

Feasibility and Complications of Spinal Anaesthesia in Percutaneous Nephrolithotomy: Our Experience

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ABSTRACT

Introduction: Percutaneous Nephrolithotomy (PCNL) is the treatment modality used for the extraction of large renal stones, or multiple calculi or stones resistant to shock wave lithotripsy. The General Anaesthesia (GA) is the standard modality for PCNL. However, few studies conclude that Spinal Anaesthesia (SA) can be an alternative method of anaesthesia with similar incidence of complications.

Aim: In our study we evaluated the feasibility of spinal anaesthesia in terms of intraoperative and postoperative results in patients undergoing PCNL.

Materials and Methods: The total 1298 PCNL operations were done for kidney stone from January 2013 to December 2016, out of which 1160 patients underwent PCNL under SA while remaining 138 operations were carried out under GA in the prone position. We retrospectively collected data from the patient's documents. The intraoperative haemodynamic stability was primary objective, and average fall of haemoglobin, postoperative anaesthetic outcome like total tramadol used in first 24 hours, surgical outcome like total clearance of stone

burden, patient satisfaction, surgeon satisfaction, need of blood transfusion, conversion to general anaesthesia and pleural puncture were the secondary objectives.

Results: The mean age of the patients was 38.0±17.1 years, and the mean operative time was 80.0±25.9 minutes. The mean calculus size was 30.2±11.8 mm. Return of sensory and motor activity took 150.0±29.2 minutes and 111.0±18.8 minutes, respectively. In first 10 minutes of anaesthesia, 148 (12.75%) patients developed hypotension, which was managed by ephedrine 6 mg intravenously (IV). Total seventy two patients (6.2%) needed blood transfusion and 32 (2.75%) complained of headache, dizziness and low back pain for two to four days after the operation, which improved with analgesics and bed rest. Ninety percent of the patients had complete clearance of calculus or there were no significant residual calculi larger than 5 mm on follow up ultrasonography.

Conclusion: It can be concluded from our study that spinal anaesthesia is the safe and effective method of anaesthesia for PCNL in adult patients.

Keywords: General anaesthesia, Regional anaesthesia, Renal stone

INTRODUCTION

Fernstrom I and Johansson B reported the removal of renal calculus through nephrostomy tract by open surgery in 1976, though at present PCNL has become the treatment of choice for removal of renal stones [1]. With the enhanced expertise of surgeons, skills of anaesthesiologist and advancement in instrumentation, PCNL is nowadays the procedure of choice [2]. PCNL is used for larger renal stones of size more than 20 mm, staghorn stones and stones that are multiple or resistant to extracorporeal shock [3]. PCNL can be done under local, general or regional anaesthesia. The literature mention that GA has many advantages over Regional Anaesthesia (RA) in term of better haemodynamic control, airway control, better patient and surgeon satisfaction [4]. A meta-analysis published in 2015 by Hu H et al., on RA versus GA for percutaneous nephrolithotomy found mean operative time was shorter ($p=0.005$), discharge of patients was earlier, and less pain on first postoperative day in RA group than GA group [5]. There was no significant difference in stone free status in RA versus GA. The complication and contraindications of GA, such as pulmonary atelectasis, Chronic Obstructive Pulmonary Disease (COPD), vascular, and brachial nerve injury or spinal cord injury. The total cost of GA is also more as compared to SA [6]. The other advantages of GA for PCNL procedure include better control of tidal volume, airway control especially in prone position, and extensibility of anaesthesia time [7]. SA has many advantages over GA, like better postoperative pain control in turn less consumption of analgesic drugs and avoidance of side effects of multiple

medications used in GA. The rate of complications was also less in PCNL surgeries with use of SA [8].

The aim of this study was to evaluate the intraoperative measures like haemodynamic stability as the primary objective and average fall of haemoglobin, patient and surgeon satisfaction, postoperative anaesthetic outcome like total dose of tramadol used in first 24 hours, surgical outcome like total clearance of stone burden, need for blood transfusion, conversion to GA, and pleural puncture are the secondary objectives.

