PERCUTANEOUS NEPHROLITHOTOMY WITH MULTIPLE TRACTS: COMPARISON OF MORBIDITY WITH SINGLE-TRACT PROCEDURE

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Abstract

Objective: *To findout a method of percutaneous nephrolithotomy (PCNL) that can achieve greater stone clearance with acceptable morbidity.*

Patients and Methods: *From January 2007 to May 2008, seventy patients were studied prospectively in two institutions and two other hospitals in Dhaka city for their complex renal stone management by percutaneous nephrolithotomy either with single tract or with multiple tract procedures. On the basis of assessment of calculus configuration and collecting system anatomy, patients who were managed with single tract PCNL labeled as Group A and those with multi-tract PCNL as Group B. Per-operative and post-operative events of all cases were analyzed for overall stone clearance, duration of operation time, per operative blood loss, post operative duration of haematuria, fever and analgesia requirement, urinary leakage through the nephrostomy tract, renal function and post operative hospital stay.*

Results: *The mean stone size in Group A was 4.4(range 3.3- 6.9) cm and 5.8(range 4.1- 8.8) cm in Group B (p<0.05). Stone clearance in group A was 82.0 %(n=39) and in group B was 87.0 %(n=31).The mean operative time (min) of group A and B were 97.0+3.9 and 124.0+2.7 respectively(p<0.05). Mean blood loss was 347±18.7 ml and 424±42.7 ml with single and multiple tract group respectively (P<0.05). Blood transfusion needed in 25.8% patients of multiple tract group and 12.8% patients of single tract group (p>0.05). Among the post-operative outcomes, fever occurred in group A was 17.9 %(n=7) and in group B was 16.2 %(n=5). Analgesia requirement was higher in Group B (mean 187.50 ± 14.00 mg) than in Group A (mean 194.17 ± 15.71 mg) (p > 0.05). The mean haematuria (in days) occurred in group A was 1.97±0.93 and in group B was 2.23±0.92(p>0.05). Urine leakage stopped earlier in group-A (24.79 ± 4.15hours) than that in Group-B (26.73 ± 4.04 hours) (p>0.05). The mean serum creatinine (mg/dL) levels preoperatively was 1.14±0.40 and 1.58±0.98; postoperatively was 1.24±0.58 and 1.91±1.64 in group A and group B respectively (p<0.05). Mean hospital stay in days was 3.05± 0.17(range 7-2days) and 4.12 ± 0.15 (range 11-2days) in group A and group B respectively (p<0.05). During procedure, No conversion to open surgery was needed in either group. In two patients, one from each group, the procedure had to be deferred due to excessive bleeding and managed conservatively keeping nephrostomy tube followed by second look PCNL.*

Conclusion: *Percutaneous nephrolithotomy with multiple tracts in a single session for treating complex stones in selected cases is safe, feasible and effective within acceptable morbidity in achieving a greater stone clearance.*

Key Words: *Percutaneous nephrolithotomy, Single Tract PCNL, Multiple Tracts PCNL, Renal calculi, Stag horn calculi, Percutaneous access point number and Location, Success rates, Complication rates.*

Introduction

Percutaneous trocar nephrostomy for hydronephrosis opened the door of a new technique done by Goodwin WE and coworkers (1955) about 50 years ago. Since then, the procedure of percutaneous nephrostomy has been refined and has vastly enriched the armamentarium of the contemporary urologist (Streem, 1996). Initially, percutaneous nephrostomy was used only for urinary diversion; subsequently it has been used for more complex procedure such as stone extraction.

The revolution of minimally invasive surgery began in 1976 when Fernström and Johannson performed the first percutaneous nephrolithotomy (PCNL). Subsequent reports on PCNL from the Mayo Clinic (Segura et al, 1982) and the University of Minnesota (Clayman et al, 1984) and from West Germany (Alken et al, 1981) and England (Wickham and Kellet, 1981) established PCNL. Further refined and advances in technique and equipment have allowed urologists to perform percutaneous stone

removal with increasing efficacy and decreasing complications (Lingeman et al, 1995). Developments in stone fragmentation, newer instruments and improved fluoroscopy have increased the versatility of percutaneous surgery. Flexible, steerable nephroscopes have allowed access to all parts of the kidney. The indications for open surgery in stone disease have thus become greatly reduced. However, in spite of all these developments, PCNL may be complicated by residual stone. Some times, complete clearance of stones may not be possible with every effort through a single percutaneous subcostal tract. They can be dealt with second look intervention through a mature nephrostomy tract. But it prolongs the hospital stay and increases the morbidity. Large stone burden also can be dealt with multiple tracts for complete clearance of stone. Therefore, in case of large stone burden with predictive chance of residual stone or when single percutaneous tract does not offer complete stone clearance, creating multiple tracts may be a useful alternative.

