

Extracorporeal Shock wave Lithotripsy (ESWL) Versus Percutaneous Nephrolithotomy (PCNL) in the Eradication of Persistent Bacteruria Associated with Infected Stones

Esam M. Riad, Mamdouh Roshdy, Mohamed A. Ismail, Tarek R. El-Leithy,
Samir EL. Ghoubashy, Hosam El Ganzoury, Ahmed G. El Baz and Ahmed I. Kamel

Urology department, Theodore Bilharz Research Institute, Giza, Egypt.

Abstract: Infected stones function as a sanctuary for organisms and may attenuate the effects of antibiotics against them. Therefore, to treat urinary tract infection associated with urinary calculi, complete extirpation of the stones is necessary. The obtained results indicated that out of the 73 patients included in the study, only 67 patients were available for follow - up (32 underwent ESWL and 35 PCNL). Out of the 35 patients treated with PCNL, 32 patients (91.4 %) were rendered stone free and only 2 patients out of the 3 patients with residual stones showed evidence of persistent bacteruria (5.7 %). while 32 patients treated with ESWL, only 16 patients (50 %) were stone free and 13 patients out of the other 16 with residual stones showed evidence of persistent bacteruria (40.6 %). A positive relation was found between the residual stone fragments and persistent bacteruria, as all patients in either group who were stone free were free of persistent infection. The study also showed that in the ESWL group, with small stones less 2cm, the result of eradication of stones and persistent infection was much better than with large stones more than 2cm (90.9 % vs. 28.6 %). Another finding is that the incidence of residual infected stone fragment was directly related to the degree of hydronephrosis. PCNL is better than ESWL monotherapy in the eradication of persistent bacteruria associated with infected stone specially when associated with moderate and marked hydronephrosis as it had much better clearance rate of residual infected stone fragments.

Key words: persistent bacteruria, stones, ESWL, PCNL

INTRODUCTION

Infected stones function as a sanctuary for organisms and may attenuate the effects of antibiotics against them causing persistent infection (Schwartz *et al.*, 1999). Incorporation of urea splitting bacteria within the developing struvite stones as well as calcium oxalate stones that had become secondarily infected results in a focus of infection that is resistant to conventional antimicrobial therapy and manifested clinically by repeated urinary tract infections caused by the infecting organism, therefore complete removal of all the infected stones material is considered to be essential for the eradication of persistent bacteruria associated with the infected renal calculi (Selverman *et al.*, 1983). Pros and cons of Percutaneous Nephrolithotripsy (PCNL) versus Extracorporeal Shockwave Lithotripsy (ESWL) have often been highlighted when one discusses on the management of renal stones. An often quoted point is that PCNL entails a prolonged hospital stay whereas ESWL sessions are day surgical in nature. However, PCNL has superior stone clearance rate as compared to ESWL especially for lower pole stones. In addition, PCNL is more suitable for large stones and when ancillary procedures are required e.g., endopyelotomy (Chang *et al.*, 2002). ESWL effectively pulverizes infected renal calculi. However stone fragments usually remain in the renal collecting system for weeks to months with the possibility that this material may harbor infecting bacterium. (Stoller *et al.*, 1990).

Studies were held to determine whether extracorporeal shock wave lithotripsy can sterilize infection stones and, thus, decrease the recurrence rate of infection and investigated its impact on the microbiological flora of staghorn calculi on true stone fragments or on the viability of the infecting bacteria within a simulated struvite stone matrix and they concluded that extracorporeal shock wave lithotripsy has no discernible effect on the microbiological flora of infected staghorn calculi and that the ESWL treatment of infected stones must be accompanied by antimicrobial coverage (Stoller *et al.*, 1990 and Reid *et al.*, 1990). When compared to non

Corresponding Author: Mamdouh Roshdy, Urology department, Theodore Bilharz Research Institute, Giza, Egypt.
E-mail: dr.m_roshdy@yahoo.com

infected stones studies show that provided the urine is sterile and a negative history of urosepsis is available, antibiotic prophylaxis is unnecessary in patients with non-infected renal stones submitted to ESWL treatment (Kattan *et al.*, 1993).