MATERIALS AND METHODS

This retrospective study was carried out at Vinayaka Hospital and Dr. S.N. Medical College, Jodhpur, Rajasthan, India. We had reviewed data of 1160 patients, American Society of Anaesthesiologists (ASA) grade I and II, who underwent PCNL under SA, aged 20-60 years, from January 2013 to December 2016. All information was extracted from medical files. The patient consent was obtained for type of anaesthesia. The urologic workup included Ultrasonography (USG) of abdomen, Kidney Ureter And Bladder (KUB) X-ray, Intravenous Pyelography (IVP). The Isotope scan or Computed Tomography (CT) scan were advised if necessary. The general physical examination, Complete Blood Count (CBC), Fasting Blood Sugar (FBS), Blood Urea Nitrogen (BUN), Serum Creatinine (S.Cr), Prothrombin Time (PT), Partial Prothrombin Time (PTT) were done in all patients. The pre anaesthetic check up was done one day prior to the surgery. The demographic characteristics and baseline haemodynamic data

were recorded. SA was given with bupivacaine 15 mg, and fentanyl 25 µg injected intrathecally at the L2-L3 interspaces, by 25 G pencil point spinal needle under all septic precaution, and the head of the bed was tilted down for five to 10 minutes in supine position. The Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), and Pulse Rate (PR) were recorded every two minutes for the first 10 minutes than every 10 minutes during surgery till the end of procedure and every 20 minutes in the Post-Anaesthetic Care Unit (PACU). The intraoperative blood loss was measured by the drop in haemoglobin levels after operation. The operative time was recorded from the beginning of anaesthetic administration to termination of the operation. As the study was retrospective so ethical clearance was not taken from the institute. The study was done at two centres and permission was obtained from institutes to collect the data.

Intravenous midazolam 1 mg to 2 mg was used for conscious sedation during the surgery. During cystoscopy, ureteric catheter was put through cystoscope in lithotomy position under direct vision. All the patients received 4 mg of dexamethasone, and prophylactic antibiotics preoperatively. Then patients were rotated to the prone position to obtain the position for percutaneous access to the affected renal system. The percutaneous nephrolithotomy was done under fluoroscope with the help of Amplatz dilator, 28-F to 30-F Amplatz sheath, and the use of a 22 F nephroscope. The severity of pain was assessed by VAS with a score range of 0 (no pain) to 10 (intolerable pain). Patients were asked to draw the line vertically at a point which matched their pain [9]. VAS scoring was done by attending nurse at 1, 2, 4, 6, 9, 12, 15, 18, 21 and 24 hours postoperatively. At the completion of surgical procedure, nephrostomy tube was inserted and clamped for 12 hours. The tube was opened after 12 hours and if there was no drain for next 24 hours, then the tube was removed. Adverse effects including hypotension, bradycardia, nausea, vomiting, shivering or pruritus were recorded during postoperative period. Hypotension was defined when SBP was <90 mm Hg. Bradycardia was defined when pulse <60 beat/min. Hypotension was managed with fluid bolus and inj ephedrine 6 mg. Bradycardia was managed with inj atropine 6 mg. The number of patient who needed conversion from SA to GA was recorded. Intravenous tramadol 50–100 mg was given when VAS was 4. The total dose of tramadol consumed by each patient was noted.

At the end of the operation, patients and surgeon satisfaction score was recorded from 0 (extremely unsatisfied) to 5 (extremely satisfied) [10]. The patients were advised to have complete bed rest for at least 24 hours postoperatively. The patients were discharged after 72 hours of PCNL. All the patients underwent screening ultrasonography two weeks after operation for detection of any residual calculi.

STATISTICAL ANALYSIS

The statistical analysis was done with SPSS 16 software. The data were represented as mean±standard deviation.

RESULTS

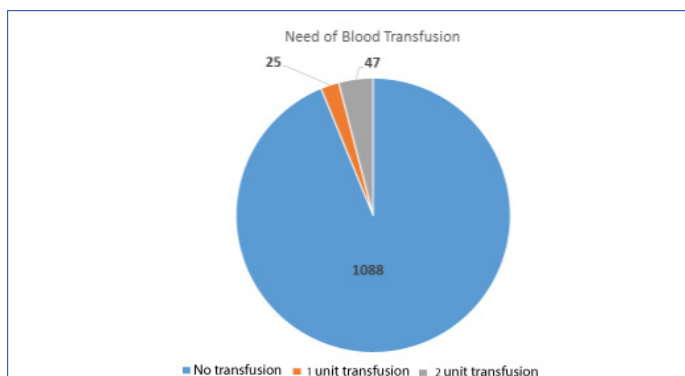
The mean age of the patients was 38.0±17.1 years [Table/Fig-1]. The 812 (70%) patients were male and 348 (30%) patients were female. The mean operative time was 80.0±25.9 minutes. The mean calculus size was 30.2±11.8 mm. In the first 10 minutes of anaesthesia 148 (12.75%) patients developed hypotension, and was managed by ephedrine IV 6 mg. The mean time for return of sensory and motor activity was 150.0±29.2 minutes and 111.0±18.8 minutes respectively [Table/Fig-1]. In 12 (1.0%) patients surgery was abandoned because of excessive blood loss and procedure was repeated after 48 hours. In 638 (55%) two puncture, in 348 (30%) single puncture and in 174 (15%) patients three puncture was done for complete clearance. In 522 (45%) patients intercostal puncture, in 290 (25%) patient supracostal puncture, and in 348 (30%)

