Original Research Article

Prospective study: Safety of PCNL in Altered Renal function patients at our centre

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Received: 17-04-2021 / Revised: 15-05-2021 / Accepted: 11-06-2021

Abstract

Background: Percutaneous nephrolithotomy (PCNL) for stones in solitary kidney poses a significant challenge and potential threat for acute kidney injury or progression of chronic kidney disease (CKD). Present study aimed to evaluate the outcome of percutaneous nephrolithotomy (PCNL) in patients with altered renal function.**Materials and Method**: A prospective study was conducted and PCNL was performed in all the eligible cases with due aseptic precautions and prophylactic antibiotic cover. In the present study, in a series of continuous 600 patients who were operated by PCNL, 57 patients with altered serum creatinine more than 1.5 were studied, observed and followed. Postoperative complications and stone-free rate were recorded**Results**: Prevalence of patients with urolithiasis with altered renal function is significantly higher (9.5%). Most of the patients are of 40-60 years of age group with more prevalence in males. If the patients has diabetes, hypertension, previous surgery for calculus like nephrolithotomy, pyelolithotomy improvement in renal function is less likely. Approximately 80.70% patients were benefited from doing PCNL either in the form of stable function or improvement in renal function.**Conclusion**: PCNL is safe and effective endoscopic technique for urinary stones in patients with altered renal function.

Keywords: Nephrolithotomy, pyelolithotomy, urolithiasis

Introduction

Patients with renal insufficiency comprise 0.78–17.5% of the cases treated for urinary stone disease . Renal stones may lead to varying degrees of Renal Failure (RF) by causing urinary stasis and chronic infections . The rate of end-stage renal disease development is between 0.2-3.2% . Although it is not clearly demonstrated, it is believed that there is a strong relation between renal stone disease and renal failure [1-4]. These patients often have bulky stones. Gupta et al. [1] reported that 75.8% of urolithiasis patients with mild to moderate renal insufficiency required multiple procedures for treatment including extracorporeal shock wave lithotripsy (ESWL), percutaneous and ureteroscopic procedures and even open surgery. Patients with renal insufficiency frequently have various medical conditions such as diabetes, hypertension, anemia, and bleeding disorders, which have detrimental effects on their general health. Consequently, there may be concerns that these patients will suffer from lower success and higher complication rates compared to patients with normal renal function. According to the EAU 2015 guideline, percutaneous nephrolithotomy (PCNL) is the standard surgical treatment for large renal stones [5]. In cases with RF and co-morbid renal stone, information on the clinical course of RF is inadequate[2]. However, elimination of obstruction and eradication of chronic infection by removal of renal stones may lead to regression of RF. Management of renal stones in patients altered renal function is a daunting task due to various inherent problems associated with CRF like anemia, coagulation defects, poor fluid and electrolyte balance, poor wound healing and weak immunological status. Although there are many studies in the literature regarding the optimum managementof renal stones with Percutaneous Nephrolithotomy (PCNL) yet the issue of management of renal stones with renal failure has not been addressed adequately till date.

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In this study we aimed to determine the outcome of PCNL treatment on renal functions in renal stone patients with altered renal function and we also aimed to study various surgical parameters associated with it.

Review of Literature

The ancient Egyptians, thousands of years BC, documented urolithiasis. It has been found that as many as 15% of humans during their normal lifespan, irrespective of age, gender or ethnicity affected with urolithiasis. Stone disease related mortality is very rare, but morbidity and economic impact associated with renal urolithiasis are considerable[2,3].In India upper and lower urinary tract stones occur frequently but the incidence shows wide regional variation. The incidence of renal calculi is comparatively low in the southern part of country compared to other parts. The prevalence of urolithiasis is as high as 7.6% in Satpura part of Maharashtra.Pendse et al had reported a high and progressively increasing incidence of urolithiasis in Udaipur and some other parts of Rajasthan in the western part of India[5].Many studies from India have documented that calcium oxalate forms the major constituent of renal calculi disease in India. In United States its prevalence has doubled since the sixties being now between 2% and 7%. Similarly in other countries its prevalence has also been rising. It has recently been shown that the real prevalence might even be higher reaching 8.4%.Urolithiasis manifest itself clinically mostly between 30 and 50 years of age. The risk of recurrent renal colic after the first stone episode is roughly 15% during the first 3 years and grows up to 50% for the next 7 years. In patients with more than one stone diagnosed during their first renal colic this ratio might increase to 75%. After every urolithiasis treatment, the patients should be stratified and accordingly assign to low or high risk group of stone recurrence. Urolithiasis promoting factors as patients' age, recurrent stone formers, familial urolithiasis, calcium hydrogen phosphate (brushite), uric acid, cystine, and so called infection stones have to be analyzed and appropriately considered for the further management. This group requires thorough metabolic evaluation and a close follow-up. However, only in 20% of the patients a systemic disease predisposing to stone formation can be identified[6].

Epidemiology of renal calculi

- The lifetime prevalence of kidney stone disease is estimated at 1% to 15%, with the probability of having a stone varying according to age, gender, race, and geographic location.
- Stone disease typically affects adult men more commonly than adult women.
- Highest prevalence of stone disease in whites, followed by Hispanics, Asians, and African - Americans, who had prevalence's of 70%, 63%, and 44% of whites, respectively.
- Stone occurrence is relatively uncommon before age 20 but peaks in incidence in the fourth to sixth decades of life.
- Higher prevalence of stone disease is found in hot, arid, or dry climates such as the mountains, desert, or tropical areas.
- Heat exposure and dehydration constitute occupational risk factors for stone disease as well.
- The prevalence and incident risk of stone disease were directly correlated with weight and body mass index (BMI) in both sexes, although the magnitude of the association was greater in women than men.
- The beneficial effect of a high fluid intake on stone prevention has long been recognized.

Classification of nephrolithiasis

The most common component of urinary calculi is calcium, which is a major constituent in nearly 75% of stones. Calcium oxalate makes up about 60% of all stones; mixed calcium oxalate and hydroxyl apatite, 20% and brushite stones, 2%.

Both uric acid and struvite (magnesium ammonium phosphate) stones occur approximately 10% of the time, whereas cystine stones are rare (1%). Stones associated with medications and their by products such as triamterene, adenosine, silica, indinavir, and ephedrine are very uncommon and usually preventable (6).