A concern with creating multiple percutaneous tracts is the potential for bleeding and higher complication rates compared with procedure that require a single tract. In Bangladesh, studies have been yet to done to compare the result of PCNL with single-tract versus multiple tracts. This study had been designed to focus on the outcomes in patients with multiple (>2) percutaneous access tracts with those in patients with single percutaneous access tract, and was able to compare the morbidity with specific reference to bleeding, transfusion requirements, complications, and postoperative renal function.

Materials & Methods

This hospital based prospective interventional comparative study was done in one institute and three other hospitals between January, 2007 and May, 2008. A total of 246 patients were evaluated during the study period with renal stone. Of them 70 patients with complex renal stone were enrolled for the study according to age limit between 18 to 70 years, stone size- 3 cm. or more, complex stone and excreting Kidney. Patient with bleeding disorder, anatomic abnormality of the kidney (horseshoe kidney/ Malrotated kidney) and history of previous surgery on the proposed PCNL side were excluded. Purposive sampling was applied for this study. All cases were evaluated for stone size, location and renal function by doing the X-ray KUB, ultrasonogram of KUB and excretory urogram.

On the basis of assessment of calculus configuration and collecting system anatomy, patients who might be managed with single tract PCNL labeled as Group A and those with multi-tract PCNL labeled as Group B. Decision of access point numbers were taken by senior urologist having experience in this field. Though in 4 cases during operative procedure, decision of single tract was changed into multiple tracts according to the findings of RGP or facing difficulties to approach stones or part of it with single tract. They were grouped according to the tract number(s).No patients of preoperatively determined multitract PCNL group had to be changed into single tract group during procedure.

The system for measuring the size of the staghorn calculus was based on the measurement of the longest linear diameter in cm observed on plain X-ray KUB and stones were basically classified as simple (isolated renal pelvis, or isolated caliceal stones) and complex (Staghorn , renal pelvis stones accompanying caliceal stones). Again classification of the staghorn stones into borderline, partial and complete staghorn.

A standard technique of percutaneous nephrolithotomy was used. For calculi in the superoanterior, superoposterior, and inferoposterior calices and pelvis, the inferoposterior calyx was usually chosen for entry. Entry through the midposterior calyx was chosen for calculi in the midposterior calyx, the pelvis, and sometimes in the ureter. No supracostal puncture was done in this series. Each patient underwent PCNL beginning with cystoscopy and insertion of a ureteral catheter to allow contrast material delineation of the renal collecting system. Patients were then placed prone on the C- arm compatible operative table with all pressure points padded.

Percutaneous access was obtained at a single setting in the operating room with C-armed fluoroscopy (Siemens, Germany). With the C-arm in the vertical position, the collecting system was inspected and the appropriate calyx identified. Examination with the C-ram at 90 degrees defined the medial vertical plane for entry into the calyx. The C-arm was then rotated approximately 30 degrees toward the surgeon. This placed the axis of the C-arm in the same central posterior plane of the kidney, providing a direct end-on view of the posterior calyces. Percutaneous access was created under fluoroscopic guidance using 18 G access needle into the selected calyx with the C-arm in the 30-degree and 90-degree positions. After determination of the appropriate plane, the needle was advanced in 1 to 2cm

increments. Rotating the C-arm back to the vertical position monitored the depth of needle penetration. When the needle appeared in the selected calyx, the stylet was removed, and the correct needle position was confirmed by flow of urine. A .038-inch floppy-tipped J guide wire was inserted into the needle and either advanced across the UPJ or coiled within the renal pelvis. Access needle was removed and the skin and fascia incised. A second J tipped guide wire was introduced into the collecting systems passed through the pelvis to the ureter if possible after dilating by screw dilator, which act as a safety and other as a working guide wire. The nephrostomy tract was dilated with Alken coaxial metal dilators (Karl Storz, Germany) and a 30 F Amplatz sheath positioned into the renal collecting systems. Nephroscopy was performed with a rigid, 28 ro 26-Fr nephroscope (Karl Stortz, Germany). Fragmentation of the stone burden was accomplished using a pneumatic lithotripter (R&D Tech, India). Forceps were used to remove stone fragments. Additional tracts were created when it had become obvious that another tract was needed to get to an inaccessible calyx.

On the basis of assessment of calculus configuration and collecting system anatomy when additional tracts were indicated , all possible tracts were punctured right at the outset, and the guide wires were secured, because it is significantly easier to confirm percutaneous needle placement in an intact collecting system. Once even a single tract has been dilated, the extravasations of fluid and contrast makes confirmation of precise caliceal puncture difficult.

