Percutaneous Nephrolithotomy: Comparison of the Efficacies and Feasibilities of Regional and General Anesthesia

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Purpose: To compare surgical outcomes and complications after percutaneous nephrolithotomy (PCNL) under regional or general anesthesia.

Materials and Methods: One hundred and one patients who underwent PCNL as a first-line treatment for kidney calculi between June 2004 and June 2013 were enrolled in this retrospective study. Patients were classified into two groups by anesthetic method: 77 were allocated to the regional anesthesia group and 24 to the general anesthesia group. Patient general characteristics, stone features, surgical outcomes, and complications were compared between the two groups.

Results: 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 (8.9±3.2 days vs. 11.5±6.9 days, respectively, p=0.025). Also, the postoperative fever rate was significantly higher in the general anesthesia group (53.2% vs. 83.3%, respectively, p=0.007).

Conclusions: Regional anesthesia is as effective as general anesthesia during percutaneous nephrolithotomy and is associated with shorter hospital stays and lower rates of postoperative fever.

Keywords: Anesthesia; Kidney calculi; Percutaneous nephrolithotomy

INTRODUCTION

Various modalities, such as percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy, and retrograde intrarenal surgery, are used to manage renal stone disease [1-3]. However, PCNL is regarded as the treatment of choice for most renal stones, especially for patients with a large renal stone (>2 cm), an infected stone, or a cystine stone and for those with a history of failed shock wave lithotripsy [4,5].

General anesthesia during PCNL has many advantages, for example, it enables breathing control and improves patient comfort [6]. Thus, at most experienced centers, PCNL is usually performed under general anesthesia [7]. However, associated complications and cost are higher for general anesthesia than for regional anesthesia [8]. For example, endotracheal tube migration and neurologic problems, particularly at the time of position transition, may arise during PCNL under general anesthesia [9]. Unfortunately, few research studies have been conducted to compare regional and general anesthesia with respect to operative parameters [10]. In the present study, therefore, to determine whether PCNL under regional anesthesia is a better alternative than PCNL under general anesthesia, we examined surgical outcomes after these two procedures.

MATERIALS AND METHODS

One hundred and one consecutive patients who underwent PCNL as a first-line management for renal stones, including staghorn, pelvic, and calyceal stones, from June 2004 to June 2013 at Inje University Sanggye Paik Hospital...
were included in this retrospective study. This study was conducted according to the Declaration of Helsinki [11]. The patients were classified into two groups by anesthesia method: a regional anesthesia group (n=77) and a general anesthesia group (n=24). Decisions regarding anesthesia method were mainly based on considerations of medical status, such as cardiac problems and the presence of respiratory illness or coagulopathy. In the absence of such factors, regional anesthesia was performed on the basis of surgeon or patient preference. The contraindications for PCNL were uncorrected coagulopathy, congenital renal anomaly, and metastatic malignancy.

In addition to history taking, we performed a physical examination, preoperative laboratory tests, and a radiological evaluation, which included plain radiography of the kidney-ureter-bladder (KUB) region and abdominopelvic computed tomography (CT). Stone size was defined as the sum of the maximal lengths of renal stones on CT images. Patients with a urinary tract infection were treated preoperatively in accordance with urine culture sensitivity. Blood transfusions were done in the operating room on the basis of decisions made by anesthesiologists.

Statistical analysis was performed by using SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). Because the number of patients in the general anesthesia group was small (n=24), continuous variables were assessed by using the Mann-Whitney test, and categorical variables were analyzed by using the chi-square test. Clinical parameters are expressed as mean±standard deviations, and statistical significance was accepted for p-values <0.05.

RESULTS

Patient and stone characteristics in the regional and general anesthesia groups are compared in Table 1. Mean ages in these groups were 54.8±12.2 years and 50.8±17.8 years, respectively (p=0.338). Gender and body mass index were nonsignificantly different, and mean stone sizes (34.5±24.0 mm and 42.3±36.1 mm, respectively; p=0.309), mean stone numbers (2.0±2.4 and 2.9±5.1, respectively; p=0.648), and the distributions of renal stones were similar (p=0.254).

