EFFECT OF PELVICALICEAL ANATOMY ON "POST ESWL STONE CLEARANCE OF LOWER CALICEAL STONE"

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Abstract

Objective: *To find out stone clearance rate of lower calyx and to determine important anatomic predictive factors responsible for the stone clearance of lower calyx following ESWL.*

Methods: *This prospective quasi experimental study was conducted in the Department of Urology, Dhaka Medical College Hospital, Dhaka, from January 2006 to July 2007. Patients with single lower calyceal stone (Stone size d" 20mm), age between 12 to 75 years and were agreed to participate in the study were selected. Different lower calyceal predictive factors were measured from IVU with the help of radiologist before ESWL. Selected patients were treated with ESWL by siemens lithostar machine in the department of Urology, Dhaka Medical College Hospital. Patients were discharged on the same day with advice to follow up after 1 month. All patients were followed up with plain X- ray KUB region to see stone clearance. Purposive sampling methods were followed. Data were processed and analyzed using software SPSS (Statistical Package for Social Sciences).*

Results: *Lower caliceal stones with favorable anatomy (infundibulo-pelvic angle e"70^0, infundibular length d" 30mm, infundibular diameter >4mm, and infundibular length to diameter ratio < 7) were stone free in cases and was statistically significant in stone clearance. But number of minor calices , caliceal pelvic height and stone morphology have shown no impact on stone clearance in this study.*

Conclusion: *ESWL for lower caliceal stone should be recommended only those patients those have favorable anatomy for discharge of fragments.*

Key words: *Lower caliceal stone; ESWL; stone morphology.*

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Introduction

Urinary stones have plagued human being since the beginning of recorded history. Archaeologists have uncovered urinary stones from Egyptian mummies, estimated to be more than 7000 years old. Since then, humans have sought improved methods for dealing with stones[1,2]. Currently urinary stone formation affects 10 to 12% of the population, the peak incidence seems to be at ages 20 to 40 years, ratio among male and female is 3:1, geographically more common in northern part of our country and ranked third of all urological diseases[2,3,4]. Initially open surgery was the main stay of management of urinary stone disease. Now extracorporeal shock wave lithotripsy (ESWL) and endo-urological procedures virtually eliminates open surgical procedures [5]. Extracorporeal shock wave lithotripsy was first introduced for the treatment of stone disease in February 1980 in Germany by Dornier Company [6]. The goal of ESWL is the creation of stone fragments that are smaller than one mm, which can pass spontaneously and painlessly from the urinary tract[7,8]. The majority of (about 80 to 85%) of simple renal calculi (d"2cm) can be treated satisfactorily with ESWL. There is a general consensus that the treatment of lower caliceal stones by ESWL has a poor success rate [9]. Sampaio & Aragao (1992)[10], Elbahansy et al. (2002)[11] and Sumino et al (2002)[12] all had shown that the lower pole anatomy might be responsible for retention of stone fragments.

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Methods

This prospective quasi experimental study was conducted in the Department of Urology, Dhaka Medical College Hospital, Dhaka, from January 2006 to July 2007. Patients with single lower caliceal stone (Stone size d" 20mm), age between 12 to 75 years and were agreed to participate in the study were selected. Patients having with stones in other sites of urinary tract i.e. renal pelvis, other calyces, caliceal diverticulum, ureter, urinary bladder, extreme age (<12 years and >75 years), Stone size > 20mm, multiple lower caliceal stones, any anatomical abnormality of urinary tract, congenital anomalies of the skeleton, obstructed kidney leading to any degree of hydronephrosis, morbid obesity of the patient, history of previous surgery on affected kidney, patient refuse to give consent were excluded from the study. Different lower caliceal predictive factors were measured from IVU with the help of radiologist before ESWL and they were recorded in a prescribed proforma. Selected patients were treated with ESWL by siemens lithostar machine in the department of Urology, Dhaka Medical College Hospital. Patients were discharged on the same day with advice to follow up after 1 month. All patients were followed up with plain X- ray KUB region to see stone clearance. Purposive sampling methods were followed. Data were processed and analyzed using software SPSS (Statistical Package for Social Sciences).

