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FATE OF LOWER POLE STONE LESS THAN 2 CM, A PROSPECTIVE STUDY AT TICKRIT TEACHING HOSPITAL

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ASTRACT

Objective: This study was done to determine the fate of lower pole renal stones less than 2 cm in diameter and factors that impeded the passage of this stone which include lower pole anatomy, renal morphology, stone size, and stone nature. **Patients and Methods:** 150 patients with lower pole renal stones less than 2 cm in diameter were followed up prospectively at Tickrit Teaching Hospital.113 patients were chosen for this study having complete data with age range between 15-75 years. All patients had been assessed by history, good physical examination and investigation, which include general urine examination (G.U.E), blood test, ultrasonagraphy (U/S) for kidney, urethra, and bladder, and intravenous polygraph (IVP). Stone Free State asses by U/S for kidney, urethra, and bladder (K.U.B) and stone free correlate with lower pole infudibular length, width in mm as well as infundibulopelvic angle Statistical significant of each factor were correlated with stone free rate using Chi-square test. **Results:** overall stone free rate in our study was 70% (79 patients were stone free whether spontaneous or after extracorporal shocke wave lithotripsy (ESWL).Thirty two patients were spontaneously passage of stone within six months, while forty seven patients were passage of stone after ESWL. Mean lower infundiblar length ± SD was 29.9±6.56 mm, mean width was 5.65±2.34 mm. lower pole infundibulopelvic angle was 48.33±14.84 degree.In fifty (44.2%) and sixty three (55.7%) patien infundibular length were greater than 30 mm and 30mm or less respectively, infundibular width was greater than 5mm and 5mm or less in forty seven (41.5%) and sixty six (58.4%) patients respectively, no obtuse infundibulopeivic angle were noted. None of three lower pole anatomical factor had statistically significant impact on the stone free rate. Renal morphology significantly affecting the stone free rate since stone clearance was less than pyelonephritic kidney ($P \leq 0.01$). Also stone size had significantly ($P \leq 0.00001$) impact on stone clearance, small stone had better clearance than larger one. Stone nature whether the stone first attack or recurrent also affecting stone free rate since clearance was less in recurrent stone whether after ESWL of stone in another part of the kidney or after open surgery ($P \leq 0.46$). **Conclusion:** different in the intrarenal anatomy of the lower pole have no significant impact on stone clearance. Renal morphology, stone size, and stone nature significantly affected stone free rate.

KEYWARDS: Kidney, lower pole renal stone, stone size, stone nature.

INTRODUCTION

Urinary calculi are the third most common affliction of urinary tract exceeded only by the urinary tract infection and pathological condition of the prostate. Urinary stones have plagued human since the earliest record of civilization. The etiology of stones remains speculative.[1-2]

Two separate epidemiological factors are involved in genesis of urinary caculi Intrinsic and extrinsic factors.

Among intrinsic factors are those related to inherit. Many generic studies have concluded that urolithiasis is associated with a polygenic defect and partial penetrance.[3] Several disorders that caused renal stone are hereditary, familial renal tubular acidosis is associated with nephrolithiasis in almost 70% of patients, while cystinurea is a recessive disease.[4] The peak incidence of stones occurs between 20 – 40 yr. About three males are afflicted for every one female.[3]

Extrinsic factors are sometime called environmental factors which include geography, climate and seasonal factors, water intake, dietary factor, and occupation.[5]

Etiology of Urinary Stones

Mineralization in all biological system has a common theme in that the crystals and matrix are intertwined. Urinary stones are no exception, and they are polycrystalline aggregates composed of varying amount of crystalloid and organic matrix.[1]

Many theories have been proposed to explain the cause and development of urinary calculus, but none of them have been able to answer fully the questions concerning stone formation, These theories include nucleation theory, stone matrix theory, and Crystal inhibitor theory.[1]

There are many types of urinary stones are calcium calculi (80 – 85 % of all stones) and non – calcium calculi as struvite stone (2 –20 % of all stones), uric acid stones (less than 5% of all stones), cystine lithiasis (1% of all stones), xanthine stones and other rare types of stones (silicate stones and triamterene stone).[6-9]

Clinical Features of Urinary Stone

Upper tract urinary stones usually eventually cause pain (renal colic and non-colicky renal pain), heamaturea, infection nausea and vomiting.[1,6] associated fever,