Operative outcomes are summarized in Table 1. Intergroup differences between initial stone-free rates (68.8% and 41.7%, respectively; p=0.246) and overall stone-free rates (80.5% and 66.7%, respectively; p=0.371) were nonsignificantly different. No significant intergroup differences were found between mean surgical times (143±72 minutes and 151±112 minutes, respectively; p=0.185) or changes in hemoglobin levels (-1.6±1.2 g/dL and -1.7±1.3 g/dL, respectively; p=0.734) in the regional and general anesthesia groups. Furthermore, white blood cell levels were not significantly changed in the two groups (3,883±3,110/µL and 3,910±3,509/µL, respectively; p=0.480). However, mean hospital stay was significantly shorter in the regional anesthesia group (8.9±3.2 days vs. 11.5±4.9 days, respectively; p=0.025).

Perioperative complications were investigated by using the modified Clavien grading system, and the results are summarized in Table 2. A smaller proportion of patients in the regional anesthesia group experienced postoperative fever (p=0.007). However, mean dosages of anti-pyretics (p=0.397), analgesics (p=0.800), antiemetics (p=0.179), and diuretics (p=0.737) administered were not sig-
TABLE 1. Comparison of patients' characteristics and operative outcomes

| Characteristic                  | Regional anesthesia group (n=77) | General anesthesia group (n=24) | p-value |
|--------------------------------|---------------------------------|-------------------------------|---------|
| Patient                        |                                 |                               |         |
| Age (yr)                       | 54.8±12.2                       | 50.8±17.8                     | 0.338   |
| Gender (M:F)                   | 47:30                           | 14:10                         | 0.746   |
| Body mass index (kg/m²)        | 25.1±3.9                        | 23.3±2.8                      | 0.053   |
| Stone                          |                                 |                               |         |
| Laterality (right:left:bilateral) | 32:44:1                         | 9:13:2                        | 0.594   |
| Stone size (mm)                | 34.5±24.0                       | 42.3±36.1                     | 0.309   |
| Stone number                   | 2.0±2.4                         | 2.9±5.1                       | 0.648   |
| Stone location                 |                                 |                               |         |
| Complete staghorn stone        | 12                              | 3                             | 0.254*  |
| Partial staghorn stone         | 19                              | 7                             |         |
| Pelvis stone                   | 40                              | 10                            |         |
| Calyceal stone                 | 6                               | 4                             |         |
| Operative outcomes             |                                 |                               |         |
| Surgical time (min)            | 143±72                          | 151±112                       | 0.185   |
| Change in hemoglobin level (g/dL) | –1.6±1.2                     | –1.7±1.3                      | 0.734   |
| Change in WBC level (/μL)      | 3,883±3,110                     | 3,910±3,509                   | 0.480   |
| Hospitalization stay (d)       | 8.9±3.2                         | 11.5±6.9                      | 0.025   |
| Initial stone-free rate        | 53 (68.8)                       | 10 (41.7)                     | 0.246   |
| Overall stone-free rate        | 62 (80.5)                       | 16 (66.7)                     | 0.371   |
| Re PCNL or postoperative ESWL  | 25                              | 7                             | 0.135   |

Values are presented as mean±standard deviation or number (%). WBC, white blood cell; PCNL, percutaneous nephrolithotomy; ESWL, extracorporeal shock wave lithotripsy. *:Chi-square comparison with linear by linear test.

TABLE 2. Complications of PCNL according to the modified Clavien grading system

| Characteristic                  | Regional anesthesia group (n=77) | General anesthesia group (n=24) | p-value |
|--------------------------------|---------------------------------|-------------------------------|---------|
| Grade I                        |                                 |                               |         |
| Fever (>37.7°C)                | 41 (53.2)                       | 20 (83.3)                     | 0.007   |
| Antipyretics                   | 0.32±0.72                       | 0.57±0.93                     | 0.397   |
| Analgesics                     | 1.9±1.8                         | 1.9±1.9                       | 0.800   |
| Antiemetics                    | 0.2±0.5                         | 0.1±0.2                       | 0.179   |
| Diuretics                      | 0.1±0.4                         | 0.2±0.6                       | 0.737   |
| Grade II                       |                                 |                               |         |
| Blood transfusion (pint)       | 0.3±0.9                         | 0.3±0.7                       | 0.811   |
| Grade III or IV                | -                               | -                             |         |

Values are presented as mean±standard deviation or number (%). PCNL, percutaneous nephrolithotomy.

significantly different. Furthermore, the mean number of pints of blood transfused per patient was similar in the two groups (0.3±0.9 vs. 0.3±0.7, respectively; p=0.811). No patient experienced a grade III or IV complication according to the modified Clavien grading system.