A. Calcium-Containing Stones
• Calcium oxalate – 60%
• Hydroxyapatite – 20%
• Brushite – 2%
B. Non–Calcium-Containing Stones
• Uric acid- 7%
• Struvite – 7%
• Cystine 1-3%
• Triamterene<1%
• Silica <1%
• 2,8-Dihyroxyadenine <1%

Etiology and pathophysiology of stone formation

Stone formation is a complex and a dynamic process involving nucleation, growth and aggregation of crystals. Abnormalities of metabolism and ion transport in the kidney and intestines can modify urinary solute composition and favour stone formation. Above 80% of stones that are formed contain calcium, mainly in the form of calcium oxalate. Since renal stone formation is the consequence of increased urinary super saturation with calcium salts, metabolic evaluation in clinical practice has primarily to consider risk factors of increased urinary super saturation[6].Kidney stones result from complex physical and chemical processes.However, two major opposing forces are the key factors. Urinary super saturation provides the driving force for stone formation, and on other hand, urinary inhibitors of kidney stones formation provide a protective effect. Stones form in urine that is supersaturated with respect to the ionic component of the specific stone. A solution containing ions or molecules of a sparingly soluble salt is described by the concentration product (CP), which is a mathematical expression of the product of the concentrations of the ions or molecules of the salt. A pure aqueous solution of a salt is considered saturated when it reaches the point at which no further added salt crystals will dissolve. The concentration product at the point of saturation is called the thermodynamic solubility product Ksp. At this point, addition of further crystals to the Saturated solution will cause the crystals to precipitate unless the conditions of the solution such as PH or temperature are changed.

In urine, despite concentration products of stone forming salt components, such as calcium oxalate, that exceed the solubility product, crystallization does not necessarily occur because of the presence of inhibitors and other molecules that allow higher concentrations of calcium oxalate to be held in solution before precipitation or crystallization occurs. In this state of saturation, urine is considered to be metastable with respect to the salt. As Concentration of the salt increase further, the point at which it can no longer be held in solution is reached and crystals form. The concentration product at this point is called the formation product Kf. The solubility product and the formation product differentiate the three major states of saturation in urine, under saturated, metastable and unstable. It is in the area of metastable range that modulation of factors controlling stone formation can take place and therapeutic intervention is directed.(6)

Abbreviated Evaluation of Stone Formers
• History
• Underlying predisposing conditions
• Medications (calcium, vitamin C, vitamin D, Acetazolamide, steroids)
• Dietary excesses, inadequate fluid intake or excessive fluid loss
• Multichannel blood screen
• Basic metabolic panel (sodium, potassium, chloride, carbon dioxide, blood
urea nitrogen, Creatinine)
• Calcium
• Intact parathyroid hormone
• Uric acid
• Urine
• Urinalysis
• PH >7.5: infection lithiasis
• PH <5.5: uric acid lithiasis
• Sediment for crystalluria
• Urine culture
• Urea-splitting organisms: suggestive of infection lithiasis
• Qualitative cystine
• Radiography
• Radiopaque stones: calcium oxalate, calcium phosphate, magnesium ammonium phosphate (struvite), cystine.
• Radiolucent stones: uric acid, xanthine, triamterene
• Stone analysis

Indications for a Metabolic Stone Evaluation
• Recurrent stone formers
• Strong family history of stones
• Intestinal disease (particularly chronic diarrhoea)
• Pathologic skeletal fractures
• Osteoporosis
• History of urinary tract infection with calculi
• Personal history of gout
• Infirm health (unable to tolerate repeat stone episodes)
• Solitary kidney
• Anatomic abnormalities
• Renal insufficiency
• Stones composed of cystine, uric acid, struvite

Urolithiasis and Renal Failure: Since the first documented utilization of a percutaneous method for treatment of renal calculi in the 1970s,65 PCNL has proven to be an effective technique for managing appropriately selected patients with large, complex renal stones.66,67 However, many of these kidneys are obstructed before this procedure and stone removal via this technique may promote an improvement in function.

The impact of PCNL on renal function has been assessed with various methods. Serum and urine tests have been used. Handa and associates performed a retrospective analysis of 196 patients undergoing single-stage unilateral PCNL75 where serum creatinine was measured before and 1 day after intervention. Overall, the entire group had a significant increase in concentration (0.14 0.02 mg/dL;P .001). Sixty-four percent had a significant increase

(average, 0.26 0.02 mg/dL), 19% remained unchanged, and 17% had a decrease. This group completed another retrospective analysis in which they evaluated 576 patients undergoing unilateral and bilateral PCNL.77 In each group, they found that a majority of the patients had a significant increase in serum creatinine 1 day after intervention, with a greater increase found in the bilateral PCNL groups. In another study, Saxby assessed urinary creatinine clearance immediately before, 24 hours after, and 2 weeks after unilateral PCNL and noted no differences.In another long-term study, though, Chandhoke and associates found that between 36 and 65 months after PCNL of a solitary kidney, two out of seven patients had a significant deterioration in GFR, one patient had a significant increase, and four patients had preservation of GFR.Agrawal and colleagues performed a retrospective study of 75 patients with severe renal functional impairment (mean serum creatinine of 7.5 mg/100 mL).100 Thirty-two patients had a solitary functioning kidney. Preoperative serum creatinine was compared with levels after renal drainage with PCN and also after subsequent stone removal via PCNL at 2.5- to 9-year follow-up. Overall, the average serum creatinine decreased significantly to 3.01 mg/dL at final follow-up. Sixty four patients had an improvement in function, whereas 11 patients had stable or declining function. Interestingly, in 50 patients initially treated by PCN, the authors report that renal function increased with decompression and further improved with subsequent stone removal. In another long-term follow-up study, Kuzgunbay and associates retrospectively analyzed data from 16 patients with renal insufficiency (creatinine 1.4 mg/dL); minimum follow-up of 39 months.101 Overall postoperative creatinine was not significantly different; although levels returned to normal in six patients, it remained stable in six patients and increased in four patients. Yaycioglu and colleagues compared a group of 19 patients with impaired renal function (serum creatinine 1.5 mg/dL) with patients with normal renal function undergoing PCNL.102 At an average follow-up of 15.6 months, there was no significant change in renal function as determined by serum creatinine in either group.

