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A Critical Evaluation of Safety and Efficacy of Spinal Anesthesia in Comparison with General Anesthesia in Percutaneous Nephrolithotomy

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Abstract

Context: Percutaneous nephrolithotomy (PCNL) under general anesthesia plays a major role in larger size kidney stones, but in many times spinal anesthesia will be more advantageous owing to better hemodynamic stability and also equally effective in relieving pain. *Aim:* The aim of this current study is to compare the safety and effectiveness of spinal anesthesia with general anesthesia in percutaneous nephrolithotomy. *Settings and Design:* It is a randomized prospective study done in MelmaruvathurAdhiparasakthi Institute of Medical sciences and research from April 2016 to April 2018. *Methods and Material:* 100 patients who were undergoing PCNL were randomly selected and divided into two groups. Group SA (n=50) received total dose 3.4 ml of 0.5% hyperbaric Bupivacaine with 0.6mg of Nalbuphine. Group GA (n=50) received premedication with Glycopyrolate and Fentanyl and they were anesthetised with Propofol and Succcinylcholine Anesthesia was maintained with Vecuronium and N_2O/O_2/Isoflurane. Heart rate, mean arterial blood pressure and complications like hypotension, bradycardia were recorded intraoperatively and postoperatively. *Statistical analysis used:* Statistical analysis were calculated with the graph pad prism 5.0 software. The data were expressed as a mean and standard deviation.All the quatitative variables were analysed using Unpaired t-test. *Results:* Pulse rate at 5, 10, 45, 60 minutesintra operatively and at 0, 3, 5 hours postoperatively were significantly less in patients receiving spinal anesthesia group when compared to general anesthesia group ($p<0.0001$). Mean arterial pressure at 5, 10, 15, 20, 25, 30, 45, 60 minutes intra operatively and at 0, 3, 5 hours postoperatively was found to be less in spinal anesthesia group then the GA group ($p< 0.0001$). The VAS score at 0, 3, 5, 8 hours was found to be less and statistically significant in spinal anesthesia group as compared to general anaesthsia group (0.66±0.51/4.14±0.75, 1.38±0.49/5.4±0.61, 1.8±0.45/4.32±0.47, 3.78±0.58/4.34±0.47). Moreover analgesic requirement of tramadol more than 100mg was lower in SA group than GA group. *Conclusions:* Our study shows that spinal anesthesia for PCNL is relativelysafe and equally effective alternative to general anesthesia with better hemodynamic stability, lower postoperative pain, minimal analgesic requirements, and early recovery.

Keywords: PCNL; Spinal Anesthesia; VAS Score; General Anesthesia; Hemodynamics, Analgesia.

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Introduction

Urinary tract stone is a major and common health problem with an increasing incidence, prevalence and frequency of recurrence . PCNL is a choice of treatment for removing large pelvic stones, upper ureteric stones and staghorn stone [1-3]. It is a minimally invasive procedure but usually done under general anesthesia. However PCNL done under GA have risk of developing postop atelectasis. Moreover other complications of GA like nausea, vomiting, drug reactions, displacement of ET tube, injury to tongue, rarely spinal cord injury while shifting the patient

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from supine to prone can also occur. Whereas Spinal anesthesia provide less drug intake, reduced intraoperative bleeding and less postoperative pain and reduced requirement of analgesic [4-7]. The important factor in spinal anesthesia is the hemodynamic variation likely the hypotension and bradycardia [8-13]. Some studies have quoted that spinal anesthesia has better outcomes with less cost when compared to GA. However, there is no such studies done in comparison made by BP and PR during intra and postoperatively [1-3]. Hence, in this study, in addition to efficacy we tend to compare the safety of SA in terms of hemodynamic variables such as heart rate and their mean arterial pressure during surgery and postoperatively.

The aim of this current study is to compare the safety and effectiveness of spinal anesthesia with general anesthesia in percutaneous nephrolithotomy by comparing the heart rate, mean arterial pressure and pain.

