Spinal Anesthesia Is an Efficient and Safe Anesthetic Method for Percutaneous Nephrolithotomy

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OBJECTIVE To investigate the effect of spinal anesthesia (SA) vs general anesthesia (GA) administration on the safety and efficiency of percutaneous nephrolithotomy (PCNL).

METHODS We retrospectively evaluated 1478 patients who underwent PCNL in our clinic between 2004 and 2011. We excluded the patients with bilateral PCNL, renal abnormality, or solitary kidney. The remaining 1004 adult patients were divided into 2 groups according to anesthesia administration as GA (n = 564) or SA (n = 440). The groups were compared according to operative and postoperative properties. Complications of PCNL were evaluated according to the modified Clavien classification. Independent *t* test, chi-square test, and analysis of covariance were used for the comparison of groups.

RESULTS The durations of hospitalization, operation, and fluoroscopy of patients in the SA group were significantly shorter than that of the patients in the GA group ($P < .01$). The number of patients with postoperative requirement of narcotic analgesic and blood transfusion was significantly higher in the GA group ($P < .01$). The GA group had more grades 2, 3a, 3b, and 4b complications according to modified Clavien classification ($P < .05$). The significant differences in postoperative analgesic requirement and hospitalization duration between the groups did not affect postoperative urinary drainage ($P < .01$; adjusted $r^2 = 0.064$).

CONCLUSION PCNL with SA demonstrated shorter hospitalization, operation, and fluoroscopy durations. GA has some disadvantages as a greater requirement of narcotic analgesic and greater frequency of major complications. SA administration is a safe and effective method in appropriately selected patients with PCNL. UROLOGY 83: 50–55, 2014. © 2014 Elsevier Inc.

Percutaneous nephrolithotomy (PCNL), which has been described by Fernström and Johansson,[1] is widely used for the treatment of large kidney stones, symptomatic stones after unsuccessful shock wave lithotripsy, and kidney stones with obstruction.[2] PCNL has a lower frequency of complications when compared with open surgery in urinary system stone diseases.[3] Although Michel et al[4] reported the total complication ratio in PCNL operations as 83%, most of these complications could be treated using conservative methods or minimally invasive treatments. The modified Clavien classification (MCC) has been used by various researchers for postoperative complications of PCNL.[5,6] de la Rosette et al[7] also reported the validation of MCC for use in PCNL.

The commonly applied anesthetic method in PCNL procedure is general anesthesia (GA).[1,8] Nevertheless, the application of GA can cause pulmonary complications, drug side effects, and increased intraoperative hemorrhage.[9-11] As a result, in a limited number of studies, PCNL has been applied under regional anesthesia in an effort to decrease morbidity and mortality.[12-15] It has been reported in these studies that the efficacy of the operation did not change with regional anesthesia, whereas the requirement of postoperative analgesics decreased.[12,13,15]

We aimed to compare the effects of GA and spinal anesthesia (SA) on the efficacy and safety of PCNL in a wide series of patients, retrospectively. In our study, the complications of PCNL using the different anesthesia methods were compared according to MCC.

MATERIALS AND METHODS

We included 1478 patients who underwent PCNL between 2004 and 2011. The demographic data, operation characteristics,

This study was approved by the Baskent University Institutional Review Board (Project No: KA11/231).

Financial Disclosure: *The authors declare that they have no relevant financial interests.*

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Submitted: April 22, 2013, accepted (with revisions): August 17, 2013

0090-4295/14/$36.00
http://dx.doi.org/10.1016/j.urology.2013.08.064

and postoperative complications of the patients were evaluated retrospectively according to information obtained from the medical records of patients. Patients younger than 18 years and those with bilateral PCNL, renal anomalies, or solitary kidney were excluded from the study. The remaining 1004 patients were divided into 2 groups according to the anesthetic method applied. Group GA (n = 564) included patients who had been treated with PCNL under GA, and group SA (n = 440) included patients who had been treated with PCNL under SA. The patients in both the groups underwent PCNL operations in the same time frame. PCNL operations were performed by the same surgical team, including 6 experienced surgeons. The initial patients with PCNL in 2004 were excluded to preserve the effect of learning curve. The demographic data and preoperative American Society of Anesthesia risk groups of patients, hospitalization, operation and fluoroscopy durations, stone burden, the percentage of blood hemoglobin change during the operation, preoperative and postoperative serum creatinine levels, success rate of operations, postoperative analgesic requirement, and postoperative complications were compared between the 2 groups.