Evaluation of patient with urinary calculi

Evaluation of patient with urinary calculi was based on patient history, risk factors which include crystalurea, socioeconomic, diet, occupation, medication, and climate.[1]

Physical examination is an essential component of the evaluation of any patient suspected of having a urinary calculus presenting with acute renal colic sever pain, tachycardia, sweating, and nausea often prominent. Flake mass may be palpable in patient with long standing obstructive urinary calculiand sever hydronephrosis.[1]

Investigations of urinary calculus were based on urinalysis (24 hour urine collection), Blood test, U/S Scanning of kidney(demonstrating both the urinary stone and consequent hydronephrosis), radiographic investigation(plain abdominal films of kidneys, ureter, bladder (KUB), often show how big the stone is and where it is), intravenous pylography, computed tomography, tomography, retrograde pyelography , magnetic resonance imaging, and nuclear scintigraphy.[1,3,6]

In this study the factors that impede the passage of lower pole stone were investigated. These factors includes Lower pole anatomy (infundibular length, infundibular width, and infundibulopelvic angle), and renal morphalogy.

Patients and Methods

The clearance of lower pole stone was evaluated prospectively

Out of these 150 patients, 37 didn't complete the follow up, thus were excluded from the study.

The actual number of this study was 113 with age range between (15-75) years. The period of study was 18 mn.

All patients have been assessed by history and physical examination.

Investigation G.U.E. urine(C/S) to exclude urinary tract infection.

U / S of urinary tract had been done for all patients U/S scans try by the same sonorist to avoid the inter observer error IVP and blood biochemistry was done.

IVP was reviewed to assess the character of the stone, stone size, renal morphology and to measure the infundibulopelvic angle, infundibular length, and infundibular width.

Stone Free State was assessed monthly by U/S and KUB for any evidence of residual stone.

Statistical analysis

All data were arranged and tabulated as mean ± SD. Association between different variable measured by using Chi-square and fisher exact test when it is appropriated ($P \leq 0.05$ considered to be significant).

RESULTS

The total number of patients that were included is 113, their age ranged between (15-75) years with a mean (41.77 ± 11.31 SD) Males were 87 and females 26 with a male to female ratio 3.3 / 1.

Renal calculi in highly educated sedentary people is (60%) and in hard labour workers of relatively low educated level is (39%) 77% patients were presented with pain which is colicky in nature (68%), hematuria 56(49%), nausea and vomiting in 41 (36%), and the least common presentation was urinary tract infection 26(23%) as demonstrated in figure 1.

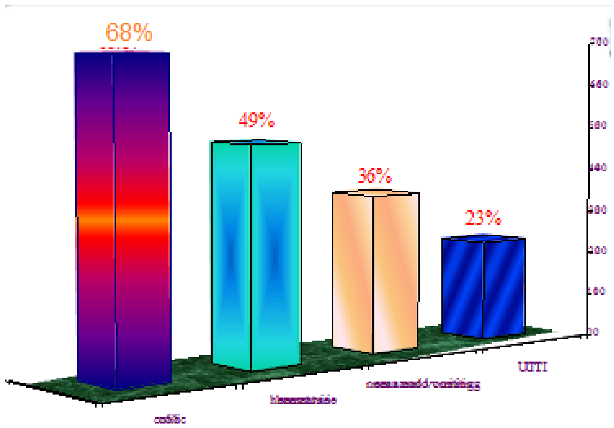

Figure 1: distribution of patients according to their presentation.

In past history of previous stone passage five patients had previous pyelolithatomy and seven patients had history of lithotripsy for stone in another part of kidney.

69 of patients have positive family history of stone with first degree relative. 13 patients (11.5%) had hyperuricemia and only 5 patients had hypercalcemia (4.4%) while most of patients with normal renal function.

The results of urinalysis were demonstrated in figure 2. Urinary reaction was acidic in most of patients (101).

