urinalysis were done in every patient. Intravenous pyelography (IPV) was done to know the size and location of the stones. Noncontrast spiral CT was done for nonopaque stones.

In general anaesthesia group, patients were premedicated with intravenous glycopyrolate 10 mcg/kg, inj. midazolam 0.04 mg/kg, inj. Pentazocine 0.4 mg/kg and were preoxygenated and induced with inj. Propofol 2mg/kg. and inj Rocuronium 0.9 mg/kg. Then the patients were intubated and maintained with inj. Vecuronium, isoflurane, and nitrous with oxygen (2:1 ratio). All standard monitors like NIBP, ECG and SpO<sub>2</sub> were attached. First 5-6 F urethral catheter was introduced in lithotomy position and then the patients were rotated to prone position with caution. Then the standard procedure was done by one shot technique using the dilator, sheath, nephroscope under fluoroscopic guidance. All procedures were terminated within 2 hour. During the procedure SBP, DBP, MAP, ECG, HR, SpO<sub>2</sub> and amount of bleed were monitored. After the procedure was over, the patients were reversed with inj. Neostigmine and inj glycopyrolate and transferred to post anaesthesia care unit.

In spinal anaesthesia group, 4 ml of 0.5% bupivacaine (heavy) was given in the L3 and L4 intervertebral space by 25 G quincke spinal needle in midline sitting position. Then the patient lied in supine position for 5 min. The anaesthesia level was checked. After adequate level of block was achieved (T6 to T7), 5-6F urethral catheter was inserted in lithotomy position by the urologist and the position of the patient was changed to prone. Then percutaneous nephrolithotripsy was performed by standard method with the guidance of fluoroscopy. The procedure was limited to 2 hours. During the procedure SBP, DBP, MAP, ECG, HR, SpO<sub>2</sub>, intraoperative pain, nausea, vomiting and amount of bleed were monitored. The patients were shifted to the post anaesthesia care unit after the operation. The patients' satisfaction level and amount of narcotic used for pain control were recorded. Visual analogue scale was used to know the severity of pain. Morphine was used as postoperative analgesia. SBP, DBP, MAP and HR were recorded at every 10 min interval starting from baseline for 48 hrs. In PACU incidence of backache, sore throat, PONV and change in haemoglobin level was noted and compared.

The patients were also followed up for 48 hours for any fever, leakage of urine, flank pain which were noted and treated. The patients were transferred to ward on 3<sup>rd</sup> postoperative day and discharged subsequently. After one week they visited again and followed up with x-ray and ultrasonography of kidney, ureter and bladder. Standard treatments were given to patients with significant residual stone. The hospitalization days, stone free rate, cost of drugs and consumables used were recorded from beginning of procedure in both group.

Data were analyzed using the SPSS software version 16.0. All the data were taken as mean±SD. Qualitative data was analyzed by Chi-square test and quantitative data were analyzed by student's t test. P value < 0.05 was considered as significant.

## 3. Results

There were no significant differences between two groups regarding age, gender, body mass index, mean stone size, stone location and operative time as shown in table 1.

**Table 1.** Comparison of patient and stone characteristics

Variable	GA Group (n=30)	SA Group (N=30)	p Value
Age (yrs)	52.5±10.2	50.8±8.6	0.488
Male: Female ratio	20:10	20:10	1.0
Mean BMI ±SD, in kg/m <sub>2</sub>	25.3±4.8	24.5±5.1	0.534
Stone Side (left:right)	18:12	16:14	0.794
Mean stone size, in mm	28.3±8.6	29.6±7.8	0.313
Stone no	2.4±2.6	2.8±2.1	0.203
<i>Stone loction</i>			
Complete staghorn	8	2	0.079
Partial staghorn	6	5	1.00
Pelvic stone	12	15	0.604
Calyceal stone	4	8	0.333

Table 1 show demographic characteristics of patients and stones and there were no significant differences between two

groups (p>0.05)

Intraoperative complications among the both groups were

not statistically significant as shown in table 2. Complications of spinal anaesthesia during surgery were seen in 7 patients. Most common complication was hypotension (5 patients) and nausea and vomiting (4 patients) which were controlled by ephedrine and ondansetron respectively. One

patient complained pain which was controlled by giving iv fentanyl. One patient developed chills which were treated by iv tramadol. Though both groups were hemodynamically stable, bleeding was slightly more in general anaesthesia group which may be due to higher blood pressure.