patients sub costal puncture was attempted to retrieve the stone. In 522 patients (45%), supracostal access was used. In 22 (1.89%) patient intercostal tube placement required. The overall surgeon and patient satisfaction score was 3 and 4 respectively. A total of two patients required endotracheal intubation to assist respiration due to high level of SA while six patients required GA due to incomplete RA. Overall, fifteen (1.29%) patients had mild pain during the operation which was managed by intravenous sedation in form of fentanyl and ketamine. The baseline mean haemoglobin value was 11.2±1.2 g/dl and mean decrease in haemoglobin was 1.6±0.8 g/dl. Total seventy two patients (6.2%) required blood transfusion out of which 25 patient's required one unit and 47 patients required two unit transfusion of packed cells [Table/Fig-2]. About thirty two (2.75%) patients had headache, dizziness for two to four days after the operation, which was improved with analgesics and bed rest.

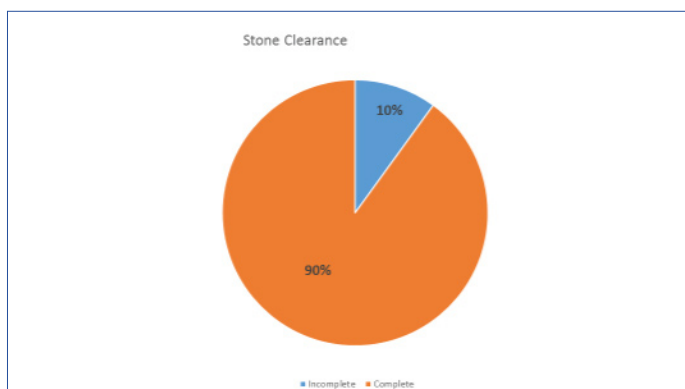
The average tramadol 125 mg was used in first 24 hours postoperative period for pain management. In ninety percent of the patients complete removal of calculus or no significant residual calculi (>5 mm) was found on follow up ultrasonography [Table/Fig-3]. One patient had shoulder dislocation intraoperatively. The

Mean Age (yrs)	38.0±17.1
Number of Male/Female Patients	812/348
Mean Calculus Size (mm)	30.2±11.8
Number of Patient with hypotension (%)	148 (12.75)
Return of Sensory Activity (min.)	150.0±29.2
Return of Motor Activity (min.)	111.0±18.8
Mean Operative Time (min.)	80.0±25.9

[Table/Fig-1]: Demographic details of the patients included in the study.



[Table/Fig-2]: Pie diagram showing need for blood transfusion.



[Table/Fig-3]: Pie diagram showing stone clearance.

visceral, vascular, and neurologic complications did not occur in any of the patients.

DISCUSSION

The PCNL results in less morbidity and shorter convalescence. PCNL is used for the breakdown and removal of large or multiple calculi from the renal pelvis and renal calyceal system [2]. The literature

shows that PCNL can be done under assisted local anaesthesia [7]. GA can be a challenge in PCNL for staghorn calculi, because of the possibility of fluid absorption and electrolyte imbalance. Therefore, RA would be a better alternative in these circumstances [10]. The patient in RA may report early pleural puncture by complaining of difficulty in respiration and with shoulder pain. The chances of shoulder dislocation are more in GA as compared to RA. In one patient we faced shoulder dislocation even in SA. For the fast tracking of the patient in a safe condition, the choice of anaesthesia matters.

