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Original Article

Possibility of Post Percutaneous Nephrolithotomy Renal Function Alterations leading to Acute Kidney Injury

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HIGHLIGHTS

- As the main definition of AKI, the serum level decline in our study was reversible too.
- The peak time of AKI incidence was second day post PCNL.
- PCNL remains very safe and unwilling to cause permanent RF.

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ABSTRACT

Introduction
Percutaneous nephrolithotomy has obtained the mainstay role as a procedure of gold standard in patients harboring renal lithiasis larger than 2 cm. It has earned an outstanding reputation as a low complications/low mortality minimally-invasive procedure worldwide. Therefore, its complications carry a great deal, and considering bleeding as its main problem, possible post-bleeding Acute Renal Injury must be checked out.

Methods
This is a cross-sectional study planned for 91 patients who underwent PCNL. The renal Function variable had been tuned primarily as Serum Creatinine levels, which had been obtained before surgery following afterwards sessions as the order of days 1, 2, and 30 after surgery.

Results
Demographic data were as Gender: 63(69.2%) males. The mean age of the patients was 47.8± 4.7 years. Analytic Data as Mean stone size was 25 mm, Serum sodium & potassium & hemoglobin & hematocrit level &GFR. Data analysis uttered the considerable rise in the creatinine levels on the second day (p value<0.05), although respecting its levels after 1 month, all recovered in one month and meant no considerable decline neither in GFR or other biochemical levels.

Conclusions
Our Data revealed a considerable decrease in the overall kidney function through an increase in the serum creatinine and electrolytes levels on the second postoperative day which was shown to be completely recovered based on their measured levels after one month.

Keywords: PCNL; Percutaneous Nephrolithotomy; AKI, Acute Renal Injury; Creatinine GFR

Introduction

Complications are expectable up to 7% of patients undergoing PCNL suffer a major complication, and minor complications can be faced with over 25% of patients. Hemorrhage is a remarkable complication of PCNL. Hazard event of bleeding has been associated with stone burden and overall patients` theatre time. Massive Bleeding from an arteriovenous fistula or pseudoaneurysm that demands angiographic embolization happens in less than 1% of patients. Other noteworthy possible complications involve CIRC or developing sepsis syndrome as postoperative temperature >38.5°C [101.3°F] is discoverd in almost a quarter of patients recieving PCNL, meanwhile others as neighborhood organ injury (bowel, spleen), states of failed access or multiple false access tracts, and perforation or multiple punctures of the renal pelvis and ureter. It is uncommon to have Urgent or emergent open surgery and mostly has been presented as a part of a short learning curve or "early experience" in different research. Estimated mortality rate of PCNL is between 0.03% and 0.8%. PCNL has been reported to be performed at 96 centers across the world. The highest stone-free outcomes with the lowest complication rates have been reported from endo-urological centers with more than 120 PCNL cases per year. We must declare that in our center, Sina Hospital, Tehran University, approximately we perform about 180 to 240 PCNL per year. Because the kidneys are very rich in their vascular origin, spontaneously some degree of bleeding is predictable during each PCNL. Remarkable or massive bleeding normally mandates cessation of the method due to the resulting blurring of vision leading to progressive impaired visualization. Generally, it has been stated that hemorrhage source is venous, here we put a compliment as some have prescribed placement of a nephrostomy tube to be typically enough to control the bleeding, but as the result of our high degree of experience and long-time learning curve rarely use nephrostomy, performing the tubeless method.

As mentioned before, because of our very high rate of PCNL and our long learning curve and experience totally in tubeless fassion, In critical cases, we take benefit of a high-level CAT LAB in our main theatre and angiography is available as both diagnostic for confirming bleeding site and therapeutic tool, because arteriovenous fistulas and malformations and pseudoaneurysms or false aneurysms are shown to be best managed by embolization. We prepare partial nephrectomy or, in extremely rare cases, nephrectomy if bleeding cannot be controlled with angiography. AKI is charactrized by a sharp or sudden rise in serum creatinine and/or an acute decline or significant sudden in urine output. This hazardous abrupt decline in kidney function occurs over hours and may last to days and results in the accumulation of bioproducts of metabolism and the dysregulation of the electrolyte homeostasis, acid-base mismatch, and intra-vascular volume status. Changes in blood urea nitrogen (BUN) and Cr have been used as surrogate markers for changes in kidney function.

A classic way to divide AKI is by "prerenal," "intrinsic," and "postrenal" or obstructive causes. However, prolonged prerenal physiology may lead to intrinsic kidney ischemia and injury, such as is seen with prolonged hepatorenal syndrome (HRS). Prolonged obstruction can also lead to intrinsic kidney damage. The most considerable proportion of hospital-acquired AKI is secondary to kidney cellular damage or acute tubular necrosis (ATN). A Spanish analysis of 748 cases of AKI in 13 special care centers revealed that ATN caused about 45% of all AKI cases.