PCNL is the treatment of choice for renal stones specially when larger than 2 cm based on its high stone free rate (87%) and low complication rate but residual stone burden following PCNL is problematic as fragments may propagate forming new stones or serve as a source for recurrent urinary tract infection (Kely *et al.*, 2007).

Objective:

The aim of this study is to compare the incidence of persistent bacteruria among patients with infected renal stones who were treated by extracorporeal shock wave lithotripsy (ESWL) and received long term antibiotics versus those who were treated by percutaneous nephrolithotomy (PCNL) with the aim to completely eradicate all stone fragments.

MATERIALS AND METHODS

We studied 73 patients with infected stones during the period from June 2002 to June 2005, who presented with the picture of recurrent UTI or persistent UTI. All patients have normal lower urinary tract. Mean age was 47 years (ranged from 25-63 years), 51 males and 22 females, 22 patients had previous surgical intervention for stone disease. The mean stone size as measured from KUB standard AP film was 3.56 ± 1.73 cm.

Urine culture was positive in all patients and localization of site of infection was carried out via bilateral ureteric catheterization and pelvic urine sampling. Quantitative urine cultures were performed by inoculating sheep blood and Mc Conkey agar plates with 0.1 ml urine and isolates were identified by standard biochemical tests. Isolates of different species in concentrations more than 10^3 in the bladder and pelvic urine were considered as evidence of infection. Infected stones were diagnosed when the specimens of the bladder and pelvic urine samples tested positive from the side of the stone and when stone fragments from PCNL or ESWL tested positive, as all stone fragments retrieved after ESWL or PCNL were collected in strainers and cultured.

Stones occupied the pelvis only in 27 % (19 patients), extended into the lower calyx in 38% (28 patients) and more than one calyx in 35 % (26 patients). Hydronephrosis was mild in 23 % (17 patients), moderate in 37 % (27 patients) and severe in 40% (29 patients). The infecting organism was E-coli in 45 % (33 patients), proteus mirabilis in 38 % (28 patients), klebsiella pneumonia in 13 % (9 patients) and pseudomonas aeruginosa in 4 % (3 patients). After obtaining informed consent patients were directed randomly to receive either ESWL or PCNL. There was no significant difference between the 2 groups regarding the mean stone size.

Thirty five patients received ESWL of whom 23 patients with stones larger than 2 cms underwent ESWL with a D.J. stent fixed to provide drainage and prevent obstruction by gravels and the stents were removed between 4-6 weeks post their fixation. The remaining 12 patients had stones less than 2cm and were managed by ESWL without stenting. Patients were discharged after overnight admission, if no complications supervened. ESWL fragmentation was considered to be complete when the entire stone material had been reduced to fragments measuring not more than 3mm. three months after starting the treatment. Twenty eight patients (80 %) received more than one session of ESWL.

Thirty eight patients were managed by PCNL through single (29 patients) or multiple punctures and/or sessions (9 patients) and were discharged after removal of the nephrostomy tube/s, usually after 3 ± 1 days.

The 2 groups of patients were discharged provided there was no pain, fever, sepsis or manifestations of systemic inflammatory response syndrome (SIRS) defined as presence of 2 or more of the following (Paramanathan *et al.*, 2006):

- Temperature ≥ 38 °C or ≤ 36 °C.
- Heart rate <100 /min.
- Respiratory rate ≥ 20 /min.
- White blood count $< 12,000$ or > 4000 .

All patients received antibiotics according to culture and sensitivity. Patients who received ESWL started the antibiotic treatment 48 hours before the procedure and continued for 48 hours afterwards, then continued on oral ciprofloxacin (500mg – twice daily) for 2 weeks period. Patients who were stented by D.J., received

chronic suppressive antimicrobial therapy till the D.J. stents were removed. Patients who were managed by PCNL started the antibiotic treatment 48 before the procedure that continued for 48 hours after nephrostomy tube removal. Patients in either group with pyrexia or sepsis received further appropriate antibacterial therapy for at least 10 days. Patients were followed up at the outpatient clinic by KUB, Non -contrast spiral CT when needed, and midstream urine samples culture at monthly intervals.

