Original Article

Shock wave lithotripsy outcomes for lower pole and non-lower pole stones from a university teaching hospital: Parallel group comparison during the same time period

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Abstract

Introduction: Shock wave lithotripsy (SWL) is a treatment option for all locations of renal and ureteric stones. We compared the results of SWL for lower pole renal stones with all other non-lower pole renal and ureteric stones during the same time period.

Material and Methods: All SWL procedures were carried out as day case procedures by a mobile lithotripter from January 2012 to August 2013. The follow-up imaging was a combination of KUB X-ray or USS. Following SWL treatment, the stone free rate (SFR) was defined as ≤3 mm fragments.

Results: A total of 148 patients with a mean age of 62 years underwent 201 procedures. Of the 201 procedures, 93 (46%) were for lower pole stones. The non-lower pole stones included upper pole ($n = 36$), mid pole ($n = 40$), renal pelvis ($n = 10$), PUJ ($n = 8$), mid ureter ($n = 3$), upper ureter ($n = 5$) and a combination of upper, middle and/or lower pole ($n = 6$). The mean stone size for lower pole stones (7.4 mm; range: 4-16 mm) was slightly smaller than non-lower pole stones (8 mm; range: 4-17 mm). The stone fragmentation was successful in 124 (62%) of patients. However, the SFR was statistically significantly better ($P = 0.023$) for non-lower pole stones 43 (40%) compared to lower pole stones 23 (25%). There were 9 (4%) minor complications and this was not significantly different in the two groups.

Conclusions: Although SWL achieves a moderately high stone fragmentation rate with a low complication rate, the SFR is variable depending on the location of stone and the definition of SFR, with lower pole stones fairing significantly worse than stones in all other locations.

Key Words: Lithotripsy, lower pole stone, outcome, stone free rate, urolithiasis

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INTRODUCTION

Since being first introduced in the 1980s[1] extracorporeal shock wave lithotripsy (SWL) has become the treatment of choice for renal and ureteral stones up to 20 mm. It is relatively non-invasive, and has a reasonable efficacy in treating stones in all locations.[2]

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Several studies have shown that treatment of lower pole stones (LP) stones has a lower stone free rate (SFR) than other renal or ureteral stones due to the LP anatomy.[3-5]

In this study, we looked at the outcomes for SWL in both lower pole (LP) and non-lower pole (NLP) stones during the same time period to evaluate if there was a difference in SFR after treatment.

MATERIALS AND METHODS

Between January 2012 and August 2013, 148 patients were treated for renal and ureteral stones using a mobile piezoelectric lithotripter (Wolf Piezolith 3000). Data were collected retrospectively on all patients who underwent SWL in this time period with stone size ranging from ≥4 mm to <20 mm. All patients had IVU or non-contrast CT (NCCT) for diagnosis of stones and plain X-Ray (if radio opaque stone) or USS for follow-up.

Pre-operatively, patients were given a combination of diclofenac 100 mg per rectum, intramuscular pethidine (100 mg/2 ml) and intramuscular metoclopromide (10 mg/2 ml). The maximum number of shocks administered within each operation was limited to 4000 (mean shock numbers were: Lower pole: 3015; non-lower pole: 3140). Post-operatively all patients were given a 7 day course of trimethoprim and oral ibuprofen as pain relief if required.

Multiple variables including patient characteristics such as age, sex and number of procedures, procedural characteristics such as number of shocks and energy of shocks, stone characteristics such as size, location and number, and treatment characteristics such as SFR, stone fragmentation rate and complications were recorded. Following treatment, stone fragmentation was defined as evidence of fragmentation on follow-up imaging and stone free rate (SFR) was defined as stone fragments ≤3 mm on X-Ray KUB or USS.

Stones were classed as lower pole (LP) if they were exclusively within the LP. Stones in all other locations within the kidney and ureter were classed as non-lower pole (NLP). Stones were also called as NLP in case of multiple stones one of which was in LP. This included stones in the upper pole, mid pole, renal pelvis, pelviureteral junction (PUJ), mid ureter or upper ureter.

Data were collated using Microsoft excel. Data analysis was performed using SPSS version 21 and *P* values were achieved using the χ^2 test.

