

# Effectiveness of Extracorporeal Shockwave Lithotripsy and Percutaneous Nephrolithotripsy for the Management of Moderate Size Kidney Stone

TAUSIF AHMAD<sup>1</sup>, KHURSHEED ANWAR<sup>2</sup>, NOORSHAD KHAN<sup>3</sup>, LIAQUAT ALI KHAN<sup>4</sup>, RAFIULLAH<sup>5</sup><sup>1</sup>Consultant, <sup>2</sup>Head of Urology & Transplant, PAEC General Hospital Islamabad<sup>3,5</sup>Consultant Urologists, <sup>4</sup>Consultant General Surgeon, Timergara Teaching Hospital, TimergaraCorrespondence to: Tausif Ahmad, Email: [tausifkmc@gmail.com](mailto:tausifkmc@gmail.com), Cell: 0333-9287451

## ABSTRACT

**Aim:** To provide a specific guidance in managing renal stones.**Study Design:****Place and Duration of Study:** Pakistan Atomic Energy Commission, General Hospital Islamabad from 1<sup>st</sup> 2018 to 30<sup>th</sup> November 2018.**Methodology:** Eighty two patients were included and divided into two groups. Patients in group A underwent ESWL, while those in group B underwent PCNL. All of the participants underwent thorough diagnostic and therapeutic procedures. As per inclusion and exclusion criteria, patients with renal stones (10-20 mm), detected by CT scan were selected for either ESWL or PCNL.**Results:** Thirty four patients in the PCNL group and 21 patients in the ESWL group, had post-operative hematuria at the time of presentation ( $p=0.072$ ). There is a substantial difference between patients between 18-38 years and those in the 60+ years. According to the stone-free rate, 76 individuals had favourable results whereas only 6 had negative ones ( $p=0.756$  and  $p=0.050$ ).**Conclusion:** Extracorporeal shockwave lithotripsy and percutaneous nephrolithotripsy are both effective technique options for kidney stones. However, since ESWL is non-invasive and has fewer adverse effects than PCNL treatment option, it is more successful in treating medium-sized kidney stones (20 mm or smaller).**Keywords:** Extracorporeal shockwave lithotripsy, Percutaneous nephrolithotripsy, Kidney stone

## INTRODUCTION

Kidney stones are global health problem contributing 2-3% of the general population.<sup>1</sup> Kidney stones are complex and multifactorial process including genetic, environmental and dietary factors.<sup>2</sup> For management of kidney stones, multiple factors must be taken into account including patient's preferences, treatment expenses, renal anatomy, body habit, and availability of local infrastructure and resources.<sup>3</sup> Initially, percutaneous nephrolithotomy (PCNL) considered as the major procedure for kidney stone problems.<sup>4</sup> However, ESWL was presented to further reduce the adverse effects associated with surgical intervention.<sup>5</sup> Although the treatment with ESWL showed the variation in the stone-free rate between 50-70%, 70-90% and 50-90% respectively.<sup>6</sup>

However, a number of variables, including stone size, content, pelvicalyceal anatomy, and others, affect the success rate of ESWL.<sup>7</sup> Additionally, there are issues with numerous sessions, in complete stone clearance, the necessity for additional operations, and complications following ESWL.<sup>7</sup> Nevertheless, compared to ESWL, PCNL is more invasive and has greater related morbidity.<sup>8</sup>

Now-a-days, patients with upper-tract calculi (10 mm) receive standard care using shockwave lithotripsy (SWL) but PCNL is the preferred approach for treating calculi (>20mm).<sup>9,10</sup> Kidney stones are common problems in Pakistan because it is a nation located in the "Stone Belt".<sup>11-14</sup>

The purpose of this study is to evaluate the efficiency of extracorporeal shockwave lithotripsy and percutaneous nephrolithotripsy for treating moderate-sized renal stones with an area between 10-20 mm.

## MATERIALS AND METHODS

This study was conducted at General Hospital (PAEC) of Islamabad between 1<sup>st</sup> March 2018 and 30<sup>th</sup> November 2018. A total 82 patients were registered and divided in two groups; group A and group B, each group comprised 41 patients. Group A patients were undergone through ESWL while group B patients undergone through PCNL. All affected individuals with renal stone of size measuring 10-20 mm diagnosed by CT scan and suitable for either ESWL or PCNL were included. The affected individual's data of pre-operative, during surgery and post-operative data were recorded.

The ethical approval from Ethical Committee of PAEC Hospital was received. Informed consent was also obtained from the patient that was explained in their native language. The data was entered and analyzed through SPSS-20. Chi-square test was also applied and  $p \leq 0.05$  was considered as significant.

## RESULTS

The average age of the group A and group B (PCNL) patients were  $56.8 \pm 5.6$  years and  $57.9 \pm 4.8$  years respectively. The mean size of stone of group A and group B were  $1.43 \pm 0.5$  mm and  $1.46 \pm 0.8$  mm respectively (Table 1). There were 53.6% males and 46.3% females in group A while in group B, 53.6% males and 46.3% females (Table 2). The frequency of post-operative infection and stone removal success rate was shown in Table 3.