Statistical Analysis:

Results were expressed as mean ± standard deviation (SD) or number (%). Comparison between the mean values of the two groups was done using Mann Whitney U test. Comparison between categorical data [n (%)] was done using Chi square test. SPSS computer program (version 11 windows) was used for data analysis. P value less than 0.001 was considered extremely significant.

RESULTS AND DISCUSSION

Results:

The 73 patients who were included in the study, 35 were directed toward ESWL and the other 38 were treated by PCNL, only 67 patients were available for follow up (32 patients in the ESWL group and 35 in the PCNL group). Follow up after termination of antibiotics ranged between 1- 12 months (mean 9.7 ± 3.6 months). There were no significant difference between the 2 groups regarding follow up period. Characteristics and results of the 2 groups treated with either ESWL or PCNL are shown in Table (1).

Table 1: Characteristics and results of the 2 groups treated with either ESWL or PCNL.

Parameters	ESWL	PCNL
No. pts available for follow-up	32	35
Follow up period (months)	8.2 ± 4.1	7.3 ± 3.9
Mean stone size (cms)	3.5 ± 1.8	3.6 ± 1.7
Mean days oral antibiotics	16 ± 3	5 ± 2*
Stone free patients	16 (50%)	32 (91.4%)*
No. pts with residual stone fragments (%)	16 (50%)	3 (8.6%)*
No. pts. with persistent bacteruria	13/32 (40.6%)	2/35 (5.7%)*
No. pts with persistent bacteruria in pts. with residual stones	13/16 (81.25%)	2/3 (66.6%)
Fever after treatment	8 (22%)	5(13%)

*p> 0.001.

Table 2: Results of the ESWL group in relation to the stone size.

Stone size	Less than 2 cm	More than 2 cm
<i>No. of patients</i>	11	21
<i>Stone free</i>	10/11 (90.9%)	6/21 (28.6%)*
<i>Residual stones</i>	1/11 (9.1%)	15/21 (71.4%)*
<i>Incidence of persistent infection with residual stones</i>	0/1	13/15*p> 0.001.

In the ESWL group, out of the 32 patients included, 16 patients (50%) had residual fragments 3 months post ESWL. None of the stone free patients showed persistent bacteruria in their follow- up, while 13 out of the 16 patients with residual stones showed persistent bacteruria (81.25%) i.e., 13 out of 32 patients included in this group showed persistent bacteruria (40.6%) all had residual stone fragments.

By further analyzing this group ,we found that 10/11 patients (90.9%) who had stones less than 2cm. were stone free, all of them showed no bacteruria in their follow – up, even the one who had small residual stone fragment. While 15/21 patients (71.4%) with stones more than 2cm had residual stone fragments, 13 out of them showed persistent bacteruria, as shown in Table (2). In the PCNL group, 32 out of the 35 patients included in this group were stone free (91.4 %), all were free of persistent bacteruria. The 3 patients (8.6%) who had residual fragments, 2 of them showed persistent bacteruria in their follow – up i.e., the 2 patients out of the 35 patients (5.7%) showed persistent bacteruria had residual stone fragments. In both groups, a positive relation was found between the residual stone fragments and persistent bacteruria as shown in Fig. (1).

The types of the bacteria recovered postoperatively were similar to those originally found preoperatively in the pelvic urine cultures and the stone fragments cultures. No correlation was found between the infecting organism and the success rate of eradication of infection or between previously operated and non operated kidneys. We noticed from this study that the percentage of residual stone fragments is directly proportional to the degree of hydronephrosis as shown in Figs. (2 and 3).

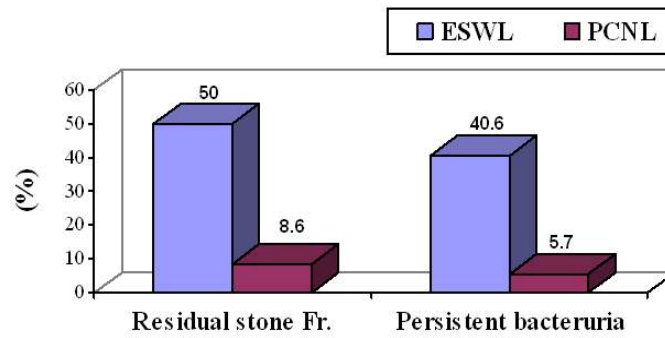


Fig. 1: Residual stone fragments and persistent bacteruria in ESWL and PCNL patients.