Chandhoke and associates evaluated three patients with moderate renal insufficiency (serum creatinine 2 to 3 mg/dL) undergoing PCNL, and found that two had preserved GFR, whereas one had significantly improved GFR at long-term follow-up between 24 and 60 months.47 GFR also improved significantly in one patient with severe renal insufficiency (serum creatinine 3 mg/dL).

Bilen and colleagues used the MDRD estimated GFR to evaluate short-term renal functional changes in 185 patients classified according to the K/DOQI CKD system.103 Baseline for all patients was CKD Stage 3 or higher. At patient discharge, there was a significant increase in GFR for patients in each stage. Three months after intervention, the overall preoperative GFR significantly increased from 42.4 mL/min/1.73 m2 to 48.4 mL/ min/1.73 m2 . They did note, however, that renal function improvement was more likely to be found in patients who had a higher CKD stage than in patients with lower stage disease.Kukreja and associates retrospectively studied 84 patients with various degrees of renal insufficiency, evaluating serum creatinine after intervention (of 96 renal units, 87 PCNL, 7 open surgical nephrolithotomy, and 2 nephrectomy).104 Overall, 67.9% of patients had improvement or stabilization of their renal function at an average follow-up of 2.2 years. In contrast to other studies, however, they reported that patients with more severe CKD were at risk for developing end-stage renal disease. Only 1 out of 13 patients (7.7%) with serum creatinine 2 mg/dL had decline in renal function, whereas 11 of 43 (25.6%) with a serum creatinine of 2.0 to 2.9 mg/dL, and 10 of 23 (43.5%) with a serum creatinine of 3.0 to 5.9 mg/dL sustained reductions in renal function. All five patients with serum creatinine 6 mg/dL progressed to ESRD. Additionally, they found that in 12 patients with solitary kidneys, 6 experienced worsening renal function. In summary, for patients with a renal insufficiency a majority of the literature indicates that there is no significant impairment of renal function even improvement after PCNL. This trend may be due to relief of underlying obstruction.

Materials and Methods

This prospective study was conducted in Department of Surgery, Rama Medical college, Kanpur from Oct 2017 to Dec 2020.

Inclusion Criteria

- Creatinine level greater than 1.5 mg/dL.

Exclusion Criteria;

- uncorrected urinary tract infection
- Bleeding disorders
- an acute rise of creatinine
- aspirin or anticoagulant use
- pregnancy

All patients were investigated on OPD basis in form of CBC,APTT,PT,RFT,LFT URINE R/M,C/S ,X RAY KUB ,USG KUB ,IVP and Preoperative medical fitness .metabolic work up in patients with bilateral stones and recurrent stones in form of serum calcium, phosphate and uric acid and 24 hr urinary calcium, phosphate and uric acid and oxalate .

The calculus burden, anatomy of the renal collecting system, and the degree of hydronephrosis were evaluated using plain radiography; renal ultrasonography; and non–contrast-enhanced spiral computed tomography.Antimicrobial therapy was administered for patients with a positive urine culture for microorganisms.

Methods

PCNL was performed in all the eligible cases with due aseptic precautions and prophylactic antibiotic cover.

Pre operative advice included

- NPO night before surgery
- Injection Ceftriaxone 1 gm in morning before surgery
- Tab dulcolax (2 tabs) night before surgery
- Soap-water enema on coming morning after admission to hospital
- X-ray KUB on the morning of surgery
- Detailed explained informed consent
- Part clean & shave & prepare

Under general anaesthesia with the patient intubated, eye pads were put on. Patient was placed in a lithotomy position, the parts were cleaned and draped, cystoscopic examination was done and placement of ureteral access catheter (5F or 6 F) under fluoroscopic guidance was done. This was fastened to a Foley's catheter (14 F or 16 F) so as to prevent its subsequent accidental dislodgement. The patient is placed in prone position. Delineation of pelvicalyceal system by injecting contrast agent through ureteral access catheter.

Standard Puncture was made with needle and help of "C" Arm and a J tipped guidewire is negotiated into the pelvicalycealsystem.Tract dilatation done under fluoroscopy over the guide wire with the help of Sequential Amplatz dilators .At the end Amplatz sheath is positioned over the last dilator to the appropriate site as this will be the conduit for further instrumentation.

Stone Removal:Small stones removed intact with forceps and pneumatic lithotripsy is required to break the larger stones into manageable fragments.In some cases where the stone is large or has extension into different calyces than additional tract required in some cases to achieve stone free Kidney.By fluoroscopy and nephroscopy the pelvicalyceal system is checked for residual fragments and once all the stones are removed, a Malecot's catheter 24 or 28 F passed through Amplatz sheath as a nephrostomy. In post operative period X ray KUB and chest X ray PA view done in all cases. Nephrostomy tube removed after 4 -7 hrs if no significant residual stone burden on post operative X- ray KUB necessitating relook surgery or post op CXR showing no hemo /pneumothorax and a repeat X- ray chest 2-3 hrs after removal of nephrostomy tube to rule out hemo /pneumothorax (which may necessitates intercostals chest tube drainage) and patient is discharged before nextmorning after removal of ureteric catheter along with per urethral catheter.

Asked for **regular follow up** on day 7,1 month and 3 months for ultrasonography of abdomen and for D-J stent (if placed during surgery) after 4wks and as and when required if complications (persistent urine leak from nephrostomy site, hematuria,bleeding or any febrile episode,stent related lower urinary tract symptoms) arise.

Observations

In the present study, in a series of continuous 600 patients who were operated by PCNL, 57 patients with altered serum creatinine more than 1.5 were studied, observed and followed.

A. Preoperative Parameters

i) Age Distribution: In PCNLwith altered RFT group, average age among the group was 47.75 years. The youngest being 28 and the eldest being 70 years of age.

