Stone Free Rate and Complications in Kidney Stone Patients Undergoing Open Nephrolithotomy and Percutaneous Nephrolithotomy (PCNL) Methods

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Abstract. The operations for treating kidney stones include open nephrolithotomy, Extracorporeal Shock Wave Lithotripsy (ESWL), Percutaneous Nephrolithotomy (PCNL), ureteroscopy, and laparoscopic surgery. The aim of this study was to analyzing the differences in stone free rates and complications in kidney stone patients undergoing open nephrolithotomy (ON) and Percutaneous Nephrolithotomy (PCNL) methods. This research observational analytics using a cross sectional approach, was carried out at Abdul Moeloek Hospital Lampung Province, from April-September 2023. Target population in these study are kidney stone patients seeking treatment in 2023 with a sample size of 85 person. The dependent variables in this study were stone free rate and complications. The independent variable in this study was patients diagnosed with kidney stones with supine PCNL and open nephrolithotomy. Instruments uses patient medical record. Analysis of this research data includes percentage and Mann Whitney test. The results of the study found that the average age and stone free rate in the PCNL group were 50.6 and 84.03, while in the Open Nephrolithotomy group they were 51.09 and 89.54. The study found that most complications were experienced by the open nephrolithotomy group. This is because the surgical procedure causes wounds.

Keywords: complication, open nephrolithotomy, percutaneous nephrolithotomy, stone free rate

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INTRODUCTION

Technological developments in the medical field have changed the approach to surgical intervention in cases of kidney stones (especially kidney stones withstone burden > 2cm), from open surgery to endoscopic surgery or minimally invasive surgery (Sawal and Soebadi, 2020). Minimally invasive surgery for the treatment of kidney stones, among others Extracorporeal Shock Wave Lithotripsy (ESWL), percutaneous nephrolithotomy, Percutaneous Nephrolithotomy (PCNL), ureteroscopy, and laparoscopic surgery (Chongruksut *et al.*, 2012).

Open nephrolithotomyis a surgical process that involves making a small incision in the back. This procedure will insert a special tool through the incision and crush the stone into smaller pieces, then remove it. During the operation the patient will be anesthetized and asleep (Cassell *et al.*, 2020). This operation will be recommended by the doctor if ESWL has previously been carried out, but was not successful in destroying the kidney stones. Or when the kidney stone is more than 2 cm in size. Patients who undergo this process will need recovery time in the hospital for one or two days. During the recovery period, the doctor will ask the patient to practice pushing or pulling for 2-4 weeks (Aldaher *et al.*, 2021).

The PCNL method in principle is to create access to the calyx or pyelum percutaneously. Then through this access we insert a rigid or flexible nephroscope, or ureteroscope, then the kidney stone is taken whole or broken up first. The technique for creating a percutaneous tract to the kidney to remove kidney stones was first reported in 1976 (Desai *et al.*, 2017). Then PCNL was reported again for use as a routine technique for managing large and complex kidney stones. The PCNL that is routinely carried out currently is PCNL in the supine position and the prone position (Haghighi *et al.*, 2020). The advantages of PCNL arestone free ratehigh level, the process takes place quickly and can immediately be known whether it was successful or not.

The disadvantage is that it requires special skills for urologists. PCNL is superior to open surgery in terms of morbidity and cost, so that the use of PCNL has replaced open surgery for large and complex kidney stones in many institutions (Srisubat *et al.*, 2014).

Currently, PCNL in the supine position is the main choice for treating kidney stones when viewed from the benefits obtained (Basulto-Martínez *et al.*, 2020). This technique is generally performed under fluoroscopy guidance but carries a risk of radiation exposure to the patient and surgical team (Sanguedolce *et al.*, 2013). For this reason, the use of ultrasound can be a good alternative, but it also has limitations in visualizingvguide wireclearly (Syahputra *et al.*, 2016). So this research uses a combination technique of fluoroscopy and ultrasonography, it is hoped that it can reduce radiation exposure and also increase the efficacy and safety of this procedure (McClinton *et al.*, 2020).

This research aims to analyze stone free rate and complications in kidney stone patients undergoing open nephrolithotomy and percutaneous nephrolithotomy (PCNL) methods.

SUBJECT AND METHOD

This research observational analytics using a cross sectional approach, was carried out at Abdul Moeloek Hospital Lampung Province, from April-September 2023. Target population in these study are kidney stone patients seeking treatment in 2023 with a sample size of 85 person. The dependent variables in this study were stone free rate and complications. The independent variable in this study was patients diagnosed with kidney stones with supine PCNL and open nephrolithotomy. Instruments uses patient medical record. Analysis of this research data includes percentage and Mann Whitney test.