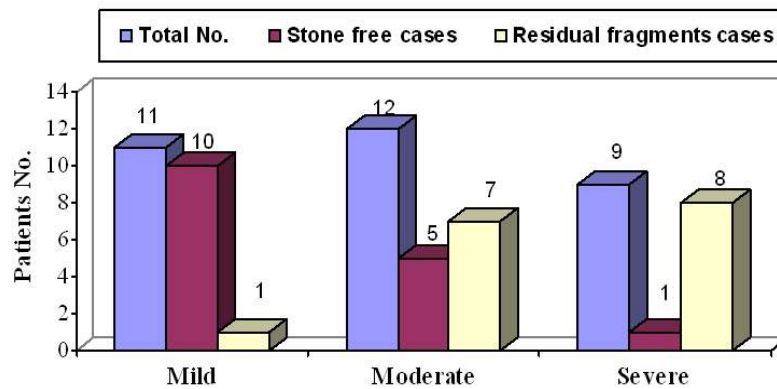


Fig. 2: Relation between the degree of hydronephrosis and the stone clearance in ESWL cases.

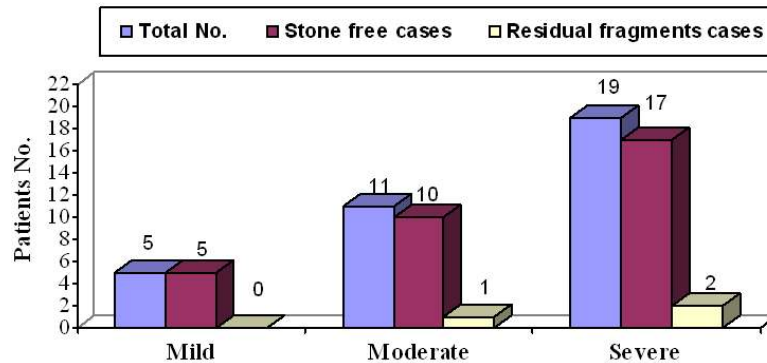


Fig. 3: Relation between the degree of hydronephrosis and the stone clearance in PCNL cases.

Discussion:

Extracorporeal shock wave lithotripsy can be performed without difficulty on infected stones yet, it should be stressed that the association of infection and urinary stones calls for a different approach from that of non infected stones. Experience to date suggests that small collections of sterile non obstructing fragments after ESWL are of no clinical significance; on the contrary infected fragments even minute ones are foci of persistent infection that places the patient at risk of general morbidity of a chronic bacterial infection as well as stone recurrence (Paramanathan *et al.*, 2006).

Many authors studied the proposed bactericidal effect of ESWL on the infected stones but all concluded that it has no clinical significance regarding this point (Stoller *et al.*, 1990 and Guti *et al.*, 2008). In comparison to the infected stones patients, patients with non infected stones showed no evidence of bacteruria or bacteremia after ESWL treatment (Kattan *et al.*, 1993). PCNL is in favor over ESWL in patients with large stones, as often a single session of PCNL can achieve complete stone removal without the necessity of ancillary procedures. (Paramanathan *et al.*, 2006).

The incidence of persistent bacteruria was studied in a group of patients with infected stones treated by ESWL who received long term antibiotics versus those treated via PCNL aiming at complete removal of the stone fragments. None of our patients had any other abnormalities that could be responsible for the persistent bacteruria and pelvic urine and stone fragments cultures proved that the source of infection were the stones. In both groups it was found that the most important factor in clearance of infection was the eradication of all infected fragments not the prolonged use of antibiotics and in this regard PCNL has the upper hand in clearing stone fragments as shown in Fig. (1).