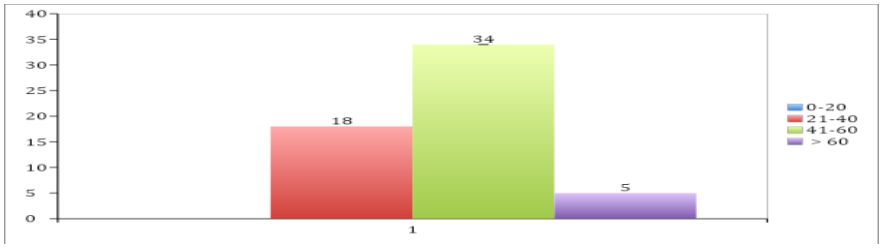

Fig 1:Age distribution

ii) Sex Distribution:In the study, out of total 57 patients 39 (68.42%) are male and 18(31.58%) patients are female.

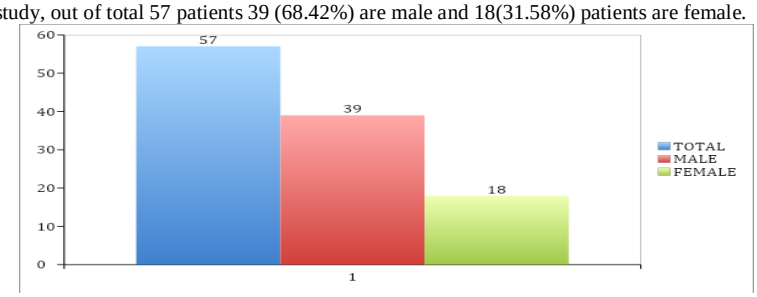

Fig 2:Sex distribution

iii) Stone Parameters (Stone burden& Location): In study, 18 patients had stone burden of less than 500 mm^2, 16 had 501 to 1000 mm^2, 7 patients had 1001 to 1500 mm2, 6 patients had 1501 to 2000 mm^2 and 10 patients had stone burden more than 2000 mm^2.

Fig 3:Stone parameters

iv.Location:In the study, out of 57 patients stone in renal pelvis 21,17 stones in middle calyx, 21 in the inferior calyx and 11 patients in the superior. Total 22 (38.59%) out of 57 patients included in the study had staghorn stones.

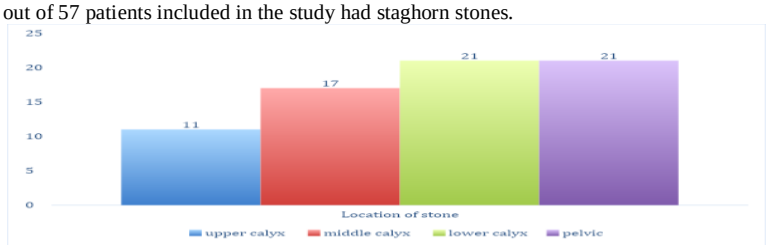

Fig 4:Location of stone

v.**Number of patients with pre operative PCN / DJ stent:**49(85.96%) out of 57 patients were decompressed either by PCN/ DJ Stent.

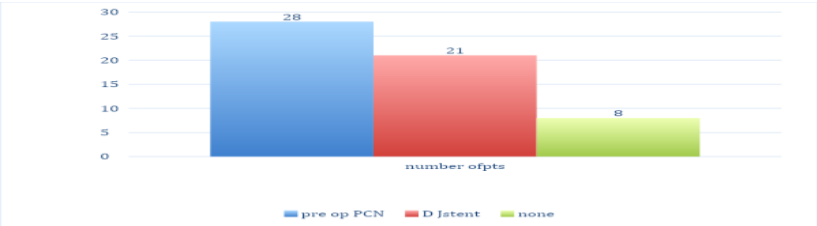

Fig 5: Number of patients with pre operative PCN / DJ stent

vi) Solitary kidney- in our study no patient of renal insufficiency with solitary unit underwent PCNL.

vii) Laterality:- In this study 28(49.12%) out of 57 had bilateral renal stones.

viii) Comorbidities:-In this study total 4 patients were diabetic, 13 patients were hypertensive and 34 patients underwent surgeries for urolithiasis earlier.

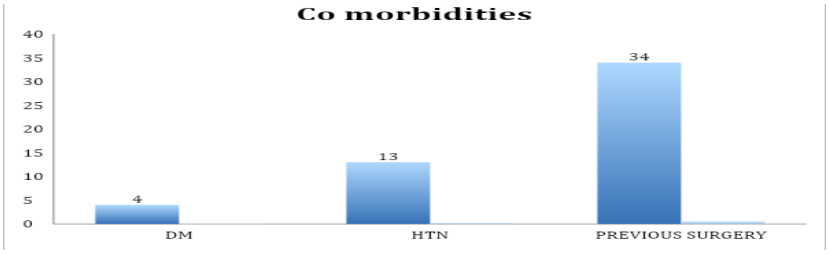

Fig 6:Comorbidities

ix)parenchymal thickness on USG:-

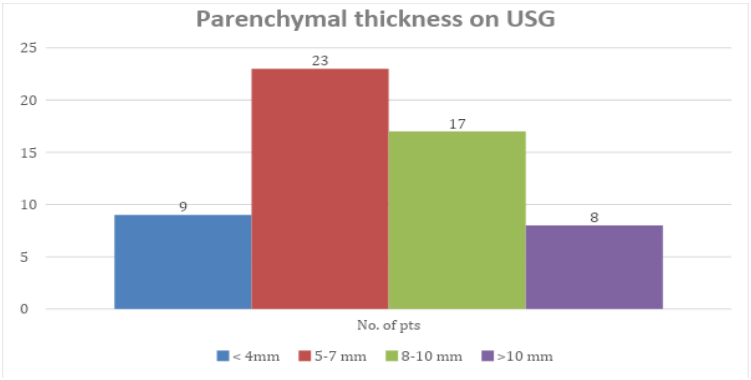

Fig 7:Parenchymal thickness on USG

x)Serumcreatinine:-47 (82.45%) out of 57 patients had serum creatinine values more than 2 mg/dl which reflects higher prevalence of moderate to severe renal failure in patients of urolithiasis included in the study.