RESULTS

The research results are shown in tables 1 and 2 below.

Table 1: Stone Free Rate with Kidney Stone Treatment at Abdul Moeloek Hospital, Lampung Province

Variable	PCNL		Open Nephrolithotomy (ON)	
	Mean	SD	Mean	SD
Stone Free Rate	84.03	6,11	89.54	3,92

The results of the study found that the stone free rate in the PCNL group was 84.03, while in the Open Nephrolithotomy group was 89.54.

Table 2: Proportion of Complications with Kidney Stone Treatment at Abdul Moeloek Hospital, Lampung Province

Grade	Kidney Stone Action		Total	p-value
	PCNL	ON		
1	23	35	58	0.292
	39.7%	60.3%	100.0%	
2	7	10	17	
	41.2%	58.8%	100.0%	
3	0	0	0	
	0.0%	0.0%	0.0%	
4	0	4	4	
	0.0%	100.0%	100.0%	
5	1	5	6	
	16.7%	83.3%	100.0%	
Total	31	54	85	
	36.5%	63.5%	100.0%	

The majority of kidney stone patients with PCNL stone procedures experienced grade 2 complications (41.2%), whereas most of the open nephrolthotomy patients

experienced grade 4 complications (100.0%). The research results obtained that there is no difference in the proportion of complications in the two kidney stone procedures.

DISCUSSION

The results of the study found that the stone free rate in the PCNL group was 84.03, while in the Open Nephrolithotomy group was 89.54.

Stone free rate is the percentage of patients without any stones left after the procedure. It measures the success of the procedure in clearing the patient's kidney stones (Kang *et al.*, 2022). The higher the percentage of stone free rate, the more successful the procedure was in clearing the patient's kidney stones (Thomas *et al.*, 2011).

Since the introduction of PCNL for the treatment of kidney stones, there has been a rapid development in the techniques that can be used to treat staghorn kidney stones and complex stones (Wishahi *et al.*, 2023). PCNL is reported to be safe in treating staghorn kidney stones. PCNL is a treatment option for patients with staghorn kidney stones, complex stones, and large stones. This treatment is completely stone-free with minimal morbidity (Chung *et al.*, 2019).

The duration of surgery is an important factor in comparing different procedural techniques, because the risk of postoperative complications can indirectly affect the surgical outcomes such as the amount of blood loss, decrease in hemoglobin, and the need for blood transfusion, as well as complications associated with PCNL (Chung *et al.*, 2019).

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Complications during or after PCNL can occur up to 83%. However, there is no method to predict the stone-free rate after PCNL. Previous studies have found that to obtain a fast, simple, and reproducible method to predict PCNL results using the Guy scoring system to assess the stone-free rate of PCNL and its complications. This scoring system helps in choosing surgery and produces better results (Joshi, 2019).

Surgery for kidney stones has risks and complications. These risks include bleeding, where blood loss occurs during the procedure, but blood transfusions are rarely required. In addition, there is the potential for infection, so patients are treated with broad-spectrum antibiotics to reduce the chance of infection after surgery. If the patient shows symptoms of infection after surgery (fever, drainage from the incision, frequent or uncomfortable urination, pain), contact your doctor immediately. Tissue/Organ Injury can also occur, although rarely, injury to surrounding tissues/organs including the intestines, blood vessel structures, spleen, liver, lungs, pancreas, and gallbladder may require further surgery. Loss of kidney function is rare but is a potential risk. Scar tissue may also form in the kidneys or ureters requiring further surgery (Wagenius *et al.*, 2020).

Bleeding may occur during PCNL, but acute bleeding due to injury to a major vessel or major renal vessel is rare and occurs in less than 0.5% of cases. Most major vessel or major renal vessel injuries occur during initial percutaneous access. Major vessel

injury is best avoided by using a systematic approach to percutaneous renal access. The renal collecting system should be accessed along a line extending from the infundibulum to the posteriorly oriented calyceal fornices. Percutaneous renal access performed in this manner allows direct access to most of the renal collecting system and avoids the hypervascular area adjacent to the infundibulum. Direct percutaneous renal access to the renal pelvis should be avoided. The potential for severe bleeding during direct percutaneous access to the renal pelvis is greater because of the proximity of the major hilar renal vessels, and the lack of renal parenchyma to provide tamponade (Taylor *et al.*, 2012).

CONCLUSION

Although there are various methods for treating kidney stones, PCNL is less invasive than open nephrolthotomy and is now the choice of most surgeons. Open nephrolthotomy was compared with PCNL and the results showed that both methods have similar outcomes. In addition, PCNL has the advantage of a much shorter hospital stay. The preferred choice of PCNL is a very effective modality for the treatment of kidney stones.

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