DISCUSSION

PCNL remains the first-line treatment of choice for managing renal stone disease, although minimally invasive modalities, such as retrograde intrarenal surgery, have been introduced [4,5]. Furthermore, most urologists prefer general anesthesia for PCNL owing to the high level of anesthesia achieved, the ability to control the patient's breathing, and because it is more comfortable for patients [7,14]. However, general anesthesia is more likely to cause severe morbidities, such as drug-induced anaphylaxis, complications associated with endotracheal tube insertion, and cardiovascular, pulmonary, and neurologic complications, than is regional anesthesia [15]. Studies have been conducted to demonstrate the benefits of regional anesthesia in other types of surgery, such as radical retropubic prostatectomy [16] and total hip arthroplasty [17]. Salonia et al. [16] asserted that regional anes-
thesis permits fine muscle relaxation and achieves excellent surgical outcomes after radical retropubic prostatectomy. Furthermore, regional anesthesia has been reported to reduce the risk of intraoperative hemorrhage, to be associated with less postoperative pain, and to allow earlier restoration than general anesthesia [18-20]. In addition, Gonano et al. [21] reported that the cost of regional anesthesia is 40% less than that of general anesthesia during orthopedic surgeries.

Several comparative studies on anesthesia methods in PCNL have demonstrated various benefits for PCNL under regional anesthesia compared with general anesthesia. In a retrospective comparative study of 37 patients who underwent regional anesthesia and 45 who underwent general anesthesia, it was concluded that the results were comparable in terms of general profiles, operative times, and stone-free rates [14]. In another study of 50 patients who underwent PCNL, regional anesthesia was found to be associated with greater patient satisfaction, less early postoperative pain, and fewer adverse events than general anesthesia [15]. Furthermore, in a prospective randomized study on PCNL in 64 patients (32 general and 32 regional anesthesia), patients in the regional anesthesia group were found to have significantly lower postoperative analgesic demands and shorter hospitalization periods [7]. Corbel et al. [22] reported that general anesthesia increases the probabilities of fluid absorption and electrolyte imbalance, and other authors have recommended regional anesthesia for patients with an electrolyte imbalance, especially for morbidly obese patients [2,23].

Despite the opinion held by some that regional anesthesia is unsuitable for PCNL of calculi in the upper pole of the kidney [24], regional anesthesia (bupivacaine [Marcaine], 12–15 mg) can be used to anesthetize up to the T4 level (level of axilla) according to an anesthesiology textbook [25]. Furthermore, this allows enough access to the supra-costal and intercostals from this level. General anesthesia is associated with significant changes in the shape of the chest and alveolar gas contents. This process results in atelectasis and postoperative fever. Outside of that, these changes result in continued elevation of the risk for reintubation, mechanical ventilation, and nosocomial pneumonia, all of which prolong the hospital stay [26].

Regarding hospital stay, it was previously reported that average hospital stay is approximately 5 to 7 days regardless of anesthesia type [27]. However, in the present study, hospital stays were 8.9±3.2 days and 11.5±6.9 days, respectively, which could have been due to the exclusion of time spent at the hospital before surgery and the procedure used to determine the discharge date. In addition, according to a large-scale study, initial and overall stone-free rates were 69.9% and 88.8%, respectively [27], and another study conducted on 610 patients found corresponding rates of 57.6% and 84.9%, respectively [28]. In the present study, values were 68.8% and 80.5% in the regional anesthesia group and 42.9% and 71.4% in the general anesthesia group, which were relatively low and did not represent a significant intergroup difference. We attribute these differences to the different definitions used for the stone-free rate and patient descriptive features.

In brief, this retrospective study showed 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 PCNL under regional anesthesia than general anesthesia in matters of fever control and cost of hospitalization.

The present study had some limitations that deserve mention. First, it was inherently limited by its retrospective design; as such, lack of control of basic patient factors may have introduced bias. Second, the study was performed at a single center, and the general anesthesia group was appreciably smaller than the regional anesthesia group. Third, no attempt was made to assess patient satisfaction with treatment. Accordingly, we suggest that a prospective study is needed to confirm our results.

CONCLUSIONS

The present study showed that in terms of general characteristics and procedural success, the outcomes of PCNL conducted by use of regional or general anesthesia are similar. Nevertheless, PCNL with regional anesthesia required fewer hospital days and was associated with a lower postoperative fever rate. Accordingly, we conclude that PCNL under regional anesthesia is at least as advantageous as PCNL under general anesthesia in patients with kidney calculi.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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