The results showed that 32/35 patients treated by PCNL were stone free (91.4%) and all were free of infection in their follow-up, and that 2/3 patients with residual stones had persistent infection [5.7 % of patients in this group showed persistent infection]. While 16/32 patients managed by ESWL had residual stones, of them 13 patients had persistent infection [40.6 % of the patients in this group], and that 81.25 % of patients with residual stones had persistent infection (13/16 patients), as shown in Table (1). The success rate of stone clearance in the ESWL group was related to stone size, with stone less than 2cm, 10/11 patients (90.9 %) were stone free and non have persistent bacteruria, on the other hand with stone more than 2cm only 5/21 patients (28.6 %) were stone free, and 13 patients with residual stone have persistent infection, as shown in Table (2).

Another finding is that the degree of residual fragments clearance is directly related to the degree of hydronephrosis in both groups of the study and the greater the degree of Hydronephrosis the lesser the degree of stone clearance yet still PCNL has the upper hand in stone fragments eradication (figures 2 and 3). Other studies support this concept as the study of Shigeta *et al.*, who reported that in cases of stones with moderate or marked hydronephrosis PCNL is recommended rather than ESWL monotherapy (Shigeta *et al.*, 1999). The selection of ESWL monotherapy for small infected stones (> 2cm) in the renal pelvis of kidneys with only mild hydronephrosis may results in a better outcome of patients free of stones and bacteruria. But in case of moderate and marked hydronephrosis, when there is a likelihood of fragments remain in the lower calyces, PCNL is of particular relevance specially in patients with large infected stones, in whom complete evacuation of all fragments is mandatory to eradicate persistent bacteriuria.

Conclusion:

PCNL is better than ESWL monotherapy in the eradication of persistent bacteruria associated with infected stone specially with large stones when associated with moderate and marked hydronephrosis, as it have much better clearance rate of residual infected stone fragments. ESWL for small infected stones in the renal pelvis of kidneys with only mild hydronephrosis had a good result as regards stone and infection clearance.

REFERENCES

- Chang, W.L. and S. Murali, 2002. Day care percutaneous renal surgery – is this viable? *Med. J. Malaysia.*, 57(1): 108 -10.
- Guti Wachter, C., U.M. Alvarez, M. Quintero, J. Durrez, E Castano-Tostado, F. Fernandez, A.M. Loske, 2008. Interaction of Shockwaves with Infected Kidney Stones: Is There a Bactericidal Effect. *J. Endourol.*, 25.
- Kattan, S., I. Husain, S.R. El-Faqih and R. Atassi, 1993. Incidence of bacteremia and bacteriuria in patients with non-infection-related urinary stones undergoing extracorporeal shock wave lithotripsy. *J. Endourol.*, 7(6): 449-51.
- Kely, A.H. and O. Kenneth, 2007. Pathphysiology and mangment of infectious staghorn calculi. *Urologic Clinics of North America.*, 34: 363-374.
- Paramanathan, M., S. Gordon, A. Sami and A. David, 2006. One week ciprofloxacin before percutaneous nephrolithotomy significantly reduces upper tract infection and urosepsis: A prospective controlled study. *British J. Urol.*, 98(5): 1075-1079.
- Reid, G., M.A. Jewett, J.C. Nickel, R.J. McLean and A.W. Bruce, 1990. Effect of extracorporeal shock wave lithotripsy on bacterial viability. Relationship to the treatment of struvite stones. *Urol Res.*, 18(6): 425-7.
- Schwartz, B.F. and M.L. Stoller, 1999. Nonsurgical management of infection – related renal calculi. *Urol.Clin. North Am.*, 26: 765-78.
- Shigeta, M., Y. H. Kasoaka, Yasunoto, K. Inuoi, T. Usui, M. Hayashi and S. Tazuma, 1999. Fate of residual fragments after successful extracorporeal shock wave lithotripsy. *Int. J. Urol.*, 6(4): 169-72.
- Silverman, D.E. and T.A. Stamey, 1983. Effects of antibiotics on bacteria within infected stones. *Medicine*, 62: 44.
- Stoller, M.L. and S.J. Workman 1990. The effect of extracorporeal shock wave lithotripsy on the microbiological flora of urinary calculi. *J. Urol.*, 144(3): 619-21.