The access that was more likely to clear most of the stone burden was dilated first and additional accessory tracts were dilated subsequently, as required. Stone clearance and the integrity of the collecting system were confirmed intraoperatively by fluoroscopy. A 6 Fr JJ stent was placed antegradely over a safety guide wire under direct vision and was adjusted with the grasping forceps. On completion of the procedure the Amplatz sheath was removed after putting a 26 or 28-Fr nephrostomy tube into the renal pelvis or the involved calyx at the end of the procedure and compressed dressing applied. If doubt about complete clearance or bleeding from other tracts was present, additional nephrostomy tubes were placed in those tracts. If residual stone fragments were noted, a decision to proceed to a second-look nephroscopy or ESWL was taken depending on the location and size of the residue and surgeon preference.

Antibiotic prophylaxis was maintained by ceftriaxone. The first ceftriaxone dose (1 gram) was administered intravenously when anesthesia was initiated, and the dose continued until their nephrostomy tube/tubes were removed. In case of patients with post operative fever urine culture and sensitivity were done and they were treated accordingly.

On postoperative day 1, nephrostomy tube/tubes were removed if the urine was clear and if plain X-ray KUB region showed stone free or no clinically significant residual fragments. The urethral catheter was removed on postoperative day 2. The JJ stent was removed after 3 weeks. A postoperative Hb%, serum creatinine and urine culture were also obtained from each patient. The nephrostomy tube was left in place if a second PCNL session due to residual stones was planned. Re-PCNL, ureteroscopy, and shock wave lithotripsy (ESWL) were considered as accessory treatment alternatives when indicated.

After meticulous checking and rechecking data were compiled and statistical analysis were done based on statistical software (SPSS- Statistical package for social science, Version-13). A ‘p’ value <0.05 was considered as significant.

Results

Attempt was made to compare the morbidity between single tract PCNL and multiple tract PCNL by duration of operative time, per operative blood loss, over all stone clearance, post operative fever and analgesia requirement, duration of haematuria, urinary leakage through the nephrostomy tract, renal function and post operative hospital stay.

246 cases of renal stone disease patients were evaluated, of them 70 patients were enrolled for study according to selection criteria.

Percutaneous nephrolithotomy was performed through subcostal puncture under general anaesthesia. After the procedure, they were grouped as Group A (Patients who were managed with single tract PCNL) and Group B (Patients requiring multi-tract PCNL). A total of 121 tracts were established in the 70 renal units. The maximal number of tracts used in a single renal unit was four (in multi-tract group range two to four). Single tracts were established in thirty nine cases, two tracts were established in sixteen patients, three tracts in ten patients and four tracts in five patients.

During procedure, No conversion to open surgery was needed in single tract group or in multi tract group. In

two patients, one from each group, the procedure had to be deferred due to excessive bleeding and managed conservatively keeping neprostomy tube followed by second look PCNL.

Majority of the renal stones was found in the age range 39–30 years (38.5% in Group-A and 35.4 % in Group-B) and the least frequency of stones in age 60 years or above (10.2% in Group-A and 6.4% in Group-B). The mean age of Group-A and Group-B were 42.71 ± 1.95 and 41.93 ± 1.99 years respectively. Age categories were almost homogeneously distributed in both the groups (p>0.05). Majority of the subjects in both the groups (56.4% in Group-A and 61.3% in Group-B) were male(p >0.05).

The mean stone size in Group A was 4.4(range 3.3- 6.9) cm and 5.8(range 4.1- 8.8) cm in Group B. Group B had significantly larger stone (p<0.05).

Percutaneous nephrolithotomy was performed in 39(55.8%) patient with single tract and in 31 (44.2%) patients with multiple tracts. Among them 85.7% of the single tract PCNL Group had stones located in pelvis with concomitant calyces. 8.5% and 5.7% of the single tract PCNL Group had borderline staghorn and partial staghorn calculi respectively. In multi tract PCNL Group-pelvis with associate caliceal stones, borderline and partial staghorn stones were 19.3%, 13.0% and 22.7% respectively. All complete staghorn stones (n=14) were managed by multiple tract PCNL (45.1% of Group B)

An overall success rate of 84.3% was achieved in both groups. The success rate of patients with staghorn and pelvic stone accompanying caliceal stones were 86.7% and 82.5% respectively. Patients with staghorn and pelvic stone accompanying caliceal stones had a complete stone removal rate of 53.3% and 60.0% respectively, while CIRFs were observed in 33.3% and 22.5% respectively.

Single percutaneous access was performed in 39 (55.7%) patients, while multiple (> 2) accesses were performed in 31(44.3%). Multiple accesses were necessary in 25 (83.3%) out of 30 staghorn stone, and in 6 (15.0%) out of 40 patients having pelvic stone with concomitant caliceal stones (Table-VIII). The mean size of stones treated with multiple accesses and single access tract were 5.8(4.1-8.8) cm and 4.4(3.3-6.9) cm respectively. The mean size of stone in multiple tract groups was significantly greater than those treated with single access (p < 0.05).