Materials and Methods

Hundred (100) patients of ASA physical status I & II which includes both male and female, in the age group of 20 to 55 years who were scheduled for percutaneous nephrolithotomy with stone size of less than 2cm were enrolled in this study after getting ethical committee approval and obtaining informed written consent from the patient. This is a randomized control study which is done prospectively in Melmaruvathur Adhiparasakthi Institute of Medical Sciences & Research over a period of two years from April 2016 to April 2018.Patient with anticipated difficult intubation, cardiovascular disease, bleeding disorders,spinal anomalies, local site infections were excluded from this study. Patients were randomly allocated into two groups according to computer generated random number.

All patients were assessed and explained about visual analogue pain score, where zero indicates no pain, ten indicative of severe unbearable pain. Patients were premedicated as per our protocol with tablet Alprazolam 0.25 mg and tablet Ranitidine 150mg orally at night before the day of surgery. On arrival to the preoperative room, patient was cannulated with 18 gauge iv cannula into the peripheral vein, ringer lactate infusion were started as per perioperative fluid requirement. Monitors like noninvasive blood pressure, ECG and SpO_2 were connected. Patient were then shifted to operative room.

Group SA patients received a total volume 3.4 ml of 0.5% hyperbaric Bupivacaine with an adjuvant of 0.6mg of nalbuphine at L3-L4 intervertebral space in lateral position using 26 gauge quinke's needle. Adequacy of Sensory blockade (T6) was checked by a 24 g hypodermic needle. Adequacy of motor blockade was assessed with bromage scale. Intraoperative fall in BP is corrected with Inj.Ephedrine 6 mg IV stat with IV fluid rush. Before shifting the patient to prone position we make sure that the level is fixed and does not go beyond T5 and other measures to prevent high spinal like using soft small towel rolls under the chest and pelvis instead of regular boldsters, keeping the OT Table flat throught the procedure were taken.

Group GA patients received General Anesthesia. All patients were premedicated with Inj. Glycopyrolate 0.2 mg and Inj. Fentanyl 2ug/kg iv 10 min before inducing the patient, then after adequate preoxygenation for 3-5 minutes with 100% oxygen General anesthesia was induced with Inj.Propofol 2mg/kg and intubation facilitated with Inj.Succinylcholine 2mg/kg, patients were intubated with appropriate size ET tubes and connected to ventilator after confirming bilateral air entry. Anesthesia was maintained with Inj.vecuronium and isoflurane 1% and N_2O & O_2 in a ratio of 50/50. Once the procedure was over, after getting adequate attempts patients were reversed with Inj.Neostigmine 40 ug/kg and Inj.Glycopyrolate 4 ug/kg and patients were extubated, when full motor power and spontaneous respiration was established.

Patients were monitored for heart rate, mean arterial pressure and oxygen saturation intraoperatively at 0, 5, 10, 15, 20, 25, 30, 45, 60 minutes respectively.

Patients were monitored for 12 hours (0, 3, 5, 8, 10, 12) in SICU for heart rate , mean arterial pressure, and VAS scoring. Patients were also observed for any post operative complications like nausea, vomiting hypotension, bradycardia, back pain and postural headache. The Visual analog score is a psychometric pain response scale which is a horizontal line starting from no pain which is indicated as 0 to worst pain which is indicated as 10. Patient were asked to mark on the line when he feels which type of pain. Patients who has a VAS score greater than 4 will receive 100 mg of tramadol intravenously.

Statistical analysis were calculated with the graph pad prism 5.0 software. The data were expressed as a mean and standard deviation. All the quatitative variables were analysed using Unpaired t-test. A value is considered statistically significant if the 'p' value of <0.0001 .