**Table 2.** Comparison of intraoperative events.

Variable	GA (n=26)	RA (n=24)	p-value
Duration of surgery (min)	120±25	100±30	0.166
Intra Operative Pain	0	1	1.0
Intraoperative Hypotension	2	5	0.423
Intraoperative Nausea and vomiting	0	4	0.112
Intraoperative chills and irritability	0	1	1.0
Intraoperative bleeding	4	2	0.670
SBP in mm of hg (mean)	125.6±20.4	115.8±18.6	0.056
DBP (mean)	74.8±11.4	68.8±12.5	0.112
MAP (mean)	90±10.5	85.6±9.4	0.092
HR (mean)	76±11	71±15	0.146

**Table 3.** Comparison of surgical outcome

Variable	GA group (n=30)	Spinal group 9n=30)	P Value
Postoperative fever (>37.7°C)	25(82.5%)	15(50%)	0.012
Morphine (1 <sup>st</sup> post op day)	14.6±2.4	8.2±1.2	0.0001
Patient satisfaction, n (%)	26	24	0.730
Post operative headache	0	2	0.491
Low back pain	0	1	1.0
Sore throat	2	0	0.491
PONV	3	1	0.612
Change in hemoglobin level (g/dl)	1.4±1.2	1.2±1.1	0.503
Hospitalization days	12.5±2.8	8.2±1.6	0.0001
Stone free rate	28	27	1.0
Average cost of drugs	20±2.6 US\$	5±1.1US\$	0.0001

Regarding surgical outcome, postoperative fever was more in general anaesthesia group on comparison group which was statistically significant. Both days of hospitalization and average cost of anaesthetic drugs were less in spinal group which is statistically significant. Analogue pain score and analgesic requirement were high in GA group which were statistically significant.

**Table 4.** Post operative analog pain score (from 0 to 10) at 1, 4, 12, 24, 48 and 72 hours.

Variable	GA group (n=30)	RA group (n=30)	p-value
1 Hour	6.88(1.27)	3.12(1.98)	0.0001
4 Hour	5.07(2.58)	3.42 (2.48)	0.014
12 Hour	3.88(1.88)	3.62(1.58)	0.564
24 Hour	3.42(2.10)	3.33(1.17)	0.838
48 Hour	2.61(1.49)	1.87(1.23)	0.748
72 Hour	2.03(1.66)	1.42(1.10)	0.098

## 4. Discussion

Anaesthesia can influence the early postoperative recovery and quality of life which lead to early discharge from the hospital minimizing the treatment cost.<sup>[5]</sup> Usually surgeons prefer to do PCNL under general anesthesia but in high risk patients with COPD and cardiovascular diseases regional anaesthesia can be an alternative.<sup>[6]</sup> Several studies mostly retrospective of spinal, epidural and combined spinal epidural anaesthesia in selected patients for PCNL have been done.

Ballestrazzi V et al reported in 1988 about administration of epidural anesthesia in 112 patients who underwent percutaneous nephrolithotomy and found 88% patients have satisfactory hemodynamic and respiratory parameters.<sup>[7]</sup> Our patients have also shown similar level of satisfaction.

EI –Husseiny T. et al studied in 22 high risk patients who were undergone percutaneous nephrolithotomy under regional anesthesia avoiding complications of general anaesthesia. Patients were fully awake, alert and hemodynamically stable during the operation.<sup>[2]</sup>

Sung Soo Kim et al reported in their article that despite similar patient characteristics in the two groups, postoperative fever rates and hospital stays were significantly greater in the general anesthesia group. Thus, it may be more helpful for patients to implement percutaneous nephrolithotomy under regional anesthesia than general anesthesia in matters of fever control and cost of hospitalization which was consistent with our finding.<sup>[8]</sup>

Tangpaitoon T et al studied on 50 patients who underwent percutaneous nephrolithotomy. In the study, regional anesthesia was found to be associated with greater patient satisfaction, less early postoperative pain and fewer adverse events than general anesthesia similar to our finding.<sup>[9]</sup>

Gholamreza et al found that in patients undergoing percutaneous nephrolithotomy, spinal anaesthesia was as effective and safe as general anesthesia. Patients who were undergone percutaneous nephrolithotomy under spinal

anesthesia require smaller amounts of analgesic dose and shown hemodynamic stability during surgery and recovery time. Also, spinal anaesthesia technique decreased blood loss and shortened surgery as well as anesthesia times compared to general anesthesia. MAP and heart rate showed no significant differences at designated time points between two groups. Surgery time, anaesthesia time, bleeding volume, and analgesic intake were significantly reduced in spinal anaesthesia group.<sup>[10]</sup>

Babak Borzouei et al described his 9 years experience of performing percutaneous nephrolithotomy under spinal anesthesia for 387 patients with large stones of the upper urinary tract, with regard to the effectiveness and side effects. The incidence of complications was 11.6%. He concluded that percutaneous nephrolithotomy under spinal anesthesia was feasible, safe, and well-tolerated in management of patients with renal stones.<sup>[11]</sup>

Mehrabi et al evaluated 160 patients who were undergone percutaneous nephrolithotomy in the prone position under spinal anesthesia. Their conclusion was percutaneous nephrolithotomy under spinal anesthesia was an alternative technique to general anesthesia<sup>[12]</sup>.