Table I

Location of stones and stone clearance.

Stone category and localization	n	Stone clearance			
		Stone free n (%) (a)	CIRFn (%) (b)	successful (n %) (a+b)	unsuccessful n (%)
Complex stones	70	40 (57.1)	19 (27.2)	59(84.3)	11 (15.7)
Staghorn	30	16(53.3)	10 (33.3)	26(86.7)	4(13.3)
Borderline staghorn	7	7(100.0)	0(0)	7(100)	0(0)
Partial staghorn	9	5(55.5)	3 (33.3)	8(88.8)	1 (1.11)
Complete staghorn	14	4 (28.6)	7(50.0)	11(78.6)	3 (21.4)
Renal pelvic stone and Accompanying caliceal stones	40	24(60.0)	9 (22.5)	33(82.5)	7(17.5)

CIRF: clinically insignificant residual fragments

Table II

Success (stone-free + CIRF) rates achieved according to access point number.

Access point number		complex stone		Mean	Stone	Size
Success rate	cm	n (%)				
	Pel+ cal	Borderline	Partial	Complete		
	n (%)	n (%)	n (%)	n (%)		
Single access (n = 39)	34 (85.7)	3 (8.5)	2(5.7)	0(0)	4.4(3.3- 6.9)	32 (82.0)
Multiple accesses(n = 31)	6 (19.3)	4 (13.0)	7(22.6)	14(45.1)	5.8(4.1- 8.8)	27 (87.0)
2 accesses (n =16)	5	2	3	6	-	14 (87.5)
3 accesses (n = 10)	1	2	2	5	-	9 (90.0)
4 accesses (n = 5)	0	0	2	3	-	4 (80.0)

Table III

Effects of PCNL on renal function , blood loss , transfusion and operative time .

	Single tract n (39)	Multiple tract n(31)	Calculated value	p value
Mean serum creatinine (mg/dL)				
Preop	1.14± 0.40(0.7-2.28)	1.58±0.98 (0.7-5.1)	2.35 S	<0.05
Postop	1.24±0.58	1.91±1.64	2.23 S	<0.05
Mean Hemoglobin (g/dL)				
Preop	13.4±1.9 (9.4-15.8)	11.6±2.1 (8.6-15.1)	3.72 S	<0.05
Postop	11.51±1.86	9.49±1.55	4.55 S	<0.05
Mean operative time (min)	97.0+3.9	124.0+2.7	3.41 S	<0.05
Mean blood loss (ml)	347± 18.7(180-455)	424± 42.7(320- 960)	24.7 S	< 0.05
Number transfused (%)	5(12.8)	8(25.8)	1.36 NS	>0.05

t- test, χ^2 test , S= Significant , NS= Not significant

The mean operative time (min) of group A and B were 97.0+3.9 and 124.0+2.7 respectively. Significantly longer period was required in multiple tract group (p<0.05). Stone clearance in group A was 82.0 %(n=39) and in group B was 87.0 %(n=31).

Mean blood loss was 347±18.7 ml and 424±42.7 ml with single and multiple tract group respectively. Significant difference was found among the groups (P< 0.05). Blood transfusion needed in 8 (25.8%) patients of multiple tract group and 5 (12.8%) patients of single tract group. This result was not statistically significant (p>0.05).

Post-operative outcomes were recorded in both groups. Post operative fever occurred in group A was 17.9 %(n=7) and in group B was 16.2 %(n=5). Analgesia requirement was higher in Group B (mean 187.50 ± 14.00 mg) than in Group A (mean 194.17 ± 15.71 mg). Though statistically no significant difference was found among the groups (p > 0.05).

Table IV

Comparison of outcome between group:

Outcome variables	Group		Calculated value	p-value
	Group-A (Single tract) (n = 39)	Group-B (Multi-tracts) (n = 31)		
Stone clearance %	82.0(32)	87.0(27)	0.58 NS	>0.05
Conversion to open surgery %	0 (0)	0(0)	-	-
Per operative bleeding deferred the procedure	2.5 (1)	3.2 (1)	0.17 NS	>0.05
Bleeding necessitating blood transfusion	12.8 (5)	25.8(8)	1.36 NS	>0.05
Symptomatic urinary tract infection %		7.6 (3)	6.5 (2)	0.18 NS
>0.05				
Fever(>101° F)%	17.9(7)	16.2(5)	0.18 NS	>0.05
Haematuria (days)	1.97 ± 0.93	2.23 ± 0.92	1.17 NS	>0.05
Amount of analgesics needed (mg)	187.50 ± 14.00	194.17 ± 15.71	1.89 NS	>0.05
Urine leakage (hrs)	24.79 ± 4.15	26.73 ± 4.04	1.98 NS	>0.05
Hospital stay (days)	3.05±0.17	4.12 ± 0.15	25 S	< 0.05