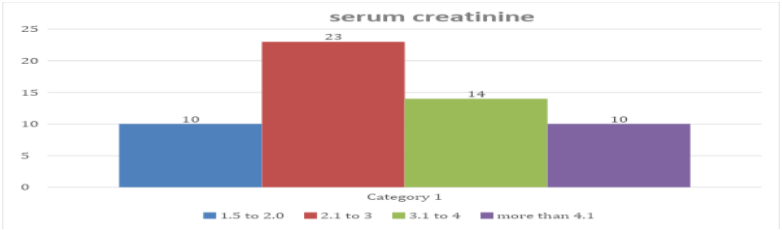

Fig 8:Serum creatinine

xi) Pre operativehemodialysis:was done in 24 out of 57 patients.

B. Operative Parameters

xii) Operating Time:In study the mean operative time 127 min (30-180 min).

Table 1:Mean operative time

Mean operative time	
Mean operative time (min)	127
Max. operative time (min)	180
Min. operative time (min)	30

xiii) Number of tracts used:In this study single tract was used in all cases except 11 with double/more punctures were done.

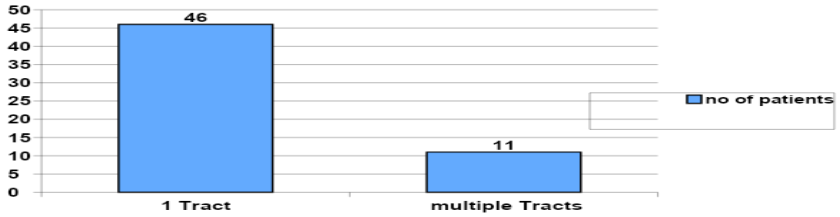

Fig 9:Number of tracts used

xiv) Number of supracostal/subcostal punctures:Out of 57 patients 9 required supracostal puncture while in 48 patients subcostal puncture was done.

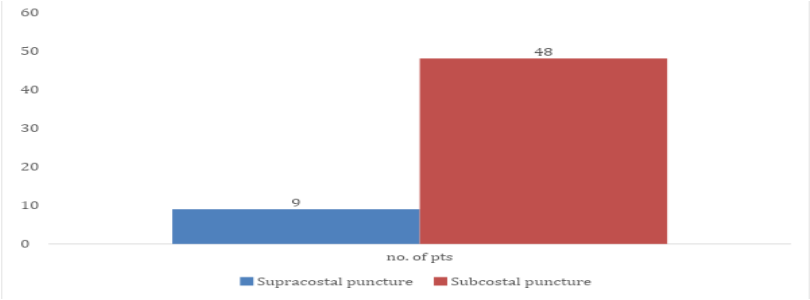

Fig 10: Number of supracostal/subcostal punctures

xiv) Postoperative analgesic requirement:In the study the mean analgesic requirement (InjTramadol) during hospital stay was 215 mg.

xv) Drainage:In the study in all the patients d j stent was kept.

xvi) Blood transfusion:In the study 6 (10.52%) patients out of 57 total patients required blood transfusion.

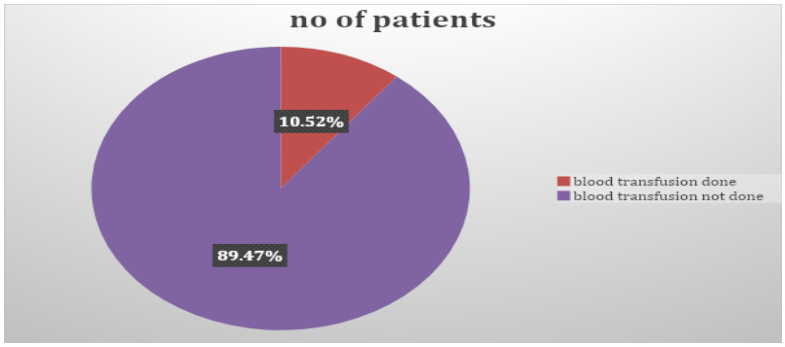

Fig 11:Blood transfusion

xvii)Drop in haemoglobin in post operative period:In this study average drop in hemoglobin percentage was 1.6.

xviii) Bleeding from nephrostomy site after nephrostomy removal:In the study 2 cases had bleeding from nephrostomy site after nephrostomy removal which subsided by pressure over puncture site.

xix) Postoperative hematuria:In this study Mean time 15.98 hrs (6-33 hrs). None required blood transfusion.

xx)Postoperative urinary leak from nephrostomy site:In this study average duration of post operative urinary leak from nephrostomy site was 18.76 hrs (4- 78 hrs).

xxi) UTI/ urosepsis:In the studygroup,2 patients had postoperative fever for which they were admitted and antibiotics given according to urine culture/sensitivity and 1 patient underwent sepsis which was managed by higher antibiotics

xxii) In this study no other complications associated with PCNL like colonic injury,pleural injury or death occurred.

xxiii) Hospital stay:In this study mean hospital stay was 3.6 days which was significantly higher because of need of optimization of renal function post operatively.

FOLLOW UP

xxiv) creatinine value in preoperative and post operative measurements:In our study out of 57 patients 32 patients after PCNL had improved renal function, in 14 patients there were stable renal function and in 11 patients renal function was worsened.

Table 2:Time and values

Time	Value
Preoperative creatinine	2.95
Creatinine POD 1	2.86
Creatinine 1 MONTH	2.61
Creatinine 3 MONTH	2.54

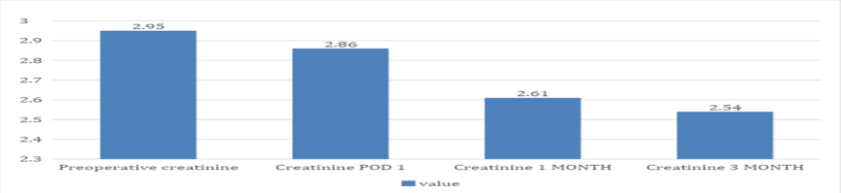

Fig 12:Values at different time intervals

xv)Parenchymal thickness on USGat 1 month POD

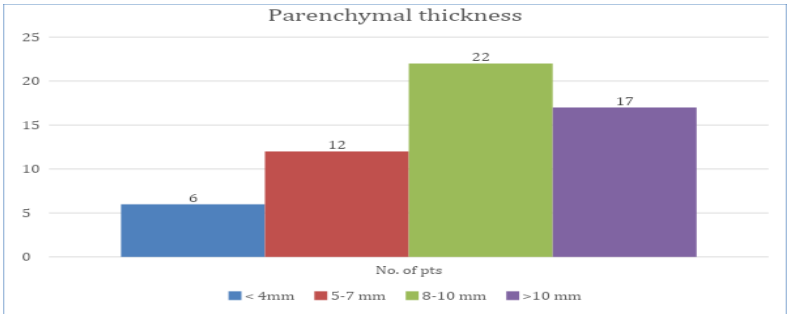

Fig 13:Parenchymal thickness

xvi) Parenchymal thickness on USG at 3 month POD .There was improvement in the parenchymal thickness in the significant number of patients which could be attributed to relief of obstruction and better drainage after PCNL.