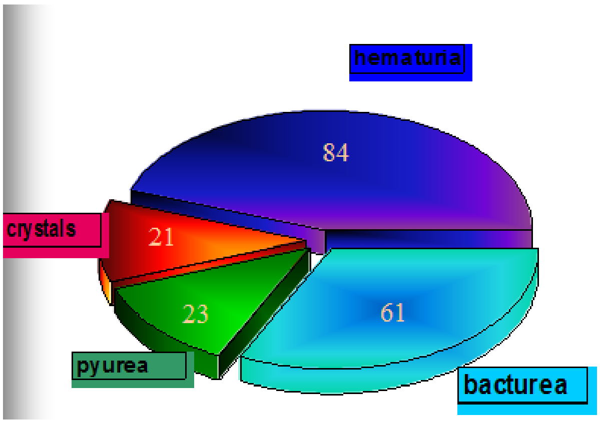

Figure 2: urinalysis in 113 patients.

All stones and kidney characterizations were shown in table 1.

The patients were divided in two groups as showed in table 2:

Group A: Those with a stone less than 1cm. in diameter.
22 patients out of 49 had spontaneous passage of stone within 3month,
10 patients had spontaneous passage of the stone in the 3-6 months period.
17 out of 49 patients had been treated by ESWL.
12 patients passed the stone fragments, and 5 patients had residual stone.

Group B: Those with the stone between 1-2 cm in diameter.
64 patients were treated by ESWL
25 patients had no residual stone on the KUB film.
39 patients had residual stone fragments and required another cession of ESWL.
19 of them passed the stone fragment (stone free)
20 had residual stones on the KUB film.

Table 1: Stone and Kidney Characterizations.

	No.	**Percentage**
Stone		
Single	105	92.9
Multiple		7
	8	
Stone size		
Less than 1 cm in diameter	49	43.3
Between 1-2 cm in diameter		56.6
	64	
Stone nature		
First attack	101	89.3
Recurrent	12	10.6
Stone side		
Right	50	44.2
Left	63	55.7
Kidney morphology		
Hydronephrosis	17	15
Localized dilation of calyx	41	36
Normal	55	48.6
Opacity		
Opaque	113	100
Lucent	0	0

Table 2: stone free rate according to size.

Stone Size	**Stone Free Rate**
< 1cm in diameter	89%
1-2 cm in diameter	54.6%

The effect of the lower pole infundibular length, width, and angle on stone free rate for three months was explained in table 3.

Table 3: The effect of the lower pole infundibular length, width, and angle on stone free rate at 3 months.

Variable	**No. of patient**		**% Stone Free Rate**	**P value**
Length				
Greater than30mm		50	(33) 64 %	0.303(NS)
30 mm or less	63		(46) 73 %	
Width				
Greater than 5mm		47	(31) 65.9 %	0.339(NS)
5 mm or less	66		(48) 74.2 %	
Angle				
90 or greater		1	(1) 100 %	0.707
less than 90		112	(78) 70 %	
greater than 45		62	(47) 75 %	0.19
45 or less	51		(32) 64 %	

The results indicated that none of three lower pole anatomical factors had any significant impacting on stone free rate. Table 4 illustrated the analysis of lower pole anatomy factors as well as different stone factors on stone free rate at clearance of lower pole calculus.

Table 4: analysis of lower pole anatomy factors as well as different stone factors on stone free rate at clearance of lower pole calculus.

Variable	NE Free Group	Residual Stone Group	P Value
Mean age ± SD	41.42 ± 11.09	42.72 ± 12.03	0.3877
Sex	65		< 0.05
Male	14	22	
Female		12	
n lower pole infundibular length ± SD	29.37 ± 6.93	31.34 ± 5.23	0.1768
an lower pole infundibular width ± SD	5.61 ± 2.34	5.76 ± 2.39	0.6608
n lower pole infundibulopelvic angle ±	49.33 ± 14.30	45.62 ± 16.18	0.2236
SD			
Morphalogy	46	9	P< 0.01
Normal	10	7	
Hydronephrosis	23	18	
Obstructed			
Side	39	11	P<0.044
Right	40	23	
Left			
Stone No.	75	30	P< 0.38
Single	4	4	
Multiple			
Stone Nature		26	P< 0.046
First attack	74	7	
Recurrent	5		
Stone Size	44	5	P < 0.00001
Less than 1cm in diameter	35	29	
Between 1- 2 cm in diameter			