t- test, S= Significant, NS= Not significant

The mean haematuria (in days) occurred during post operative period in group A was 1.97±0.93 and in group B was 2.23±0.92. No significant difference was found between the groups (p>0.05). Urine leakage stopped earlier in group-A (24.79 ± 4.15hours) than that in Group-B (26.73 ± 4.04 hours) (p>0.05). The mean serum creatinine (mg/dL) levels preoperatively was 1.14±0.40 and 1.58±0.98; postoperatively was 1.24±0.58 and 1.91±1.64 in group A and group B respectively (p<0.05). The mean Hemoglobin (g/dL) level preoperatively was 13.4±1.9 (range 9.4-15.8) and 11.6±2.1 (range 8.6-15.1), postoperatively was 11.51±1.86 and 9.49±1.55 in group A and group B respectively (p<0.05). Post operative hospital stay of the patient was also compared between the groups. Mean hospital stay in days was 3.05± 0.17(range 7-2days) and 4.12 ± 0.15 (range 11-2days) in group A and group B respectively. Group B had higher significant difference in hospital stay than the group A (p<0.05).

Apart from hospital stay, all the outcome variables responded insignificantly in both Groups. The mean hospital stay in days was less in single tract (3.05± 0.17) group than multitract group PCNL (4.12 ± 0.15) and this difference was statistically significant as the P value was <0.05. Stone clearance in group A was 82.0 %(n=39) and in group B was 87.0 %(n=31). No conversion to open surgery was needed in single tract group or in multi tract group. In two patients, one from each group, the procedure had to be deferred due to excessive bleeding and their stones were cleared in a second look PCNL session.

Table V

Complications of percutaneous nephrolithotomy in 70 patients observed during follow-up.

Complications	n (%)	Single tract n (%)	Multiple tract n (%)
Conversion to open surgery	0(0)	0(0)	0(0)
Bleeding			
Deferred the procedure	2(2.8)	1(2.5)	1(3.2)
Necessitating blood transfusion	13(18.6)	5(12.8)	8(25.8)
Hydro-hemopneumothorax	0(0.0)	0(0.0)	0(0.0)
Injury to other adjacent organs	0(0.0)	0(0.0)	0(0.0)
Perinephric abscess formation	0 (0.0)	0(0.0)	0(0.0)
Postoperative fever (>101 ° F)	12 (17.1)	7(17.9)	5(16.2)
Symptomatic urinary tract infection	5 (7.1)	3(7.6)	2(6.5)
Hematuria >24 h	8(14.4)	5(12.8)	3(9.6)
Prolonged urine leakage from tract(s)	3 (4.3)	1(2.5)	2(6.4)

Table VI

Summery of comparison of base line variables among the present study and some other studies.

	Present Study		Hegarty et al, 2006		Netto et al,2005		Muslumangolu et al, 2006	
	Single tract	Multiple tract	Single tract	Multiple tract	Single tract	Multiple tract	Single tract	Multiple tract
Mean age	42.71±1.95	41.93± 1.99	54.4±12.4	59.4±15.5	42.7	45.6	41.6	39.8
Male (%)	56.4	61.3	55	20	39.6	30.3	52.7	
Mean stone size	4.4cm	5.8cm	423.4±2 99mm^2	2156.6 ±1441.2 mm^2	6.9 cm	6.9 cm	6.7±3.6 cm	9.6±5.7 cm
Preop S. Cr (mg/dL)	1.14±0.40	1.58±0.98	1.13±0.43	1.67±1.33	*	*	1.05	1.54
Preop Hb (g/dL)	13.4±1.9	11.6±2.1	13.6±1.7	11.8±2.2	*	*	12.4	10.8

* Variable not used in the article.

Table VII

Summery of comparison of out come variables among the present study and some other studies.

	Present Study et al, 2006		Hegarty et al, 2006		Netto et al, 2005		Muslumangolu	
	Single tract	Multiple tract	Single tract	Multiple tract	Single tract	Multiple tract	Single tract	Multiple tract
Stone clearance %	82	87	100	95	83.7	84.8	96.7	89.2
Conversion to open surgery %	2.5	6.5	*	*	*	*	0	0
Per operative bleeding deferred the procedure (%)	2.5	3.2	0	0	*	*	0.73	1.5
Bleeding necessitating blood transfusion (%)	12.8	25.8	0	20.0	13.5	39.4	7.6	18.5
Symptomatic urinary tract infection %	7.6	6.5	0	5	1.1	3.0	4.7	
Fever(>101° F)%	17.9	16.2	10	15	5.4	12.3	7.6	
Haematuria (days)	1.97± 0.93	2.23± 0.92	*	*	*	*	5.5%	
Urine leakage (hrs)	24.79± 4.15	26.73± 4.04	*	*	2.4%	0	3%	
Hospital stay (days)	3. 05± 0.17	4.12± 0.15	3.42± 0.22	4.67± 0.21	3	2.4±1.1		

* Variable not used in the article.