Post-operative hematuria was significantly ( $P < 0.05$ ) less in group B as compared to group A (Table 4). There is significant ( $P < 0.05$ ) difference between group A and group B in post-operative infection according to age (Table 5). The free stone status and the group wise distribution for free stone are shown in Tables 6-7.

Table 1: Descriptive statistics of the patients

Variable	ESWL	PCNL
Age (years)	$56.8 \pm 5.6$	$57.9 \pm 4.8$
Size of stone (mm)	$1.43 \pm 0.5$	$1.46 \pm 0.8$

Table 2: Frequency of genders in both groups (n=82)

Gender	ESWL (n=41)	PCNL (n=41)
Male	22 (53.6%)	22 (53.6%)
Female	19 (46.3%)	19 (46.3%)

Table 3: Frequency of postoperative infection and stone free status (n=82)

Variable	No.	%
Post-operative infection		
Yes	13	15.8
No	69	84.2
Stone free status		
Failure	6	7.3
Success	76	92.7

Table 4: Postoperative hematuria (n=82)

Group	Postoperative hematuria		P value
	Present	Absent	
ESWL	21	19	0.072
PCNL	34	8	

Table 5: Age group and post-operative infection of the patients

Age (years)	Group	Post-operative infection		P value
		Yes	No	
18-38	ESWL	2	16	0.010
	PCNL	3	16	
39 – 59	ESWL	2	16	0.806
	PCNL	4	13	
> 60	ESWL	0	5	1.785

Table 6: Frequency of Stone free status (n=82)

Stone free status	No.	%
Failure	6	7.3
Success	76	92.7

Table 7: Stone free rate

Group	Stone free rate		$\chi^2$	P value
	Yes	No		
ESWL	39	2	0.050	0.756
PCNL	37	4		

## DISCUSSION

Kidney stones are global health problem. Pakistan as part of "stone belt" has a persistently high incidence of kidney stones.<sup>11-15</sup> Pakistan among leading countries with high incidence and prevalence of kidney stones.<sup>15</sup> For treating renal stones, ESWL is the non-invasive procedure for renal stones, considered as choice within a limited time, for the removal of renal stones.<sup>7</sup> Its importance is appreciated that annually in USA about 1 million affected individuals are treated through ESWL.<sup>16</sup> ESWL technique preferred for the treatment of kidney stone that range between 4 mm and 2cm (size).<sup>17</sup> On the other hand, PCNL was established to lessen the morbidity and mortality linked with open kidney procedures, and it is still the primary management for significant kidney stones today.<sup>4</sup> PCNL is advised for bigger stones that are >1.5 cm.<sup>4</sup> However, it is the most successful treatment but also the most intrusive, requiring general anesthesia, having minimal but potentially serious side effects, and maybe requiring a longer recovery period than ESWL.<sup>4,18</sup> Therefore, PCNL is recommended for bigger stones of >1.5 cm.<sup>3,4,8,9,18</sup> The ESWL technique for the removal and treatment of kidney stones within stable function has not been comprehensively examined and in Pakistan, limited research studies have been done on this regard.<sup>11-15</sup>

In the present study, mean size of stone was 1.43 and 1.64 respectively. There were 22 males and 19 females in ESWL group while in PCNL group, 22 males and 19 females. The individuals on ESWL sessions had a considerably better response rate. The impact on the stone clearance rate following ESWL influenced by various factors especially stone (size, shape, numbers) and individual affecting from stones. In contrast, Cevik et al<sup>19</sup> showed that ESWL approached either a single-shot or twin-shot shockwave methods has a temporary negative impact on renal function in their study. Patients with renal insufficiency and mild to moderate in nature due to kidney stones may utilize ESWL as efficient therapeutic option and main line of treatment, mainly due to non-invasive.<sup>20</sup> As previously stated, kidney stones of <10 mm are often managed with ESWL bigger stones, particularly those in the lower pole are more effectively managed by PCNL.<sup>5-7</sup>

The current study recruited subjects with renal insufficiency had 93% of stone clearance after ESWL and PCNL techniques. Lee et al<sup>20</sup> reported 56.9% of stone clearance in subject with renal insufficiency, whereas Bhatia et al<sup>21</sup> reported 68% stone clearance after ESWL technique. Thus, it was ostensible that the effectiveness of ESWL in renal insufficiency to normalize the renal function.

Hematuria condition commonly associated with the kidney stones.<sup>22</sup> According to our study, in ESWL group, 21 patients were presenting with post-operative hematuria and in PCNL group 34 patients were presenting with post-operative hematuria (p=0.072). In different age group, post-operative infection results was significant (p=0.0108). The stone free rate reveals that 76 patients

have positive results while 6 patients have negative results (p=0.756).

## CONCLUSION

Both extracorporeal shockwave lithotripsy and percutaneous nephrolithotripsy are effective technique options for kidney stones. However, since extracorporeal shockwave lithotripsy is non-invasive and has fewer adverse effects than percutaneous nephrolithotripsy treatment option, it is more successful in treating medium-sized kidney stones (20 mm or smaller) and management for patients with mild to moderate renal insufficiency.