Mehrabi et al in another prospective randomized study on percutaneous nephrolithotomy in which 52 patients received general anesthesia and 58 patients received spinal anesthesia, intraoperative hypotension, postoperative headache, and low back pain were significantly higher in spinal group. But compared to spinal anaesthesia, the costs of anesthetic drugs were more than five times, and post-operative analgesic consumption about two times in general anaesthesia group. Finally, authors suggested spinal anesthesia as a safe, effective, and cost – effective method in adult percutaneous nephrolithotomy, the same as our results.<sup>[13]</sup> Schuster et al in a retrospective study compared the cost of anaesthesia under spinal and general anaesthesia and opined that spinal anaesthesia offers cost advantage over general anaesthesia.<sup>[14]</sup> Our study also found that spinal anaesthesia was more cost effective.

Nouralizadeh et al found that using spinal anesthesia by intrathecal injection of local anesthetic solutions vs general anesthesia had comparable surgical outcomes and reduced the requirement for analgesia after percutaneous nephrolithotomy in the early postoperative period.<sup>[15]</sup>

Gonen M et al studied that tubeless percutaneous nephrolithotomy under spinal anesthesia was a good alternative for general anesthesia in adult patients. Spinal anaesthesia decreased analgesic requirement in patients who were undergone tubeless percutaneous nephrolithotomy compared to general anesthesia.<sup>[16]</sup>

Kuzgunbay B, et al studied 82 patients who underwent percutaneous nephrolithotomy and compared them in 2 groups with general anesthesia and combined spinal epidural anesthesia. They concluded that combined spinal regional anesthesia was a feasible technique in percutaneous nephrolithotomy because the efficacy and safety were not affected.<sup>[17]</sup> Their conclusive findings are consistent with our finding.

Singh et al in their study found that percutaneous nephrolithotomy under CSEA was as effective and safe as percutaneous nephrolithotomy under general anaesthesia. Patients who underwent percutaneous nephrolithotomy under CSEA required lesser analgesia within 1<sup>st</sup> 24 hours and had a shorter hospital stay.<sup>[18]</sup> Our study had shown lesser analgesic requirement in 1<sup>st</sup> 24 hr of surgery.

Singh et al in a report of case series, reported to highlight that percutaneous nephrolithotomy under regional block was technically feasible and viable option. Regional block had the advantage of avoidance of general anaesthesia and anaphylaxis due to use of multiple drugs.<sup>[19]</sup>

Karacalar et al reported the superior results of spinal epidural block compared to general anaesthesia in some aspects such as patient satisfaction, less postoperative pain and shorter duration of post operative analgesic usage. Vomiting, hypotension and bradycardia were not different between both groups but higher rate of postoperative nausea was found in general anesthesia group.<sup>[20]</sup>

Andreoni C et al in their study found that a single preoperative dose of subarachnoid spinal analgesia provided a statistically significant decrease in postoperative parenteral pain medication and earlier ambulation. It also reduced the amount of postoperative pain and decreased the incidence of nausea.<sup>[21]</sup>

Atallahs et al demonstrated, for the first time, that intrathecal low-dose bupivacaine and fentanyl offers a reliable neuraxial block for patients subjected to percutaneous nephrolithotomy, with stable hemodynamic, good post-operative analgesia and acceptable patient and endoscopist satisfaction.<sup>[22]</sup>

G sunnana et al evaluated the feasibility of doing percutaneous nephrolithotomy under spinal anaesthesia and whether addition of clonidine improves the quality of spinal block needed for percutaneous nephrolithotomy. They found that spinal anaesthesia using bupivacaine and clonidine offered a reliable block, excellent patient and surgeon acceptance and prolonged intraoperative and postoperative analgesia in patients undergoing percutaneous nephrolithotomy which is similar to our finding.<sup>[23]</sup>

Our study showed that despite similar patient and stone characteristics in the two groups, postoperative fever rates, analgesic requirement, hospital stays and treatment cost were significantly lower in the regional anaesthesia group. Thus, it may be beneficial to do percutaneous nephrolithotomy under regional anaesthesia than general anaesthesia. In this study, patients with stone in upper pole of kidney tolerated the procedure efficiently under spinal anaesthesia.

## 5. Conclusion

Surgeons are more comfortable when percutaneous nephrolithotomy is done under general anaesthesia, but from patient and anaesthetic point of view spinal anaesthesia may be an effective alternative. The present study showed that in terms of general characteristics and procedural success, the outcomes of percutaneous nephrolithotomy conducted by use

of regional or general anesthesia are similar. Nevertheless, percutaneous nephrolithotomy with regional anaesthesia required fewer hospitalization days and was associated with a lower postoperative fever rate and lower treatment cost as well. The other advantages of regional anesthesia over general anaesthesia are cheaper, easier, quicker, safer, higher patient satisfaction, less early postoperative pain and less analgesic usage. To conclude percutaneous nephrolithotomy under spinal anaesthesia helps surgeons to maintain patient in a better hemodynamic and haemostatic state, reduce the general anaesthesia complications, decrease the need of analgesics, and duration of surgery.

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