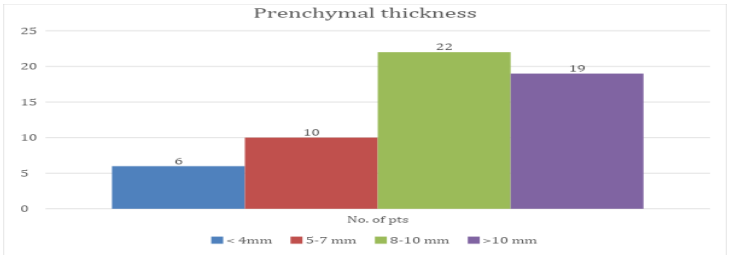

Fig 14: Parenchymal thickness on USG at 3 month POD

Conclusions

- Renal stone disease may cause rise at risk of progression to end stage renal failure.It has been shown in the literature that stone burden may also contribute to severity of parenchymal inflammation and fibrosis.
- Prevalence of patients with urolithiasis with altered renal function is significantly higher (9.5%) in this study which may be attributed to neglected stone disease due to poverty,ignorance,illiteracy and inadequate medical facilities especially in rural areas.
- In our study most of the patients are of 40-60 years of age group with more prevalence in males.
- Similar stone clearance and complication rates with PCNL were observed in patients with impaired and normal renal function.
- If the patients has diabetes,hypertension, previous surgery for calculus like nephrolithotomy,pyelolithotomy improvement in renal function is less likely.
- In our study approximately 80.70% patients were benefited from doing PCNL either in the form of stable function or improvement in renal function hence it is concluded that PCNL is safe and effective endoscopic technique for urinary stones in patients with altered renal function.

Discussion

Renal stone is a common preventable disease with a high morbidity. Renal stones may cause renal damage by prolonged obstruction,and infection.(1)

A person who develops renal stones at any time during his life has significant risk for renal failure.(Amer T et al).

The incidence of renal insufficiency in patients treated for urinary stone disease shows variations between centers and probably depends on the socioeconomic characteristics as well as the referral patterns of the region.

Different centers reported 0.78–17.5% incidence of renal insufficiency in patients with urinary stone disease. These numbers usually come from retrospective analysis of stone patients treated in one facility and not from epidemiologic studies [1–5].

1.Incidence of renal failure in patients with urolithiasis:-

In the 600 consecutive patients who underwent PCNL at our institution, 57 patients (9.5%) had impaired renal function defined as serum creatinine level greater than 1.5 mg/dl. The probable reason for high incidence of CRF in our patients is the neglected stone disease due to poverty, ignorance, illiteracy and inadequate medical facilities in rural areas and smaller towns. Most of these patients try alternate medical therapy before undergoing surgery.

Table 3: Incidence of Altered RFT

Study	Incidence of Altered RFT
Etemadian et al	12.1%
Anant Kumar et al	4.6%
Gupta et al	1.65%
Yaycioglu et al	6.31%
Our study	9.5%

2.Age distribution:-Mean age in our study was 47.75 years which is comparable to other studies with altered renal function.

Table 4: Average age with altered renal function.

Study	Average age
Etemadian et al	51.7 years
Majidyousefi et al	45.1 years
Our study	47.75 years

3.Sex distribution:-In the study, out of total 57 patients 39(68.42%) are male and 18 (31.57%) patients are female which suggests male had more incidence of renal stone disease with altered renal function compared to female in this study.

Table 5: Sex distribution

Study	Male	Female
Etemadian et al	56.7%	43.3%
Majidyousefi et al	66 %	34%
Our study	68.42%	31.57%

4.Duration of surgery:-Duration of surgery in our study is approximately 127 minutes which can be explained by the more prevalence of altered renal function in patients with staghorn stones.

Table 6: Duration of surgery

Study	Duration of surgery
Yaycioglu et al	175 minutes
Synder et al	155.1 minutes
Anant Kumar et al	152.5 minutes
Our study	127 minutes

5.Drop in haemoglobin:- The drop in haemoglobin in our study is 1.6 gm/dl which is comparable to other studies.

Table 7: Drop in haemoglobin

Study	Drop in haemoglobin
Yaycioglu et al	1.7
Anant Kumar et al	1.8
Our study	1.6

6.Nephrostomy time:-The mean nephrostomy time was 9.6 hours which is significantly lower than than other studies. This resulted in early discharge of the patients with urolithiasis.

Table 8: Nephrostomy time

Study	Nephrostomy time
Yaycioglu et al	93.6 hours
Our study	9.6 hours

7.Hospitalisation:- Mean hospitalisation time in our study is 3.6 days compared to 6.6 days in Yaycioglu et al and 12.9 days in Anant Kumar et al. This could be attributed to early nephrostomy removal, early mobilisation and rapid convalescence seen in this study.

Table 9: Mean hospital stay

Study	Hospitalisation time
Yaycioglu et al	6.6 days
Anant Kumar et al	12.9 days
Our study	3.6 days

8.Stone free rate:- Stone free rate in in our study is 78.94% which are consistent with other studies.

Table 10: Stone free rate

Study	Stone free rate
Etemadian et al	83.7%
Anant Kumar et al	56.23%
Kuzgunbay et al	50%
Our study	78.94 %%

9.Mortality:-Agrawal et al. [3] reported 3.8% mortality and 17.3% morbidity rates for PCNL in 78 patients with advanced renal failure. In our study none of the patient expired.

