



## RESEARCH ARTICLE

## Perioperative Outcome between Open Renal Stone-removal Surgery and PCNL in Patients with Staghorn Stones

Gede Wirya Kusuma Duarsa<sup>1\*</sup>, Arland Chandra<sup>2</sup>, Anak Agung Gde Oka<sup>1</sup>, I Wayan Yudiana<sup>1</sup>, Kadek Budi Santosa<sup>1</sup>, Tjokorda Gde Bagus Mahadewa<sup>2</sup>, Adinda Putra Pradhana<sup>3</sup>

- <sup>1</sup> Departments of Urology Faculty of Medicine Udayana University/Sanglah General Hospital Bali, Indonesia.
- <sup>2</sup> Departments of Surgery Faculty of Medicine Udayana University/Sanglah General Hospital Bali, Indonesia.
- <sup>3</sup> Departments of Anesthesia Faculty of Medicine Udayana University/Sanglah General Hospital Bali, Indonesia.

\*Corresponding Author: Gede Wirya Kusuma Duarsa

### Abstract

**Background:** Percutaneous nephrolithotomy (PCNL) has become the treatment of choice for staghorn stones, replacing open stone surgery. However, in a developing country, open stone surgery is still the treatment of choice due to its nature for not requiring endourology devices, it can be performed by a general surgeon, and it is financially acceptable. **Objective:** This study aims to compare the cost-related outcome between PCNL and open renal stone surgery in patients with staghorn stones. **Method:** Data were collected retrospectively, taken from patients' medical records who underwent PCNL and open stone surgery in three hospitals from 2016-2017. Seventy-eight patients were divided equally into PCNL group and open surgery group. Data of the hospital length of stay, the volume of blood loss during surgery, stone-free rate, and post-operative additional procedures were recorded. **Outcome Measurements and Statistical Analysis:** The data were analyzed using SPSS version 23.0 for Windows. **Results:** The hospital length of stay was shorter in PCNL compared to open stone surgery (3 vs. 4 days,  $p < 0.001$ ). The post-operative stone-free rate was lower in PCNL compared to open stone surgery (48.7 vs. 92.3%,  $p < 0.001$ ). More post-operative additional procedures were found in PCNL compared to open stone surgery ( $p < 0.001$ ). There was no significant difference in the amount of blood loss during surgery in both groups ( $p = 0.102$ ). **Conclusions:** PCNL is a minimally invasive procedure that is effective and safe for treating staghorn stones. Nevertheless, in places where PCNL is unavailable, open stone surgery can still be a choice for treatment.

**Keywords:** Percutaneous nephrolithotomy, Renal calculi, Cost, Length of stay, Stone-free rate, Developing country.

### Introduction

Urinary stone had been mentioned in ancient Egyptian writings since 1500 BC [1]. Stone-related kidney disease occurs in at least 12% men and 6% women in the US [2]. The annual rate for a male is 140.6 per 100 000 population, and 65.8 per 100,000 population for female [3]. In Indonesia, specifically Bali, the incidence of kidney stone was estimated around 0.7% [4]. Since the first successful removal of a renal stone via nephrostomy tract in 1976, percutaneous nephrolithotomy (PCNL) has become the

standard treatment for large renal stones, replacing open stone surgery [5,6]. PCNL offers shorter surgical time, fewer complications both intra- and post-operatively, less post-operative pain, high stone-free rate, and shorter length of stay [7]. In developing countries, major obstacles in the treatment of kidney stones are still present, like the lack of health insurance coverage, limited endourology devices, a limited number of urologists, and the high incidence of renal stones requiring immediate

treatment. Thus, unlike in other parts of the world, open stone surgery is still considered as the treatment of choice for staghorn stones. Despite being more invasive in nature, open stone surgery still offers a better stone-free rate, and it also requires less additional procedures, such as shockwave lithotripsy (SWL), to achieve stone free condition [5,6]. The goal of this study was to compare the cost-related outcome between PCNL and open renal stone surgery in patients with staghorn stones.

## Methods

This was a retrospective study involving 78 participants. Data were collected from medical records in three hospitals between January 2016 and December 2017. Inclusion criteria include patients with staghorn stones that underwent either PCNL or open stone surgery. Those with insufficient data, or requiring a conversion from PCNL to open stone surgery were excluded from the study.

The study was approved by the Committee of Ethical Research. Seventy-eight patients were enrolled and equally divided into two groups. The hospital length of stay, the volume of intraoperative blood loss, stone-free rate, and post-operative additional procedures were recorded. Data were analyzed using SPSS version 23, comparisons were made using the Mann-Whitney, Chi-square, and Kolmogorov-Smirnov tests. A p-value of less than 0.05 was considered statistically significant.

