IMPACT OF STONE SIZE, LOCATION, AND STONE COMPOSITION ON THE EFFICACY OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY FOR RESIDUAL STONE AFTER PERCUTANEOUS NEPHROLITHOTOMY

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ABSTRACT

This study aimed to determine the impact of stone size, location and stone composition the efficacy of extracorporeal shock wave lithotripsy (ESWL) in the management of residual stone after percutaneous nephrolithotomy (PCNL). The design of this study was a retrospective that conducted between January 2012 until December 2016. The population in this study were all patients with residual stones post PCNL. Exclusion criteria were patients with multiple stones and patients with a history of previous treatment for residual stones such as nephroscopy, flexible ureterorenoscopy, ESWL or medical therapy). The variables studied in this study were stone size, stone location, and stone composition. Before ESWL was carried out, all patients underwent Kidney Ureter Bladder (KUB). After ESWL, all patients underwent ultrasonography (USG) and KUB to determine the stone clearance status. The sample of this study was 125 patients. The overall stone-free rate (SFR) of ESWL in managing post-PCNL residual stones is 72%. SFR based on stone size variable are 73.7% and 71.3% respectively for stones with a size = 5 mm and >5 mm (p = 0.78). SFR based on stone location variable was 67.1%, 75.8%, and 81.8% respectively for the residual stone located at the upper pole, middle pole and lower pole. There are no significant differences in the entire variable. This study concludes that ESWL can be used as effective additional management to treat post-PCNL residual stones with satisfactory SFR.

***Keywords**: Residual stone; percutaneous nephrolithotomy; extracorporeal shock wave lithotripsy*

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengetahui pengaruh ukuran batu, lokasi dan komposisi batu terhadap efikasi dari extracorporeal shock wave lithotripsy (ESWL) dalam tatalaksana batu residual pasca operasi percutaneous nephrolithotomy (PCNL). Desain studi ini adalah retrospektif yang dilakukan pada periode bulan Januari 2012 hingga Desember 2016. Populasi pada studi ini adalah semua pasien dengan batu residual pasca operasi PCNL. Kriteria ekskulsi pada studi ini adalah pasien dengan batu multiple dan pasien dengan riwayat pernah mendapatkan tatalaksana batu residual lainnya (nefroskopi, fleksibel ureterorenoskopi, terapi medikamentosa atau ESWL). Variabel yang diteliti pada studi ini adalah ukuran batu, lokasi batu, dan komposisi batu. Sebelum dilakukan ESWL, semua pasien dilakukan pemeriksaan radiologi Kidney Ureter Bladder (KUB). Setelah ESWL, dilakukan pemeriksaan ultrasonography (USG) dan KUB untuk mengetahui status batu tersebut. Sampel dari penelitian ini sejumlah 125. Keseluruhan stone free rate (SFR) ESWL pada batu residual pasca PNCL adalah sebesar 72%. SFR berdasarkan variable ukuran batu adalah 73,7% dan 71,3% masing-masing untuk batu dengan ukuran = 5mm dan > 5 mm (p = 0,78). SFR berdasarkan variable lokasi batu adalah 67,1%, 75,8% dan 81,8% masing-masing untuk batu residual dengan lokasi di pole atas, tengah, dan bawah. Tidak terdapat perbedaan yang signifikan pada ketiga variabel tersebut. Simpulan dari penelitian ini adalah ESWL dapat dijadikan sebagai sebuah prosedur tatalaksana tambahan yang efektif untuk mengatasi batu residual pasca PCNL dengan angka SFR yang memuaskan.

***Kata kunci**: Batu residual; nefrolitotomi perkutan; extracorporeal shock wave lithotripsi*

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is an effective procedure which is being considered as the gold standard in the treatment of large/complex renal calculi. The assessment of stone clearance after PCNL is based on the endoscopic appearance of the collecting system at the completion of the procedure. The average stone-free rate (SFR) after PCNL is between 74%-83% (Desai et al 2011, Rosette et al 2011). Reasons for failure of complete clearance during PCNL include poor visualization secondary to bleeding, inability to access a fragment containing calyx, and the subjective impression of prolonged operative time (Rosette et al 2011). Improper selection of the surgical technique as well as anatomic abnormalities, stone composition, and technical constraints may influence the number and size of residual stone.

Management of residual stone is important to prevent any morbidities in patients after the procedure. Residual stones after PCNL can cause several events such as recurrent stone growth and renal colic due to residual stone obstruction. In order to prevent this event or to maximize the SFR, additional procedures after PCNL are mandatory.

Several treatment options have been proposed for management of residual stone after PCNL, such as extracorporeal shockwave lithotripsy (ESWL), flexible ureteroscopy and re-PCNL (Olvera-Posada et al 2016). Among them, ESWL remains the least invasive procedure. However, the effectiveness of ESWL for residual fragment after PCNL itself is based on various factors, such as stone size, location and stone composition. Because of that, in this study we will evaluate the efficacy of ESWL in managing residual stones after PCNL based on those factors.