10.Complications:-In our study complication rates were similar to different studies which were conducted for complications related to PCNL.In this study bleeding requiring blood transfusion was the most prevalent complication. To our knowledge, the effect of erythrocyte transfusion on renal function is currently unknown. Theoretically erythrocyte transfusion might increase red blood cell dimensions, resulting in improved tissue oxygenation. However, especially stored erythrocyte components in the blood might lose their oxygen delivery capacity.Thus, functionally impaired transfused erythrocytes may physically obstruct capillary flow, worsening the cellular and tissue oxygen balance. Also, significant perirenal or pelvicalyceal hematoma secondary to bleeding might compress the renal parenchyma,increasing intraglomerular and intratubular pressure, and adversely affecting renal function.

Table 11: Complication of PCNL

Complication of PCNL								
Series (citation)	Shin	Mousavi-Bhar	El Nahas	de la Rosette	Lee	Rana	Osman	Our study
Patient number	88	671	241	5803	582	667	315	57
transfusion	6.9	0.6	16	5.7	11.2	1.49	0	10.52
Hemorrhage requiring intervention	1.4	0.15	2	NA	NA	0.14	0.3	0
fever	11	1	1.2	10.5	22.4	NA	32	10.52
sepsis	0.6	0	0.4	NA	0.8	1.79	0.3	1.7
Colonic injury	0.7	0.3	Na	NA	0.2	0	0	0
Pleural injury	1.1	0.7	2.4	1.8	3.1	0.14	0	0
Extravasation/urine leak	0.4	5.2	8	3.4	7.2	NA	NA	5.2
mortality	0.4	0.3	0.4	0.3	0.3	0	0.3	0

(*complications in %)

11.Renal function:-In the era before PCNL, Witherow and Wickham had reported that mean creatinine clearances increased significantly after nephrolithotomy in patients with severely decreased renal function due to stone disease [7]. After PCNL became a viable method of stone-treatment, laboratory and clinical studies showed that percutaneous procedures cause no significant damage to functional nephrons [8–10]. As PCNL became the method of choice for patients with bulky stones, several authors reported the beneficial effect of PCNL on kidney function in patients with renal failure. Gupta et al. [1] treated 33 patients with serum creatinine levels of 2 mg/dl or greater at presentation. The patients underwent multiple procedures including PCNL, ESWL, ureteroscopic stone extraction, alkalinisation and open surgery. In 32 of 33 patients' posttreatmentserum creatinine value was lower than the pre-treatment value (mean 2 vs. 3.2 mg/dl, $P < 0.001$). Of the 13 patients with longer than 1-year follow-up, 4 had progression of intrinsic renal disease and elevation in serum creatinine level to greater than the pre-treatment value. Three of these patients had subsequently end stage renal disease. Agrawal et al. [3] performed PCNL in 78 patients with calculus nephropathy and advanced uremia. Forty-six of these patients had bilateral upper urinary calculi and the remaining 32 had a solitary functioning kidney. Overall, the serum creatinine levels at the last follow-up showed a significant improvement over those before treatment. Sixty-four patients had improvement of renal function and in 11 patients renal function remained unchanged or deteriorated during follow-up. Kukreja et al. [2] analyzed data from 84 patients with baseline serum creatinine of >1.5 mg/dl treated for calculous disease. The mean baseline serum creatinine concentration was 2.87 mg/dl. Twelve patients had bilateral stone disease while another 12 patients had a solitary functioning kidney. Primary surgical treatment was PCNL for most of the patients but some underwent nephrolithotomy, and nephrectomy as well. Overall renal functions improved in 33 patients (39.3%), stabilized in 24 patients (28.6%), and deteriorated in 27 patients (32.2%). The baseline serum creatinine concentration correlated well with the postoperative renal function. Renal function stabilized or improved in nearly all patients with baseline serum creatinine less than 2 mg/dl and deteriorated in all patients with baseline serum creatinine higher than 6 mg/dl. All patients with creatinine higher than 6 mg/dl, progressed to end-stage renal disease.

Goel et al. [11] reported on the role of intervention in 20 patients with a solitary kidney, nephrolithiasis and chronic renal insufficiency. In this group, 15 patients underwent PCNL, 2 ESWL and 3 open surgery. The mean glomerular filtration rate improved significantly in renal failure patients after treatment of stone disease. Improvement in glomerular filtration rate was greater in mild to moderate renal failure. GFR deteriorated in one patient with baseline serum creatinine higher than 4 mg/dl. Patients with residual disease had longer mean hospital stay, more repeatanesthesia, blood transfusions and total cost. Chandhoke et al. [12] found no significant deterioration in renal function after PCNL in patients with moderate renal insufficiency. Jones et al. [13] reported on the results of PCNL on 14 patients with solitary kidney and abnormal renal function at presentation. After PCNL, serum creatinine increased in 2 and decreased in 12 patients. In our patients there was a slight but insignificant decrease in serum creatinine values at the end of the follow-up period. Serum creatinine values decreased to normal range in 13 patients but in most of these patients pre operative baseline Serum creatinine was less than 2 mg/dl. Creatinine values did not decrease to the normal range in any of the patients with a baseline creatinine level higher than 2 mg/dl.

Table 12: Pre and post op Creatinine

Study	Pre op mean creatinine	Follow up mean creatinine
Kuzgunbay et al	2.30	2.67

Gupta et al	2.22	1.89
Iqbalsingh et al	4.79	1.53
Paryani et al	6.27	4.08
Yaycioglu et al	2.8	2.6
MajidYousefi et al	5.52	2.03
Our study	2.95	2.54

In our study out of 57 patients 32 patients after PCNL had improved renal function, in 14 patients there were stable renal function and in 11 patients renal function was worsened.

Table 13: Outcome of PCNL

Study	No of pts	improved	Stable	Worsened
Gupta et al	33	29	1	3
Agrawal et al	78	64		11
Kukreja et al	84	33	24	27
Jones et al	14	12		2
Goel et al	20			1
Chandhoke et al	No significant deterioration in renal function			
Our study	57	32	14	11

Our results and the results of previous reports indicate that most patients presenting with kidney-stone disease and renal insufficiency, experience improvement or stabilization of renal function with early aggressive intervention aimed at complete stone clearance and prevention of urinary infection. Improvement in renal function is greater in mild to moderate renal failure. Patients with severe kidney-failure, reduced parenchymal thickness and pus in the collecting system are less likely to show a significant improvement in renal function. However, even these patients will enjoy the benefits of improved quality of life and postponement of replacement therapy if their stones and infection can be cleared [1–3, 11]. Therefore, the statement "one should temper obsessive attempts at clearance of small fragments with caution in the kidney with severely damaged function" is equally true for PCNL as it is for open-surgery [7, 13].