The mean age of patients in study by Mehrabi S et al., was 40.0±14.3 years whereas in our study was 38.0±17.1 years [11], and the mean operative time was 95.0±37.8 minutes which is higher as compared to our study (80.0±25.9 minutes). The mean calculus size in their study was 34.2±9.8 mm whereas it was found 30.2±11.8 mm in our study. Return of sensory and motor activity in our study 140.0±19.7 v/s 150.0±29.2 minutes and 121.0±23.8 v/s 111.0±18.8 minutes respectively. In 15 patients (1.29%) mild sedation in form of ketamine and fentanyl was required to sedate the patient. Although incidence of pleural puncture was more in our study than others because of supracostal type of puncture used in many patients, it was managed with placement of Intercostal Tube Drainage (ICTD). Though, most of the pleural punctures did not required ICTD insertion.

Stoller ML et al., showed that the incidence of blood transfusion in uncomplicated single puncture PCNL was 14%, with an average decrease of 2.8 g/dl in haemoglobin concentration [12]. While in our study incidence of blood transfusion was 6.2% and the mean haemoglobin decrease was 1.6±0.8 g/dl. This was probably due to less stone bulk in our study than Stoller ML. Many studies had claimed that SA also results in comparatively less or similar intraoperative bleeding than GA in PCNL surgeries [13-16]. Although the reported rate of transfusion during PCNL is about 5% to 12% [13]. In our study 6.2% (72 patients) required transfusion. Overall, these data confirmed that SA is safe and comparable in terms of intraoperative bleeding during PCNL.

Mehrabi S et al., compared the efficacy and complications of SA versus GA in PCNL [11]. The incidence of hypotension, headache and low back pain in postoperative period were more in SA group than the GA group with a significant difference ($p < 0.05$). Need of narcotic medications was also less in SA group than GA of morphine sulphate respectively (12.4±3.1 mg v/s 7.8±2.3 mg) ($p = 0.03$). The average 125 mg Tramadol was used in our study within first 24 hours. The cost of anaesthetic drugs was 23±3.7 US \$ and 4.5±1.3 US \$ in Groups 1 and 2, respectively ($p = 0.001$) They concluded that SA with bupivacaine and fentanyl is a safe, reliable as well as cost effective method compared to the GA group for performing PCNL in adult patients. In our study we did not compare the cost of anaesthetic drugs.

Movasseghi G et al., compared the preference of SA or GA for PCNL [17]. The haemodynamic parameters (MAP and PR) showed no significant variability at same time points between two groups ($p > 0.05$). The duration of surgery and anaesthesia, amount of bleeding, and requirement of analgesic were significantly less in SA group ($p < 0.05$). In our study total surgical time was less in comparison to this study probably because of less stone burden and concludes that in patients undergoing PCNL, SA is as effective and safe as GA. The similar conclusion was also made by Mehrabi S et al., who evaluated intraoperative and postoperative anaesthetic and surgical outcomes in 160 patients who underwent PCNL under SA in the prone position and concluded that the SA is safe as well as effective type of anaesthesia and is a good alternative of GA in adult patients for PCNL [18]. Kuzgunbay B et al., also concluded that PCNL can be done under SA to the satisfaction of the patient, surgeon and anaesthesiologist [19].

Borzouei B and Mousavi-Bahar SH studied the safety and efficacy of PCNL under SA in patients with renal calculi in 387 patients over nine years with large stones of the upper urinary tract, in regard to the effectiveness and side effects [20]. In their study the success rate was 94.1%. The complications happened in 11.6% patients. They concluded that PCNL under SA is feasible, safe and well tolerated in patients with renal stones.

Our study showed that SA might be suitable type of anaesthesia, provided that surgeon is used to this technique. The pleural puncture was detected early in GA. Recently, a review article published by Malik I and Wadhwa R concluded that GA is safe for complicated or prolonged procedures [21]. RA is preferred only when the surgical team has a high degree of expertise and the procedure is uncomplicated.

Ninety percent of the patients had complete clearance of calculus or there were no significant residual calculi larger than 5 mm on follow up ultrasonography in our study. The success rate was 89% in study by Abraham AA and Das V [22], while 94% in study by Bulut E et al., [23]. Shah R et al., found that stone success rate was similar in RA and GA group; and concluded that SA is a safe and effective method in performing PCNL [24].

LIMITATION

The limitation of our study was that we did not compare our results of PCNL under SA with GA Future research is needed to study the impact of SA or GA on patients undergoing PCNL.

CONCLUSION

Our data showed that SA combined with sedation was good method of anaesthesia for PCNL in adult patients with overall low cost of anaesthesia and without major complications. The communication between the surgical and anaesthesia teams is mandatory to plan the correct preoperative management technique for every patient.

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