MATERIALS AND METHODS

This study used cross-sectional analytic design. The study was performed in Dr Soetomo General Hospital Surabaya. The data were taken from January 2012 to December 2016. The inclusion criteria was the presence of residual stones after PCNL. All patients with residual stones were treated with ESWL as an auxiliary procedure. Exclusion criteria were patients with multiple stone, or with history of underwent the other management for residual stone (such as nephroscopy, flexible ureterorenoscopy, medical therapy or ESWL before). All patients were evaluated preoperatively with plain x-rays of the kidneys, ureters, and bladder (KUB) and USG. Post-treatment follow-up with KUB and USG were used to monitor the fragmentation and clearance of stones. Data were analyzed descriptively and analytically with correlation using Chi-Square test with SPSS 21.

RESULTS

Our retrospective identified 125 eligible patients, including 71 males (56.8%) and 54 females (43.2%). Most samples were in age range of 51-60 years (39.2%). Stone size = 5 mm was found on 38 (30.4%) samples and stone size > 5 mm was found on 87 (69.6%) samples. Location of stone; upper, middle and lower were 39 (31.2%), 32 (25.6%) and 54 (43.2%), respectively. For composition of stone; calcium stone was found on 70 (56%), mixed 33 (26.4%) and non-calcium on 22 (17.6%). The overall SFR was 72%. (Table. 1)

Table 1. Characteristics of samples

Variables	n	%
Sex		
Male	71	56.8
Female	54	43.2
Age Interval (years)		
11 – 20	2	1.6
21 – 30	3	2.4
31 – 40	18	14.4
41 – 50	37	29.6
51 – 60	49	39.2
61 – 70	15	12.0
71 – 80	1	.8
Stone Size		
≤ 5 mm	38	30.4
> 5 mm	87	69.6
Stone Location		
Upper	39	31.2
Middle	32	25.6
Lower	54	43.2
Composition		
Calcium	70	56.0
Mixed	33	26.4
Non-Calcium	22	17.6
Stone Clearance		
Clear	90	72.0
Not Clear	35	28.0

Table 2 shows statistical analyses between SFR with stone size variable. stone location and stone composition using Chi Square test. There were no statistically significant difference between SFR in stone size variable, stone location and stone composition (p-values = 0.78; 0.35; 0.35).

Table 2. Correlation between variables with stone clearance

Variables	Stone Clearance		p-value
	Clear n (%)	Not Clear n (%)	
Stone Size			
≤ 5 mm	28 (73.7)	10 (26.3)	0.78
> 5 mm	62 (71.3)	25 (28.7)	
Stone Location			
Upper	25 (64.1)	14 (35.9)	0.35
Middle	23 (71.9)	9 (28.1)	
Lower	42 (77.8)	12 (22.2)	
Composition			
Calcium	47 (67.1)	23 (32.9)	0.35
Mixed	25 (75.8)	8 (24.2)	
Non-Calcium	18 (81.8)	4 (18.2)	

DISCUSSION

Urinary stone management has evolved over the last 30 years. Minimally invasive techniques can now be performed for urinary stones in almost all situations. Currently, several modalities have been studied to treat residual stones after PCNL. One of them is second-look flexible nephroscopy, which has a SFR up to 97%. But, nephroscopy is an invasive modality and cannot be done on tubeless PCNL. Other modalities, such as RIRS, has SFR of 81.7%-91.3% after 3 months postoperatively (Hamamoto et al 2014, Xu et al 2012). However, just like nephroscopy, RIRS is an invasive procedure that requires a surgery preparation, operating room, anesthesia and postoperative care, therefore the cost-benefit ratio between these two modalities remains unclear.

Among the therapeutic modalities for treating residual stones after PCNL, only ESWL is a non-invasive procedure. ESWL shows many potential advantages over other procedures because it provides an anesthesia free, technically less demanding, and effective therapeutic modality with a low rate of complications (Pearle et al 2008).

Our study has some important findings. We demonstrated that ESWL have overall 72% SFR for residual stone after PCNL. If we did the subgroup analysis based on stone size, location and stone composition, the SFR of ESWL will varies from 64.1%-81.8%. Study by Aminsharifi (2018) state that SFR of ESWL on residual stone post PCNL was also varied from 66.6% until 91.7%. The highest SFR was achieved on stone that located on renal pelvis. This SFR differences may be due to differences in modalities that used to identify the residual stones after PCNL. In this study, we only used USG and KUB, whereas in the Aminsharifi et al's (2018) study, they used unenhanced CT scans. Several studies have shown that unenhanced CT scans are superior to USG and KUB in detecting residual stones with a sensitivity up to 100% (Lee et al., 2015; Opondo et al., 2014; Zhang et al., 2009). This is our study limitation. However, our study also has advantages compared to Aminsharifi (2018) study. In their study, they did not examine the stone composition which might be a variable that affected the outcome, although in our study stone composition did not have significant differences. For further research, we advise that it might be better to analyzed stone composition and categorized into more specific group for example calcium oxalate stone group, tricalcium phosphate, magnesium ammonium phos-phate, and cystine.

CONCLUSION

The results of our study suggest that extracorporeal shock wave lithotripsy is an effective auxiliary procedure for managing residual stones after PNL. This procedure is associated with a satisfactory stone-free rate.

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