Discussion

Over time, an untreated staghorn calculus is likely to destroy the function of kidney and/or cause life threatening sepsis. Complete removal of the stone is an important goal to prevent further stone growth and any associated infection, and to preserve the renal function (Glenn et al, 2005). For these reasons, most urologists would agree that clearance is the most meaningful determinative factor of successful treatment of patients with complex calculi. For complex calculi, there are several considerations, such as open operation, ESWL, PCNL, and a combination treatment (Webb et al, 1987). The disadvantages of retreatment are increased risk of obstructive pyelonephritis due to impaction of dislodged fragment into ureter or steinstrasse in case of post ESWL patients and long treatment time before the stones were removed entirely.

PCNL is an integral component of the management of most staghorn and large-volume renal calculi. In the recently updated guidelines of the American Urological Association Nephrolithiasis Guidelines Panel on Staghorn Calculi (Preminger et al, 2005), present trend is towards the use of percutaneous monotherapy using multiple tracts as the preferred treatment option for most staghorn calculi. Although the safety of creating percutaneous renal tracts is well established, concern is still present about the use of multiple tracts for the treatment of complex calculi (Alken et al, 1984). The target endpoint of treatment for every patient undergoing PCNL is complete calculus clearance percutaneously.

The present study has been designed to compare the outcome of single tract PCNL (Group A) with multi-tract PCNL (Group B) for the management of large volume complex renal calculus. 70 patients were enrolled from admitted 246 patients with renal stone at department of Urology, Bangabandhu Sheikh Mujib Medical University, Bangladesh Medical College Hospital, Comfort Nursing Home and Popular Diagnostic Center, Dhaka as per selection criteria with age range from 70-18 years.
All procedures were done by single or multiple sub costal puncture on the basis of assessment of calculus configuration and collecting system anatomy for stone clearance. A total of 121 tracts were established in the 70 renal units. The maximal number of tracts used in a single renal unit was four (in multi-tract group range two to four). Single tracts were established in thirty nine cases, two tracts were established in sixteen patients, three tracts in ten patients and four tracts in five patients.

The age of the patients in both groups of the present study ranged between 68 and 22 years and the majority between 30 -39 years, of which 15 and 11 patients belonged to group A and group B respectively. Mean age + SD of Group A was 42.71 ± 1.95(range 22-68) and that of Group B was 41.93 ± 1.99(range 60-26) years.

The age range of the present study is comparable with the study done by Rodrigues Netto et al, 2005, Singla et al in 2008, Hegarty and Desai 2006 Liatsikos and collaborators, 2005 and Guohua et al. in 2007

Stone size was another baseline variable. In this study, only complex stones were included. The length of the stone size was calculated radio logically in centimeter. The mean stone size in Group A was 4.4(3.3- 6.9) cm

and 5.8(4.1- 8.8) cm in Group B. The stone size of both groups was compared and Group B had significantly larger stone ($p<0.05$). Hegarty and Desai in 2006, mean stone size of their study was 423.45±299 (144-1400) mm2 and 2156.6±1441.2 (55-4720) mm2 in single tract and multi-tract PCNL respectively which was also significantly different in both groups.

A retrospective study by Rodrigues Netto et al. in 2005 found that the mean stone burden was 6.9 (5.2-10.8) cm. Mean stone size was 6.7± 3.6 and 9.6±5.7 cm for single and multitract PCNL respectively in a study by Muslumanoglu and coworkers. Stone size was considerably greater in multiple tract groups in their studies.

Mean +SD operation times in this study were 97.0+3.9 min in PCNL with single tract and 124.0+2.7 min in PCNL with multitract including cystoscopic ureteral catheter placement ($p<0.05$). This difference may be due to variation in stone size and location and skill ness of operative surgeons. Ahmet Yaser Muslumanoglu and associates, 2006 observed the mean operation time was 87.8±32.5 (range 180-50) min in their prospective study of multiple tracts PCNL. Rodrigues Netto et al in 2005 conducted a study where the average operative time was 139.1 minutes for single tract PCNL and 134.9 minutes for the multiple access groups. No significant difference was found among the groups. Aron and associates presented data where they found that the mean operative time for multiple tracts was 146 minutes. Liatsikos and collaborators in 2005 found that the average operative time of their study in multiple angular approaches was 110 minutes (180-90).