DISCUSSION

Considerable clinical controversy still exists concerning the management of the lower pole caliceal stones.[10] Lower pole stones that are symptomatically, locally obstructing, infection related, or increasing in size requires intervention. Smaller, asymptomatic stones can be managed expectantly, though with periodic follow- up a significant number with exhibit increasing in size or become symptomatic. A contemporary area of controversy is whether small, non-obstructing, asymptomatic calyceal stones should be treated prophylactically.[11]

In 1992, Glowocki et al, noted that the risk of asymptomatic episode or need for intraveneous was approximately 10% per year.[12]

From this it can concluded that even small asymptomatic calyceal stones carry a significant risk of becoming symptomatic, and some form of prophylactic intervention may be offered especially for stones more than 1cm in size. For smaller, asymptomatic stones, there still exists no consensus as to whether prophylactic treatment should be offered.[11]

Several factors have been identified limit clearance of lower pole stone. Gupta et al had found increasing stone free rate with smaller stones with lower complication rates and needed fewer auxiliary producers such as ureteral stenting (table 5). It is a generally accepted that stone size plays a major role in treatment outcome.[13] Although stone free size is proven factor in the outcome of treatment, stone free rate are adversely affected by multiplicity of stones.[14]

Tabel 5: Stones free rate according to size Gupta et.at.[13]

Stone size	Stone free rate
< 1cm in diameter	72.1
1-2 cm in diameter	51.3

On the other hand, stone free rate according to size in my study is as follows

Stone size	Stone free rate
< 1cm in diameter	89.7
1-2 cm in diameter	54.6

Stone size was found to be of prognostic influence as in our study, we identified significant influence of calculus size on stone free rate (P= <0.0001). Chemical composition of urinary stones determines their fragility to shock waves. Improved stone clearance with small stones had been explained by minimal diameter are less likely to be associated with dilatation.[15] Chemical composition of urinary stones deyermines their fragility to shock waves.[16] Unfortunately the stone composition in many patients is not always known prior to treatment

Lower calyceal stones show a relatively poor stone free rate due to fragment retention after sufficient disintegration.[17]

Coz et. at determined stone free rate according to their calyceal site[18] as follow

Upper calyx	78.5
Middle calyx	81.9
Lower calyx	74.6

In our study the overall clearance of lower polestones of less than 2cm in diameter was 70 % (79 patients out of the total 113).

The configuration of pelvicalyceal system influences stone clearance. Several abnormalities adversely influence the outcome of treatment, thus abnormalities excluded from the study.[19]

Sampaio and Aragao first described the spatial anatomy of the lower pole as a possible factor in calculous passage. and suggested that anatomical feature of lower pole calyx may play role in lower pole stone clearance.[20] Elbahnasy et.al studied the impact of radiologic spatial anatomy on result of shock wave lithotripsy, retrograde flexible uretroscopy,[21] The larger the lower pole infundibulopelvic angle, the shorter the infundibular length, and the wider the infundibular width, the better stone clearance.

Patients with the mentioned three favorable factors, have stone free rate of 91%, compared to only 44% for those with unfavorable factors,[13]

Begley and Rittenberg measured the infundibulopelvis angle using ureteral axis and lower pole infundibular axis on IVP. Non-of their patients with stones had an angle of more than 90 degree,[22]

Kaley et.al. found the infundibulopelvic angle to be the only significant factor predicting stone free state of lower pole stones,[23]

Sampio and Aragao originally described another method of measurement the infundibulopelvic angle as angle was created by.

lower border of pelvis with medial border of the lower pole infundibulum .This technique results in much broader infundibulopelvic angle than when the ureteral or ureteropelvic axis is used.[20]

In my study, non-had an obtuse angle. ,and there was no significant impact of lower pole infundibulopelvic angle on stone free rate (P = 0.707). The difference in results are mainly due to difference in the method of measurement. Recently, Pace and associates trying to explain that difference in measurement and examined (50) out- patient intravenous pyelograms and found that there was a wide variability in lower calyceal infundibular width measurement between films, thus questioning the usefulness of this measuring.[24]

In fact, in a prospective analysis of lower pole calculi from lower pole study group examining lower pole infundibulopelvic angle as well as infundibular length and width, no difference was found in these variables among those who did or did not become stone free.[25]

There is several aspect of the problem of measuring renal anatomy, measurement of infundibular width and length is easy on pyelography but the X-ray might be influenced by technique and renal obstruction.[17] The techniques for measuring the infundibutepelvic angle were showd in figure 1.