RESULTS

The mean age of the patients for LP and NLP was 54 years (30-86 years) and 52 years (30-80 years), respectively [Table 1]. Male to Female ratios for LP and NLP were 60:33 and 60:48, respectively. A total of 148 patients underwent 201 procedures of which 93 (46%) were for LP stones and 108 (54%) were for NLP stones. Multiple stones were seen in 68/201 (34%). The non-lower pole stones included upper pole (n = 36), mid pole (n = 40), renal pelvis (n = 10), PUJ (n = 8), mid ureter (n = 3), upper ureter (n = 5) and a combination of upper, middle and/or lower pole (n = 6). The mean stone size was 7.4 mm (4-16) for LP stones and 8 mm (4-17) for NLP stones. The majority of stones were left sided for both LP and NLP with right: Left ratios being 41:51 for LP stones and 41:64 for NLP stones. Each side was treated and counted individually.

The mean number of procedures each patient received for LP and NLP stones was 1.6 and 1.3 respectively [Table 2]. The average number of shocks patients received for LP and NLP stones were 3015 (2000-3500) and 3140 (2000-4000), respectively. The average energies for LP and NLP were 17.3 and 16.7 kV, respectively.

Although the stone fragmentation rates for LP and NLP stones were 61% and 63% respectively the SFR after treatment completion was 25% (23/93) for LP stones and 40% (43/108) for NLP stones. This was statistically significant with a *P* value of $P = 0.023$.

There were three complications treating the LP stones, all of which were renal colic and there were six complications from the NLP stone treatment; five patients had renal colic and one patient suffered from abdominal pain. There were no other major or minor complications.

Table 1: Comparison of patient and procedural characteristics between lower pole and non-lower pole stones

	Mean age	Male: Female	No. procedures	Mean number of procedures per patient	Mean no. of shocks	Average energy (kV)
Lower pole	54 (30-86)	60:33	93	1.6	3015	17.3
Non-lower pole	52 (30-80)	60:48	108	1.3	3140	16.7

Table 2: Comparison of stone and treatment characteristics between lower pole and non-lower pole stones. SFR was statistically significant higher for NLP stones (P<0.05)

	Mean stone size (mm)	Right:Left:Bilateral	Multiple stones (%)	Stone fragmentation rate (%)	SFR after treatment completion (%)	Complications
Lower pole	7.4 (4-16)	41:51:1	31	61	25	3 (Renal colic)
Non-lower pole	8 (4-17)	41:64:3	36	63	40	6 (Renal colic-5; Abdominal pain-1)

SFR: Stone free rate, NLP: Non-lower pole

DISCUSSION

Shock wave lithotripsy (SWL) is the treatment of choice for renal and ureteral stones up to 20 mm as it is non-invasive and has a high efficacy. Our stone fragmentation rates are comparable to other studies using the same lithotripter.[6,7] Our average stone free rate was 32.8%, which is slightly less than the 36% and 45% achieved by Ng *et al.* and Wang *et al.*, respectively.[6,7]

A study by Öbek *et al.* showed that there was no significant difference in efficacy of treating LP stones compared to middle and upper pole stones but there was reduced SFR for LP stones in comparison to middle and upper pole stones.[8] This is comparable to our study that shows no statistically significant difference between stone fragmentation rates of LP *vs* NLP stones but does show a statistically significant difference in SFR's ($P < 0.05$).

This disparity in SFR's is, as several studies have shown, due to the anatomy of the lower pole. A study by Sampaio showed that the position of lower pole stones impedes gravity dependent drainage of fragments after SWL.[9] Other studies have shown that a shorter infundibular length (<22 mm) as well as larger stone size (>10 mm) and burden can decrease stone free rates.[3-5,8-11]

Despite having lower SFR's than percutaneous nephrolithotomy (PCNL) and flexible ureterorenoscopy (fURS), SWL remains the treatment of choice for some stones as hospital stay, complication rate and duration of treatment are lower in comparison.[5,12,13] Although our study is a retrospective study, the comparison of outcomes between LP and NLP stones is based on treatment carried out by the same team using the same lithotripter in the same time period minimizing any potential for bias.

The other issue identified in this paper is the disparity in the definition of SFR. Several papers define stone free varying from no evidence of stones either by radiological imaging or ultrasonography to residual stones up to 4 mm in size.[6,8,7,14-16] We have defined stone free as fragments ≤3 mm after a 3 month follow-up. Clarification of stone free rate and the size of clinically insignificant fragments is needed when comparing results from different studies. A consensus should be achieved on a standard definition of levels of stone free rate.[17]

CONCLUSION

SWL is generally considered a satisfactory treatment for renal and ureteral stones with a moderately high stone fragmentation rate and low complication rate. However the SFR depends on how it is defined and is statistically significantly reduced in patients with LP stones as opposed to NLP stones.

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