The dimensions of the stones were determined through direct urinary system graphy, intravenous pyelography, or computed tomography, and their surface areas were computed using the formula: "Stone Area = l.w.π.0.25".[16] The stones were classified as pelvis, calyx, pelvis + calyx, proximal ureter, or staghorn according to localizations. The presence of residual stones was checked by fluoroscopy at the end of the procedure as the standard radiological evaluation in all patients. Stones <4 mm were accepted as clinically insignificant residual fragment, whereas those greater than this dimension were considered as residual stones. All the patients were administered prophylactic antibiotics, and their treatment was continued after 12 hours with intravenous antibiotics.

Symptomatic patients with hematocrits <30 were administered erythrocyte suspension. All patients were administered intravenous nonsteroidal anti-inflammatory analgesics in the early postoperative period. Those patients who continued to suffer pain after these analgesics were administered meperidine. The MCC was used for the classification and comparison of the postoperative complications.[17]

Patients with abnormal coagulation, intracranial mass, history of intracranial surgery, cellulites or malignancy in lumbar area, or mental retardation were not administrated SA. The choice of the patient was also important in the method of anesthesia administration.

SA Technique

In the SA group, each patient had been administered 15 mg/kg normal saline solution at 20-30 minutes through intravenous infusion in the supine position. After this medication, 15-20 mg of levobupivacaine was administered through the intervertebral gap L2-L3 into the subarachnoid space with a 25-gauge needle in the lateral decubitus position. Midazolam (2.5 mg) was also administered intravenously for sedation.

GA Technique

In the GA group, 2.5 mg/kg propofol and 1 mg/kg fentanyl were used intravenously in the initial period of anesthesia. After this medication, 1.0%-2.0% isoflurane and 50% nitrous oxide in oxygen were maintained. Tracheal intubation of patients was facilitated with 0.5 mg/kg atracurium intravenously. The ventilator (Siemens Kion Anesthesia Work Station model SC 7000 ENG, Danvers, MA) was used to support the patients after endotracheal intubation. Respiration rate of patients was set at 10-12/min with tidal volume (8-10 mL/kg). The residual neuromuscular block was reversed by using 0.5 mg atropine and 1 mg neostigmine intravenously at the end of the surgery.

Table 1. Preoperative characteristics of patients

Preoperative Characteristic	Group GA (n = 564)	Group SA (n = 440)	*P* Value
Age (median/y)	47.2 ± 13.83	48.8 ± 14.03	.08
Sex M/F (%)	60.1/39.9	64.3/35.7	.17
Stone location			.16
Calyx	36.5% (206)	36.6% (161)	
Pelvis	22.5% (127)	16.8% (74)	
Pelvis + calyx	31.2% (176)	33.9% (149)	
Proximal ureter	3.4% (19)	4.3% (19)	
Staghorn	6.4% (36)	8.4% (37)	
ASA			.94
ASA I	54.3% (305)	54.1% (238)	
ASA II	38.8% (218)	38.4% (169)	
ASA III	6.9% (39)	7.5% (33)	

ASA, American Society of Anesthesia; GA, general anesthesia; SA, spinal anesthesia.

Surgical Technique

Under GA or SA, a 5F or 6F ureteral catheter was used for retrograde catheterization with a cystoscope in lithotomy position. The ureteral catheter was fixed to the Foley catheter for bladder drainage. Then, the patient was turned to the prone position, and the targeted calyx was entered with an 18-gauge needle under a biplane fluoroscopy. Amplatz dilators were used for dilation and a 30F sheath was placed, and the standard PCNL procedure was applied. A pneumatic lithotripter was used in all patients. The fractured stones were collected by a 26F rigid nephroscope and a grasping forceps.

Statistical Analysis

The Statistical Package for the Social Sciences, version 17.0 (SPSS Inc., Chicago, IL) was used in the statistical analysis. The groups were compared using the independent *t* and the chi-square tests. Values of $P < .05$ were accepted as statistically significant. The analysis of covariance test was used in the evaluation of the effects of the type of urinary drainage on the requirement of postoperative analgesics and the durations of hospitalization, operation, and fluoroscopy.

RESULTS

The preoperative characteristics of the patients in both the groups are given in Table 1 . There was no significant difference between the 2 groups of patients regarding age, sex, stone localization, or American Society of Anesthesia risk groups. The operation results of all patients are given in Table 2 . The hospitalization, operation, and fluoroscopy durations were significantly longer in group GA than in group SA ($P < .01$). Although the success ratio of the operation was similar between groups, there were significant differences between groups with respect to postoperative drainage methods and postoperative analgesic requirement. Postoperative percutaneous tube