Results

A total of 100 patients were enrolled in this study. In both groups Patients were comparable with respect to Age, ASA physical status, sex, weight and duration of surgery as shown in Table 1. The Table 2 & 3 shows that at 5, 10, 45, 60 minutes the intra operative mean pulse rate in SA group is statistically significant from GA group (p <0.0001) and at 0, 3, 5 hours the postoperative mean pulse rate in SA group is statistically significant from GA group (p<0.0001). When mean arterial pressure compared between the two groups statistically significant (p<0.0001) differences were observed at 5, 10, 15, 20, 25, 30, 45, 60 minutes in intra operative and at 0, 3, 5 and 8 hours postoperative period respectively as shown in Table 4 & 5. When compared the VAS score between the two groups, statistically significant differences were found at 0, 3, 5, 8 hours postoperatively Table 6 (p <0.0001) . Analgesic requirement of tramadol more than 100mg is less in SA group when compared to GA group as shown in Table 7.

Table 1: Demographic data and duration of surgery

Data	Group SA	Group GA	P value
Age	41.92±9.24	43.38+9.41	0.4359
ASA(I:II)	36:14	37:13	
Sex(male:female)	30:20	28:22	
Weight	59.74±6.83	61.52±6.15	0.1743
Duration of surgery	84.30±1.40	88.6±2.23	0.1058

Data are presented as mean±SD, SD: Standard Deviation, and number of patient as percentage ASA.American Society of Anesthesiologist

Table 2: Comparison of intraoperative pulse rate

Time Interval(MIN)	SA Group	GA Group	P value
0	76.50±7.14	76.26±7.12	0.8667
5	87.90±3.29	98.42±6.24	P<0.0001
10	84.12±2.56	87.74±3.33	P<0.0001
15	89.52±3.44	89.35±4.71	0.8356
20	85.70±3.41	85.68±4.47	0.9800
25	81.86±2.00	82.10±4.25	0.7191
30	89.64±4.02	89.54±4.62	0.9085
45	85.96±2.70	90.68±3.83	P<0.0001
60	83.76±2.51	92.82±4.26	P<0.0001

Data are presented as mean= ± SD, p<0.0001 is statistically significant, SD: Standard Deviation

Table 3: Comparison of Postoperative pulse rate

Time Interval(HOURS)	SA Group	GA Group	P Value
0	82.32±1.99	95.50±4.24	P<0.0001
3	84.32±2.14	90.20±4.09	P<0.0001
5	85.74±2.73	90.76±4.62	P<0.0001
8	84.30±2.36	85.40±2.65	0.0309
10	88.70±2.46	87.68±3.39	0.0885
12	88.16±2.72	89.20±3.72	0.1148

Data are presented as mean=±SD, p<0.0001 is statistically significant, SD: Standard Deviation

Table 4: Comparison of intraoperative mean arterial pressure

Time Interval (MIN)	SA Group	GA Group	P value
0	94.82±4.89	93.54±13.26	0.5234
5	86.68±3.08	107.5±4.9	P<0.0001
10	82.14±2.69	102.2±3.51	P<0.0001
15	76.82±3.14	94.20±3.75	P<0.0001
20	73.96±2.77	85.48±4.69	P<0.0001
25	80.02±3.31	88.20±3.67	P<0.0001
30	81.76±2.76	84.74±2.38	P<0.0001
45	86.40±3.08	93.32±2.83	P<0.0001
60	89.60±4.47	97.52±7.65	P<0.0001

Data are presented as mean=±SD, p<0.0001 is statistically significant, SD: Standard Deviation

Table 5: Comparison of postoperative mean arterial pressure

Time Interval (HOURS)	SA Group	GA Group	P value
0	89.86±4.13	101.5±3.89	P<0.0001
3	89.32±4.04	100.5±3.77	P<0.0001
5	87.42±3.87	99.82±4.98	P<0.0001
8	90.56±2.61	86.84±4.59	P<0.0001
10	92.74±3.06	94.88±3.43	0.0014
12	94.48±3.08	92.72±3.18	0.0060

Data are presented as mean= ± SD, p<0.0001 is statistically significant, SD : Standard Deviation

Table 6: Comparison of visual analog scale

Time Interval (HOURS)	SA Group	GA Group	P value
0	0.66±0.51	4.14±0.75	P<0.0001
3	1.38±0.49	5.4±0.61	P<0.0001
5	1.8±0.45	4.32±0.47	P<0.0001
8	3.78±0.58	4.34±0.47	P<0.0001
10	3.14±0.35	3.24±0.43	0.2063
12	3.5±0.5	3.3±0.4	0.0416