In present study mean blood loss was less in single tract group, 347±18.7 (180-455) ml than multiple tract group 424± 42.7(320- 960) ml. Significant difference was found among the groups ($p<0.05$). Transfusion was needed in 8 (25.8%) patients of multiple tract group and in 5(12.8%) patients of single tract group ($p>0.05$). The result was consistent with the previously published studies like Manish Singla et al 2008, reported in their study that 18.8%(28 out of 149) patients were needed blood transfusion in multiple tract group and they found 11.2% in single tract group of other series. Muslumanogolu and associates, 2006 reported in their study that 18.5 %(5 out of 65) patients were needed blood transfusion in multiple tract group and they found 7.6% (39 out of 210) in single tract group. Rodrigues Netto et al 2005 compared the blood transfusion between the two groups and were 39.4% in multi tract group and 14.3% in single tract group. Liatsikos and collaborators, 2005 observed in their study that the blood transfusion required in 45% cases of multiple angular renal accesses and average blood loss was 450 ml (range 300-1000ml). Zeng Guohua and associates, 2007 reported in their series the mean blood loss was about 112ml (range 483-64 ml).

The mean Hemoglobin (g/dL) levels preoperatively was 13.4±1.9 (range 9.4-15.8) and 11.6±2.1 (range 8.6-15.1); postoperatively was 11.51±1.86 and 9.49±1.55 in group A and group B respectively ($p<0.05$). In a prospective study by Hegarty and Desai in 2006, the mean Hemoglobin (g/dL) levels preoperatively was 13.8±1.6 (range 16.3-10.6) and 11.8±2.2 (range 16.7-9.0); postoperatively was 10.81±1.54 and 9.86±1.35 in group A and group B respectively ($p<0.05$).

The procedure had to be deferred in 2 patients because of hemorrhage obscuring vision and deteriorating haemodynamics of the patient. Both patients were successfully managed by conservative measures keeping the nephrostomy tube in situ and their stones were cleared in a second look PCNL session.

After completion of the procedure, patients were evaluated with fever, analgesia requirements, duration of macroscopic haematuria, urinary leakage through percutaneous tract and hospital stay.

Seven patients of PCNL with single tract and five patients of multiple tracts PCNL had fever, which was not significant. Fever was associated with urinary tract infection and with rigor following infusion, which resolved quickly after change of antibiotic according to the culture and sensitivity report and/or withdrawal of intravenous fluid.

Guohua et al. 2007, in a retrospective study found 7 (7%) patients with a postoperative fever of 38.5°C or greater. The 4 patients had bacteremia, which was cured by intravenous antibiotics. In a study done by Muslumanoglu and associates 2006 where post operative fever (>38°C) was occurred about 7.6% (21 out of 275) patients in multiple tract PCNL. Aron and associates, 2005 presented data in favors of multi tract PCNL for large complete staghorn calculi found twenty two patients (21%) had fever that was treated with broad-spectrum antibiotics.

Macroscopic haematuria occurred in 3 patients of single tract and 5 patients of multiple tract groups. In this study mean duration of haematuria in Group A was 1.97+0.93

days(range 1-6 days) and in Group B was 2.23+0.92 days (range 1-7 days); difference was not statistically significant among the groups. Two patients, one from each group, required postoperative blood transfusion. Ahmet Yaser Muslumanoglu and associates, 2006 in a prospective study observed that haematuria occurred in 5.5% (15 out of 275) patients.

In the present study percutaneous nephrolithotomy with multiple tracts had no significantly higher analgesia requirement compare to percutaneous nephrolithotomy with single tract. In this study, the mean+SD of injection pethedine in mg of group A was 187.50 ± 14.00 mg compared to 194.17+15.71 mg in group B. Rodrigues Netto et al in 2005 evaluated postoperative pain according to the amount of oral or parenteral analgesics (Meperidine) used. Patients who required no analgesics or up to one tablet daily were considered as pain free. Of the 119 patients, 77 (64.7%) were considered pain free and 42 (35.3%) as having pain. Of the 42 patients with pain, 40.5% in the single tract, and 36.4% were in the multiple access groups. No significant difference was found among the groups in their study and in the present study.

In the present study, the nephrostomy tube was removed when the color of the urine was clear and the patient was kept in the hospital for at least 12 hours thereafter. Prolonged urine leakage from tract site occurred in 3 patients (3.2%), one from group A and two from group B. In this present study, the mean urine leakage in hours from tract site was 24.79 ± 4.15 and 26.73 ± 4.04 for single tract and multitract PCNL respectively. Muslumanoglu et al. 2006 observed in their study that prolong urinary leakage occurred in 2.9% (8 out of 275 patients). In a comparative study by Liatsikos and collaborators in 2005 reported that urinary leakage occurred in 3% (3 out of 100 patients) cases in multiple angular renal accesses. Another study by Desai et al. in 2004 found that prolong urinary leakage occurred 4.5 %(1 out of 22) and 2.9 %(1 out of 34) in single tract and multiple tract group respectively. The number of percutaneous access tract is not associated with postoperative percutaneous tract site urine leak. The present study is consistence with previously published study.