Results

A total of 67 patients of lower caliceal stone who underwent ESWL were included in the study. Of them 7 patients did not attend at follow up session after 1 month leaving 60 for final analysis. The patients who exhibited complete clearance of stone at 1 month follow up were termed as stone-free group, while patients who had fragments of stones after same period of time were assigned to residual stone group.

Demographic variables

Table-I

Shows different demographic variables.

Age	Range 17- 80 years	Mean 42.6±13.1 years
Sex	Male – 40 (67%)	Female -20 (33%)
Social status	Upper and middle class 39(65%)	Lower class 21(35%)
Kidney involved	Right 27 (45%)	Left 33 (55%)
Stone clearance	Residual stone 25 (42%)	Stone free 35 (58%)

About 65% patients belong to 3rd and 6th decade of life. Two third of the subjects were male and one third were female and male and female ratio was 2:1.

Lower pole renal collecting system anatomy:

Table II compares the lower pole collecting system anatomical parameters between patients of stone-free and patients having residual stone.

Table-II

Comparison of lower pole anatomy between groups

Lower pole collecting system anatomy	Outcome		p-value
	Stone-free (n = 35)	Residual stone (n = 25)	
Infundibular length (mm)	27.60 ± 3.13	30.16 ± 2.70	0.002
Infundibular diameter (mm)	4.61 ± 0.43	3.98 ± 0.45	< 0.001
Infundibulo-pelvic angle (degree)	82.26 ± 7.93	69.52 ± 8.95	< 0.001
Caliceal-pelvic height (mm)	24.00 ± 4.39	25.76 ± 1.76	0.063
No. of minor calices	2.74 ± 0.82	2.88 ± 0.88	0.537
Infundibular length to diameter ratio	6.02 ± 0.78	7.67 ± 1.01	< 0.001

Figures in the parentheses denote corresponding %. #Data were analyzed using **Student's t-Test** and **level of significance** was 0.05.

Table-III

Comparison of stone morphology between groups

Stone morphology#	Outcome		p-value#
	Stone-free(n = 35)	Residual stone(n = 25)	
Length of stone	14.59 ± 2.16	12.76 ± 2.35	0.398
Width of stone	11.26 ± 2.11	10.00 ± 2.38	0.940
Stone surface area	143.03 ± 46.38	132.40 ± 53.55	0.868

#Data were analyzed using Student's t-Test and level of significance was 0.05.

Stone morphology:

None of parameters of stone morphology like length of stone, width of stone and stone surface area tend to be associated with clearance of stone following ESWL (p = 0.398, p = 0.940 and p = 0.868 respectively) (Table III).

Favorable and unfavorable lower pole collecting system anatomy:

Combined evaluation of lower pole anatomical features shows that 80% of the stone-free group had favorable anatomy (infindibular length 30 mm or less, infundibular diameter > 4 mm, infundibular length to diameter ratio < 7, infundibulo-pelvic angle 70 degrees or greater and < 3 minor calyces) compared to only 12% of those who had residual stone (p < 0.001) (Table V).

Table-V

Comparison of favorable and unfavorable lower pole anatomy between groups (n = 60)

Lower pole anatomy	Outcome		p-value#
	Stone-free (n = 35)	Residual stone (n = 25)	
Unfavorable	7(20.0)	22 (88.0)	
Favorable	28(80.0)	3(12.0)	< 0.001

Figures in the parentheses denote corresponding %. # Data were analyzed using Chi-square ($\chi 2$) Test and level of significance was 0.05.

Discussion

The present study has designed to compare the different anatomical predictors of lower calyx for stone clearance and try to find out most important anatomical factor or factors responsible for stone clearance. Mean age ± SD of the subjects of present study was 42.2±13.1 years and median age was 40.2 years. Age range of this study was 17 to 80 years. Kupeli et al.[19] & Ather, Memon & Sulaiman[20] studied on 42 and 518 patients respectively and found mean age ± SD was 40.8 ± 10.3 and 38.6± 12.2 years and age range was 23 to 73 years. Present study shows that the stone clearance rate after one month of ESWL was about 58% (35 patients) and 42% (25 patients) had residual stone. In a meta analysis Lingeman et al.[14] noted that overall stone free rate of lower pole stones treated with shock wave lithotripsy were 59%. Srivastava et al.[21] had shown that the stone clearance of lower pole calculi was 25-85%. They argued that, that variability of the stone retention was due to fragment retention rather than stone disintegration [21. 22].