Data are presented as mean= ± SD, p<0.0001 is statistically significant, SD: Standard Deviation

Table 7: Comparison of analgesic demand

Analgesic Demand up to 24 HRS	SA Group		GA Group	
	No	%	No	%
<100 MG	38	76	15	30
>100 MG	12	24	35	70
Total	50	100	50	100

Discussion

PCNL is the treatment of choice for removing large pelvic stones, upper ureteric stones, staghorn stone and in case of failed ESWL since it is a minimally invasive procedure . Although PCNL is done under GA because it needs prone position , it has its own merits and demerits. The risk of complications related to position, multi drug exposure, atelectasis etc are all associated with general anesthesia. Now a days PCNL under spinal anesthesia is gaining popularity. There are also several studies which shows that surgeries which required prone position can also be done spinal anesthesia without having major complications [8-14]. It has many advantages like simple technique, prolonged postoperative pain relief, reduced need of analgesic requirement and reduction of side effects from multildrug exposure from GA [2-4]. Kuzgunbay et al. shown that combined spinal - epidural anesthesia is a relatively easy technique in PCNL operations, as the efficacy is same like that of general anesthesia and safety were also not affected in spinal anesthesia [1].

The present study compared the hemodynamic changes, visual analog scale, postoperative analgesic requirements and side effects between spinal and general anesthesia in 100 patients over a period of two years who underwent PCNL surgery. Patients were comparable in both groups with respect to demographic details like age, ASA physical status, weight and sex. When compared the VAS score between the two groups, statistically significant differences were found at 0 (0.66±0.51, 4.41±0.75), 3 (1.38±0.49, 5.4±0.61), 5 (1.8±0.45, 4.32±0.47), 8 (3.78± 0.58, 4.34±0.47) hours postoperatively. Analgesic requirement was low in group SA when compared with group GA. In this study statistically significant difference is found when hemodynamic changes like mean pulse rate intraoperatively at 5, 10, 45 & 60 mins and postoperatively at 0, 3, 5 hours respectively. Similarly statistically significant difference is found in the mean arterial pressure observed intraoperatively (i.e, 5 to 60 mins) except the baseline measurement and postoperatively at 0, 3, 5 and 8 hours respectively.

Similar to our results , Elbealy et al also found that the mean arterial pressure was significantly lower in regional anesthesia group when compared with GA group from 5 to 90 mins intraoperatively following anesthesia [5].

Movasseghi G et al observed that spinal anesthesia is as effective and safe as general anesthesia for PCNL Surgeries. Patients in spinal anesthesia group required smaller amount of analgesics and better hemodynamic stabillity during surgery and recovery [4].

In our study, We compared the VAS score between the two groups, and it was statistically significant at 0, 3, 5, 8 hours postoperatively. Analgesic requirement was low in group SA when compared with group GA. . Karasu D et al. found the Postoperative analgesic requirement was assessed using the Visual Analog Score (VAS). Patients with VAS >3 were given 75 mg diclofenac sodium for analgesia.It has been found that the number of the patients who needs a rescue analgesic within the 1st hour postoperative was significantly higher in General anesthesia group when compared to Regional anesthesia group [6]. Cicek et al demonstrated that PCNL under SA patients have shorter duration of surgery, minimal analgesic requirements and shorter hospitalization [7]. Tangpaitoon et al found that postoperative tramadol requirement was found to be lower in regional anesthesia group when compared to general anesthesia group [8].

Conclusion

The present study concludes that spinal anesthesia is relatively a safe and effective alternative to general anesthesia for PCNL surgery, which is associated with better hemodynamic stability, lower postoperative pain, minimal analgesic requirements, and early recovery of the patients.

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Conflict of Interest

No conflict of interest.

Key Messages

Spinal anesthesia can be a safe and effective technique for PCNL surgery when compared to General anesthesia due to better hemodynamic stability and it can avoids all complications of general anesthesia.

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