In this study, it has been observed that the mean length of hospital stay 3.05± 0.17(range 2-7 days) and 4.12 ± 0.15(range 2-11) days for the patient of PCNL with single tract and multiple tract group respectively. The length of hospital stay in group B was higher and statistically significant than in group A ($p < 0.05$). Hegarty and Desai 2006 reported that mean length of hospital stay (days) was 4.67 ± 0.21 and 3.42± 0.22 in multiple tract group and single tract group respectively. In a retrospectively study by Rodrigues Netto and associates in 2005 found that the hospitalization time was not different among the groups, with a mean stay of 3 days ($p > 0.05$). Liatsikos and collaborators observed that the mean length of hospital stay was 4.6 (14-3) days in their series. Manish Singla and associates in 2008 found the hospital stay of their patients was 6.8 (28-3) days. Muslumanoglu et al. reported in their study the mean hospital stay was 2.4±1.1 (range 1-7 days). In the present study, mean hospital stay for single tract PCNL was significantly less than the mean hospital stay for PCNL with multiple tracts.

There was no significant impact of PCNL on renal function in patients requiring single tract access. Present study revealed that mean of pre operative serum creatinine in multiple tract group and single tract group were 1.58±0.98 mg /dL (range 0.7-5.1) and 1.14± 0.40 mg /dL (range 2.28-0.7) ($p < 0.05$). In multiple tract groups, mean preoperative serum creatinine was much higher than single tract group may be due to large stone burden, delayed presentation and associated medico-renal diseases. The mean of post operative serum creatinine in single tract group and multiple tract group were 1.24±0.58 mg /dL and 1.91±1.64 mg/dL respectively ($p < 0.05$). As a group, patients requiring multi-tracts had a significant postoperative increase in serum creatinine; however an increase of serum creatinine >0.5 mg/dL was seen only in patients with a high baseline serum creatinine of >1.4mg/dL.

Hegarty and Desai, 2006 in their study, mean pre operative serum creatinine in multiple tract group and single tract group were 1.67±1.34 mg /dL (range 0.7-5.5) and 1.13± 0.43 mg /dL (range 0.7-2.25) ($p < 0.05$). The mean post operative serum creatinine in single tract group and multiple tract group were 1.23±0.79 mg /dL and 1.87±1.85 mg/dL respectively ($p < 0.05$). These findings were consistence with present study.

In the management of patients with stone disease it does not matter how much stone burden the surgeon has cleared but from the perspective of patient satisfaction is how much is left behind. Though stone free rate varied widely reflecting the surgeon's technical skill, thoroughness and attitude in removing stone. In the present study, an overall success rate of 85.5% was achieved and higher stone clearance was observed

in patients with multi tract PCNL when compared to patients with single tract PCNL. Though mean stone burden was greater, the success rates were increased in the staghorn stones, in which multiple accesses were more commonly indicated. However, in the group of patients managed with multiple punctures, success rate was more than that achieved in the single access group, probably due to easy approach to the inaccessible calyx with multiple tracts.

In the present study, the success rate of stone clearance was 82.0% (32 out of 39 patients) and 87.0 % (27 out of 31 patients) with single tract and multiple tracts PCNL respectively. The success rate of stone clearance in a study conducted by Rodrigues Netto and associates in 2005 was 80% (56 in 70 patients) and 84.8 % (28 in 33 patients) with single tract and multiple tracts respectively. In another study by Aron and associates in 2005 reported the success rate of stone clearance was 84% with aggressive multi-tract PCNL. Complete stone clearance was achieved in 87% with multiple angular renal accesses in a study by Liatsikos and collaborators in 2005. Muslumanoglu et al. 2006 observed in their study that the success rate of stone clearance was 96.7% (203 out of 210 patients) and 89.2 % (58 out of 33 patients) with single tract and multiple tracts PCNL respectively. A prospective study by Hegarty and Desai in 2006 claimed the success rate of stone clearance with single tract and multiple tracts PCNL were 100% and 95% respectively. Zeng Guohua and associates in 2007 reported their success rate of stone clearance with minimally invasive percutaneous nephrolithotomy to treat staghorn calculi via multiple percutaneous tracts in a single session procedure was 93%(93 out of 100 patients).

Conclusion

With the development of instruments and increase experience, judiciously made multiple percutaneous tracts in a single session percutaneous nephrolithotomy for treating complex stones in selected cases is safe, feasible and effective within acceptable morbidity in achieving a greater stone clearance. A large multi centre comparative study may be done for further comment.

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