## REFERENCES

- Portis AJ, Sundaram CP. Diagnosis and initial management of kidney stones. *Am Fam Physician* 2001;63(7):1329-38.
- Alelign T, Petros B. Kidney Stone Disease: An Update on Current Concepts. *Adv Urol* 2018;2018:3068365.
- Miller NL, Lingeman JE. Management of kidney stones. *BMJ* 2007;334(7591):468-72.
- Ganpule AP, Vijayakumar M, Malpani A, Desai MR. Percutaneous nephrolithotomy (PCNL) a critical review. *Int J Surg* 2016;36:660-4.
- Cao L, Wang YQ, Yu T, Sun Y, He J, Zhong Y, Li X, Sun X. The effectiveness and safety of extracorporeal shock wave lithotripsy for the management of kidney stones: a protocol of systematic review and meta-analysis. *Medicine* 2020;99(38).
- Al-Zubi M, Al Sleibi A, Elayan BM, Al-Issawi SZ, Bani-Hani M, Alsharei A, et al. The effect of stone and patient characteristics in predicting extracorporeal shock wave lithotripsy success rate: a cross sectional study. *Ann Med Surg* 2021;70:102829.
- Shinde S, Al Balushi Y, Hossny M, Jose S, Al Busaidy S. Factors affecting the outcome of extracorporeal shockwave lithotripsy in urinary stone treatment. *Oman Med J* 2018;33(3):209-17.
- Gadelmoula M, Elderwy AA, Abdelkawi IF, Moeen AM, Althamthami G, Abdel-Moneim AM. Percutaneous nephrolithotomy versus shock wave lithotripsy for high-density moderate-sized renal stones: a prospective randomized study. *Urol Ann* 2019;11(4):426.
- Takazawa R, Kitayama S, Tsujii T. Appropriate kidney stone size for ureteroscopic lithotripsy: When to switch to a percutaneous approach. *World J Nephrol* 2015;4(1):111.
- Hughes T, Ho HC, Pietropaolo A, Somani BK. Guideline of guidelines for kidney and bladder stones. *Turkish J Urol* 2020;46(Suppl 1):S104.
- Wazir BG, ul Haq MI, ul Haq F, Nawaz A, Nawaz A, Jamil M. Experience of extracorporeal shockwave lithotripsy for kidney and upper ureteric stones by electromagnetic lithotripter. *J Ayub Med Coll Abbottabad* 2010;22(2):20-2.
- Arain MG, Malik AS. Urinary Calculus Disease: A study of 267 cases at Sir Ganga Ram Hospital, Lahore over 2 years. *Biomedica* 1997;13:38-41.
- Hussain M, Rizvi SA, Askari H, Sultan G, Lal M, Ali B, Naqvi SA. Management of stone disease: 17 years experience of a stone clinic in a developing country. *Hypertension* 2009; 6819: 17-6.
- Rajput AP, Khan S, Khan M, Din S, Nawaz H. Present trend of urolithiasis in Balochistan: a single center experience. *JCPSP* 2002;12:618-22.
- Niels-Peter B, Abbas F, Khan R, Talati JJ, Afzal M, Rizvi I. The prevalence of silent kidney stones: an ultrasonographic screening study. *JPM* 2003;53(1):24.
- Hughes SF, Jones N, Thomas-Wright SJ, Banwell J, Moyes AJ, Shergill I. Shock wave lithotripsy, for the treatment of kidney stones, results in changes to routine blood tests and novel biomarkers: a prospective clinical pilot-study. *Eur J Med Res* 2020;25(1):1-1.
- Chaussy CG, Fuchs GJ. Current state and future developments of noninvasive treatment of human urinary stones with extracorporeal shock wave lithotripsy. *J Urol* 1989;141(3):782-9.
- Malik I, Wadhwa R. Percutaneous nephrolithotomy: current clinical opinions and anesthesiologists perspective. *Anesthesiol Res Prac* 2016; 27:20-25.
- Çevik İ, Özveren B, İlçöl Y, İlker Y, Emerk K, Akdaş A. Effects of single-shot and twin-shot shockwaves on urinary enzyme concentrations. *J Endourol* 1999;13(6):403-8.
- Weiland D, Lee C, Ugarte R, Monga M. Impact of shockwave coupling on efficacy of extracorporeal shockwave lithotripsy. *J Endourol* 2007;21(2):137-40.
- Bhatia V, Biyani CS, Al-Awadi K. Extracorporeal shockwave therapy for urolithiasis with renal insufficiency. *Urologia Internationalis* 1995; 55(1): 11-5.
- Minotti B, Treglia G, Pascale M, Ceruti S, Cantini L, Anselmi L, Saporito A. Prevalence of microhematuria in renal colic and urolithiasis: a systematic review and meta-analysis. *BMC Urol* 2020 Dec;20(1):1-2.