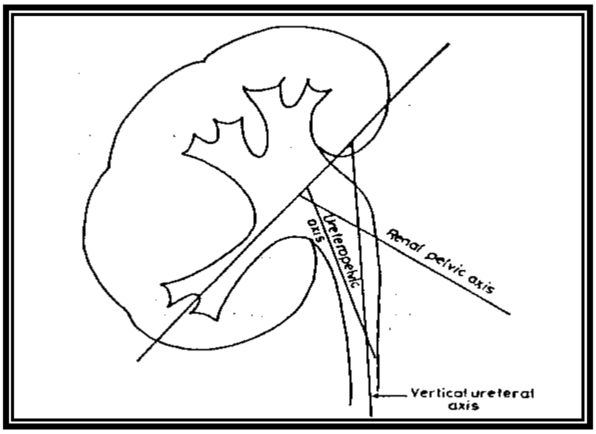

Figure 1: Methods of determining lower pole Infundibulopelvicangle using various uretropelvic axis.[10]

In our cases the overall mean infundibular length was 29.9mm, 50 patients (44.2 %) was more than 30 mm and 63 patients was less than 30mm with no significant effect observed on stone free rate (P = 0.303).

The overall mean infundibular width in our cases was 5.65 mm, in 47 patient (41.5 %)was more than 5mm, and in 66 patients was less than 5mm, with no significant effect observed on stone free rate(p = 0.339).

There is no statistically significantly difference in stone free rate in those patients with infundibular width of greater than 5 mm, and a length of less than 30 mm, and those with width of less than 5 mm, and a length of greater than 30 mm.

We agree with other authors that infundibular width and length are rarely important factors in stone clearance.

The measurement of the infundibular width and length on IVP are not reliable because the study may be done during peristalsis making the measurement imprecise.

My data show that renal dilatation and scarring was the important factor that statistically significant affected the stone rate free (P = 0.01). Patients with perfect kidney had the best chance of fragment clearance while those with pylonephritic kidney had the least chance of being free of stone.

This may be due to scarring in kidney that prevent good propulsive peristalsis and adequate lower caliceal contractions, which are themain driving forces for stone clearance. In contrast to perfect kidneys have more viable peristalsis and adequately contracting lower calix with better stone clearance.[10]

The efficient propulsion of stone is related to pelvicaliceal motility. Morphologic evidence of specialized pacemaker tissue in proximal portion of urinary collecting system has been described.[26]

Schulz ET. At. Reported that patients with stones exhibit a mean increase in the interval between two pelvicaliceal system contraction as well as in the duration of contractions in comparison to control subjects.[27]

It is possible that patients with previous urolithiasis who developed secondary stones in the lower calyx have more pronounced disturbance in their pelvicalyceal motility in comparison to patients with primary lower pole stone in whom such disturbance are localized.[28]

I found that the clearance of left lower pole stones is less than that of the right lower pole stone.

The report of the United State Cooperation Study of ESWL observed that the left kidney was more likely to be treated, impeding that some unknown process may lead to greater generation or retention of calculi in left side.[29]

CONCLUSION AND RECOMMENDATION

Lower pole stones that are symptomatic, locally obstructing, infection related, or increasing in size require intervention. Smaller asymptomatic, stones can be managed expectantly; though with periodic follow-up significant number will exhibit increasing in size or become symptomatic.

For most stones smaller than l cm in diameter, ESWL is the treatment of choice.

Stones in range of 1-2 cm in diameter represent an area of ongoing controversy regarding role of ESWL, PCNL, and uretroscopy.

The low clearance rate of lower pole renal calculi remains an enigma.

Our data revealed that difference in intrarenal anatomy of lower pole on preoperative IVP, including infundibular length, infundibular width, as well as infundibulopelvic angle, has no significant impact on the stone free rate, however reproducible method of measurements should be agreed upon before specific recommendations may be made.

Renal morphology, perfect configuration and intact propulsive peristalsis have an effective role in stone clearance Stone size had significant role in stone clearance, stone free rate higher in small stone diameter.

Further examination of lower pole anatomy and further search for other contributing factor are still warranted.

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