Mean infundibular length ±SD (mm) in stone free group was 27.60±3.13. On the other hand in residual stone group it was 30.16±2.70 and p-value among the two groups p-value was .002. Sumino et al.[12] and Srivastava et al.[21] showed in their study that mean infundibular length ± SD (mm) in stone free group was 25.3±0.7 and 24.56 ±5.65. and residual stone group was 29. ±1.1 and 28±1.34 respectively and their p-value were .005. This result correlates with the present study. Present study shows that the mean infundibular diameter ±SD (mm) was 4.61±0.43 in stone free group and 3.98±0.45 in residual stone group and p-value was <.001. Sumino et al.[12] had shown that mean lower infundibular diameter was 4.9± 0.3 in stone free group and 3.9±0.4 in residual stone group and their p-value was 0.01. Present study shows that the mean infundibulo-pelvic angle ±SD (degrees) in stone free group was 82.26±7.93 but in residual stone group was 65.52±8.95 and the p-value was <0.001. Elbahnasy et al.[11] showed that the infundibulo-pelvic angle ±SD (degrees) in stone free group was 85.2± 8.16. This'result correlates 'with present study. In this study the mean caliceal-pelvic height ±SD (mm) was 24.00±4.39 in stone free group and 25.76±1.76 in residual stone group. Their p-value was 0.063. Sumino et al.[12] showed that, in stone free group mean caliceal-pelvic height ±SD (mm) was 23.8 ±1.0 and stone free group it was 26.4±1.1. Mean number of minor calices ±SD in this study was 2.74±0.82 in stone free group and 2.88±0.88 in residual stone group. Their p-value was

0.537. Srivastava et al.[21] showed that the mean number of minor calices were 2.74±0.54 in stone free group and 3.04±0.47 in residual stone group. P-value of that study was 0.56. Both the studies had shown that the minor calices had no impact on stone clearance. This study has shown that the mean infundibular length to diameter ratio ±SD was 6.02±0.78 in stone free group and 7.67±1.01 in residual stone group. Their p-value was <0.001. Sumino et al.[12] showed that mean lower infundibular length to diameter ratio ±SD was 5.8±0.04 in stone free group and 9.8± 1.1 in residual stone group and p-value was <0.001. Present study shows that 45 (75%) patients had wide infundibulo-pelvic angle (e"70^0) and their stone clearance was 69%.On the other hand 15(25%) patients had narrow angle (<70^0) and their stone clearance rate was only 27%. Sampaio & Aragao [10] and Sabnis et al.[23] reported in their series that 74.0% and 75.61% respectively patients had wide infundibulo-pelvic angle and remaining 26% had narrow infundibulo-pelvic angle. This result correlates with the present study. Sabnis et al.[23] found 75.61% patients had wide infundibulo-pelvic angle (e"70^0) and their stone clearance rate was 88.75%. On the other hand, 24.39% had narrow infundibulo-pelvic angle (<70^0) and their stone clearance rate was 12.38%. In this study the number of minor calices and stone morphology had no impact on stone clearance. Sampaio & Aragao [10], Srivastava et al.[21]and Sabnis et al.[23] also confirmed this argument. In this study it has shown that 31(51.66%) patients had favorable anatomy and 29 (49.34%) patients had unfavorable anatomy. Those who had favorable anatomy 80% became stone free and those with unfavorable anatomy 20% were stone free. Sorensen & Chandhoke [24.] showed that the patients with favorable anatomy (lower pole infundibulo-pelvic angle e"70^0, lower pole infundibular length d"30 mm or lower infundibular width > 5mm) had an 94% chance of being stone free versus a 39% chance with unfavorable anatomy (lower pole infundibulo-pelvic angle, lower pole infundibular length or lower infundibular width <70^0, >30mm or d"5mm respectively).

Conclusion

From the present study it is concluded that the patient with infundibulo-pelvic angle e"70^0, infundibular length d" 30mm, infundibular diameter >4mm, and infundibular length to diameter ratio < 7 is recommended for ESWL for lower calyceal stone.

Conflict of Interest : None Declared

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Abbreviations

ESWL = Extracorporeal shock wave lithotripsy