Renal failure is frequently a progressive condition. The presence of stones in the urinary tract may accelerate the course of the disease. Presence of the stones deteriorates renal functions mainly by causing obstruction and infection [6]. The changes in the kidney parenchyma caused by infection are more pronounced if there is concomitant obstruction. Duration of the stone disease, multiple procedures, and stone recurrence also have negative influence on renal function [4]. Therefore, patients with compromised renal function benefit from the elimination of calculi from the urinary tract, which may lead to improved renal function and avoidance or postponement of dialysis.

Limitations of our study:-Evaluation of renal function by serum creatinine level has some disadvantages, especially in patients with two functioning kidneys. The deterioration in one kidney is compensated by the contralateral kidney. Thus, the change in serum creatinine does not accurately reflect the change in the function of the concerned kidney. Unfortunately, differential renal function and creatinine clearance measurements were not available for most of the patients in the this study. However, we feel that in the with proper follow-up, serum creatinine provides valid information on the overall renal function that reflects the effect of PCNL.

References

1. Gupta M, Bolton DM, Gupta PN, Stoller ML. Improved renal function following aggressive treatment of urolithiasis and concurrent mild to moderate renal insufficiency. J Urol. 1994; 152:1086–1090
2. Kukreja R, Desai M, Patel SH, Desai MR. Nephrolithiasis associated with renal insufficiency: factors predicting outcome. J Endourol. 2003; 17:875–879
3. Agrawal MS, Aron M, Asopa HS.Endourological renal salvage in patients with calculus nephropathy and advanced uremia. BJU Int.1999; 84:252–256
4. Marangella M, Bruno M, Cosseddu D, Manganaro M, Tricerri A, Vitale C, Linari F. Prevalence of chronic renal insufficiency in the course of idiopathic recurrent calcium stone disease: risk factors and patterns of progression. Nephron. 1990; 54:302–306
5. Gupta NP, Kochar GS, Wadhwa SN, Singh SM. Management of patients with renal and ureteric calculi presenting with chronic renal insufficiency. Br J Urol. 1985; 57:130-132
6. Gambaro G, Favaro S, D'Angelo A. Risk of renal failure in nephrolithiasis. Am J Kidney Dis. 2001; 37:233–243
7. Witherow RO, Wickham JE.Nephrolithotomy in chronic renal failure saved from dialysis! Br J Urol. 1980; 52:419-421
8. Mayo ME, Krieger JN, Rudd TG.EVect of percutaneous nephrostolithotomy on renal function. J Urol. 1985; 133:167–169
9. Trinchieri A, Mandressi A, Zanetti G, Ruoppolo M, Tombolini P, Pisani E. Renal tubular damage after renal stone treatment. Urol Res. 1988; 16:101-104
10. Wilson WT, Husmann DA, Morris JS, Miller GL, Alexander M, Preminger GM. A comparison of the bioeVects of four diVerent modes of stone therapy on renal function and morphology. J Urol. 1993; 150:1267–1270
11. Goel MC, Ahlawat R, Kumar M, Kapoor R. Chronic renal failure and nephrolithiasis in a solitary kidney: role of intervention. J Urol. 1997; 157:1574–1577
12. Chandhoke PS, Albala DM, Clayman RV. Long-term comparison of renal function in patients with solitary kidneys and/or moderate renal insufficiency undergoing extracorporeal shock wave lithotripsy or percutaneous nephrolithotomy. J Urol. 1992; 147:1226–1230
13. Jones DJ, Kellett MJ, Wickham JEA. Percutaneous nephrolithotomy and the solitary kidney. J Urol. 1991; 145:477 – 480
14. MajidYousefiMoghaddam, Muhammad Naeem Outcome of Surgical Clearance of Renal and Ureteric Calculi on Improvement in Renal Parameters in Patients with Renal Insufficiency. Ann. Pak. Inst. Med. Sci. 2015; 11(1):47-50
15. Kumar A, Verma BS, Gogoi S, Kapoor R, Srivastava A, Mandhani A. A prospective randomized trial of open surgery versus endourological stone removal in patients of staghorn stones with chronic renal failure. Indian J Urol [serial online] 2001. 2017;18:14-9.
16. Snyder JA, Smith AD. Staghorn calculi: percutaneous extraction versus anatrophicnephrolithotomy. J Urol. 1986; 136:351-354.
17. Mousavi-Bahar SH, Mehrabi S, Moslemi MK. Percutaneous nephrolithotomy complications in 671 consecutive patients: a single-center experience. Urol J. 2011;8:271-6.
18. el-Nahas AR, Eraky I, Shokeir AA et al. Factors affecting stone-free rate and complications of percutaneous nephrolithotomy for treatment of staghorn stone. Urology. 2012;79:1236-41.
19. de la Rosette J, Assimos D, Desai M et al. The Clinical Research Office of the Endourological Society Percutaneous

Nephrolithotomy Global Study: indications, complications, and outcomes in 5803 patients. J Endourol. 2011;25:11-7.
20. Shin TS, Cho HJ, Hong SH et al. Complications of Percutaneous Nephrolithotomy Classified by the Modified Clavien Grading System: A Single Center's Experience over 16 Years. Korean J Urol. 2011;52:769-75
21. Lee WJ, Smith AD, Cubelli V et al. Complications of percutaneous nephrolithotomy. AJR Am J Roentgenol. 1987; 148: 177-80.
22. Rana AM, Zaidi Z, El-Khalid S. Single-center review of fluoroscopy-guided percutaneous nephrostomy performed by urologic surgeons. J Endourol. 2007;21:688-91.
23. Osman M, Wendt-Nordahl G, Heger K et al. Percutaneous nephrolithotomy with ultrasonographyguided renal access: experience from over 300 cases. BJU Int. 2005;96:875-8

Conflict of Interest: Nil
Source of support:Nil