## Results

The baseline characteristics data of the subjects are shown in table 1. There were no significant differences between each group in terms of age, BMI (Body Mass Index), comorbidities, and the distribution of American Society of Anaesthesiologist (ASA) physical status. The proportion of male-to-female in our study were 82.1% vs. 17.29% in PCNL group, and 61.5% vs. 38.5% in the open surgery group ( $p=0.044$ ).

Perioperative outcomes are shown in table 2. There were significant differences in length of stay, stone-free rate, and a number of additional procedures. Length of stay was significantly shorter in PCNL (3(2-7) days) compared to open (4(3-9) days) ( $p<0.001$ ). Stone-free rate was significantly higher in open surgery compared to PCNL (92.3% vs 48.7%,  $p<0.001$ ).

A number of additional procedures were significantly higher in PCNL compared to open surgery ( $p<0.001$ ).

## Discussion

The EAU 2017 guidelines stated that the treatment of choice for kidney stones of  $>2$  cm in diameter was PCNL [8-10]. The stone-free rate after PCNL is considerably high. Being minimally invasive, PCNL provides a shorter length of stay, fewer complications, less post-operative pain, and minimal scarring in the flank region. PCNL however, requires endourology devices which is not readily available in most under-developed or developing countries in the world.

Therefore, the conventional, open stone-removal surgery cannot be totally abandoned. Despite being more invasive in nature, open surgery still provides a good stone-free rate. It is easily accessible even in remote hospitals. It is still the treatment of choice for complex kidney stones, failure of previous SWL/PCNL procedure, intrarenal anatomy disorder, and in some patients with comorbidities [7,11].

Kidney stones are more common in male than female [3, 4, 12, 13]. In this study, we found more males with kidney stones compared to females (82.1 vs. 17.9% in PCNL, 61.5 vs. 38.5% in open surgery;  $p=0.044$ ). Length of stay in PCNL group was shorter than those in the open group (3 (2-7) days and 4 (3-9) days,  $p<0.001$ ). Ahmed [7] and Aslim [14] reported similar reports on the hospital length of stay.

The longer length of stay in open stone surgery is correlated with higher morbidity, higher possibility of intraoperative complication, and a higher level of post-operative pain. Complications related to open renal stone surgery include bleeding, urine leakage, and post-operative infection. Any of these complications will significantly lengthen the stay [7, 14].

The amount of blood loss during surgery was calculated using the differences between haemoglobin pre- and post-surgery. In this study, no significant differences were found in terms of blood loss (223.4 mL vs. 278 mL,  $p=0.102$ ). Most kidney stone surgeries were undergone electively, thus coagulopathy treatment or alteration of anticoagulant medication was possible to be performed in

order to achieve optimal hemostasis. Although being more invasive, the bleeding in open stone surgery can easily be controlled by various methods such as electrocautery, ligation, and clamping [11]. The stone-free rate was evaluated with plain abdominal X-ray and ultrasonography (USG) two weeks after surgery. "Stone-free" was defined as no residual stones or any residual stones that were smaller than 5 mm in diameter. In this study, the stone-free rate was higher in open stone surgery compared to PCNL (92.3 vs. 48.7%,  $p < 0.001$ ). Zhang et al [6].

Also found that the stone-free rate in open stone surgery was higher than in PCNL (97.5% vs. 76.1%;  $p < 0.001$ ). The AUA guideline stated that the stone-free rate in open surgery is estimated at around 71%, compared to 78% in PCNL. These variations were most likely happened due to the urologist's experience [3, 4, 12]. Additional procedures were defined as any procedures performed after surgery to achieve a stone-free status.

These procedures include SWL, ureterorenoscopy (URS), and a removal of the DJ stent. Additional procedures were higher in PCNL compared to open stone surgery ( $p < 0.001$ ). Zhang ET al [6]. Also found

additional procedures were fewer in open stone surgery compared to PCNL (36 vs. 59%,  $p < 0.001$ ). Additional procedures were required more in PCNL to achieve stone-free status. Financially, in under-developed or developing countries, open stone-removal surgery gives less financial burden compared to endourology procedure as PCNL. Since each endourology procedure gives more financial burden, the high stone-free rate in open stone surgery will reduce the number of additional endourology procedures required to achieve a stone-free condition.

## Conclusion

PCNL was associated with shorter length of stay, lower stone-free rate, and a higher number of additional procedures compared to open stone surgery in patients with a staghorn stone. Overall, PCNL is a minimally invasive procedure that is effective and safe for treating kidney stones larger than two centimetres in hospitals with complete endourology equipment.

Nevertheless, in places where PCNL is unavailable, open stone surgery can still be a choice for treatment because it provides a good outcome and is more cost-effective.

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