Alternatively, immune-mediated AKI from glomerulonephritis or acute interstitial nephritis accounted for less than 10% of cases. The majority of items of AKI are caused by diminished blood flow to the kidneys, in patients with other comorbidities. This reduced blood flow status could be caused by diminished blood volume after bleeding, excessive vomiting or diarrhea, or severe dehydration or cachexia, heart failure or severe IHD, liver failure or cirrhosis or sepsis status, specific medications that lower cardiac output or anti-hypertensive drugs or lowering renal blood flow like ACE inhibitors, certain diuretics or NSAIDs. AKI can also be caused by kidney intrinsic devastating factors itself, such as inflammation of the filters in the kidney (glomerulonephritis), the blood vessels (vasculitis), or other structures in the kidney. This is caused by medicinal hypersensitiveness, pyelonephritis, or secondary contrast nephropathy. It may sometimes be the result of a postrenal obstruction status such as BOO, huge obstructive BPH, or obstructed nephropathy. This study aimed to survey alterations in the levels of serum creatinine in patients who underwent PCNL chronologically: pre-op, immediate post-op, late post-op, and final. As our brief survey indicates there are sporadic studies on AKI incidence and elevated serum creatinine levels following PCNL; hence inspired us to dispatch an investigational study of the functional renal markers as the alteration rates of creatinine and estimated GFR levels in our patients after PCNL surgery.

Methods

In a prospective randomized clinical trial study from January 2019 to December 2021, about 148 patients were gathered in our research after signing written informed consent from the Persian Registry for Stones of Urinary System (PERSUS). At first thorough medical history identified possible patients with an inevitable contraindication to PCNL, such as bleeding blood dyscrasias or untreated coagulopathies, and cases with an active, untreated urinary tract infection (UTI). Aspirin and other antiplatelet or anticoagulation medications were not continued before surgery. In patients with severe thrombotic complications, bridging therapy was performed. Preoperative Para clinical tests included a full blood count, serum electrolyte determinations and renal evaluating tests. A urine culture should be obtained if there is suspicion of infection; perioperative antibiotics can be justifiably sufficed toculture–specific organisms. Blood grouping and matching of the patients were nominated, although fortunately cross-match often did not show to be mandatory. The standard utilization of helical CT to evaluate the patients was harbored and discontinued the indication of preoperative intravenous urography or retrograde pyelography. In most cases, the main indication of performing PCNL has been built on the bases of the predictive stone burden declared by the CT images.

Study Design and Statistics: The type of Study was cross-sectional. As the first step, the Ethical committee approval of Tehran University of Medical Sciences (IR. TUMS.VCR.REC.1398.1033) was taken from all of the patients and as the second step informed consent was taken. The Place of the study was the Sina Hospital in Tehran, Iran and the time of the study was between 2019-2021. The Inclusion criteria were 18 years and older and negative urine culture, meanwhile, the Exclusion criteria were Pregnancy, DM (diabetes mellitus), HTN (hypertension), Heart failure, Respiratory failure, and Renal failure. The checklist included demographic and analytic features including age, gender, body mass index (BMI), side of the involved kidney, biochemical values, serum creatinine, and GFR. Preoperational imaging included conventional Computed Tomography (MDCT) to evaluate the stone burden and the pyelocalyceal system characteristics.

Procedure: After general anesthesia, the ureteral catheter was placed in the lithotomy position, then the position was changed to prone, and a Chiba needle, guidewire, and Amplatz dilators were used to obtain the best calyceal access under fluoroscopic guidance. With a clear video-nephroscopic view, a pneumatic lithoclast was used to fragment and crush the stones and remove them by graspers and irrigation. Following satisfactory stone removal, a ureteral DJ stent always and a nephrostomy tube occasionally were placed in the renal pelvis, although most of the cases were made in a tubeless fashion. Finally, the duration of surgery and the size of the stones were recorded.

Later ceftriaxone one gram was continued twice daily until discharge. On Day 1 and Day 2, the necessary tests such as serum creatinine levels were measured daily. Ultrasound was requested in the cases of rising creatinine levels. Patients with the good general condition and stable vital signs were discharged two days after the procedure. Patients were followed one month after the surgery with

Table 1. Details of variations

	Pre-Operation	Post-Operation	P-value
Body mass index (Kg/m2), mean (SD)	26.8 (4.7)	-	
Side, number (%)			
Right	32 (35.2 %)	-	
Left	55 (60.4 %)	-	
Both	4 (4.4 %)	-	
Mean stone size (mm), median (IQR)	2.5 (2-3)	-	
Surgery duration (hr.), median (IQR)	2 (2-3)	-	
Number of access, number (%)			
1	67 (88.2 %)	-	
2	9 (11.8 %)	-	
Hb, mean (SD)	14.6 (1.7)	12.8 (1.9)	<0.001
WBC, mean (SD)	8.1 (3.1)	10.1 (4.4)	<0.001
HCT, mean (SD)	41.6 (4.7)	37.7 (4.9)	<0.001
PLT, mean (SD)	248.3 (74.8)	245.5 (84.6)	0.738
Na, mean (SD)	140.3 (3.8)	139.1 (3.3)	0.023
L, mean (SD)	26.9 (11.6)	18.8 (10.6)	<0.001
N, mean (SD)	61.2 (14.9)	71.4 (12.8)	<0.001
K, mean (SD)	4.2 (0.5)	3.9 (0.5)	<0.001
Cr, mean (SD)	1.17 (0.26)		
Day 1	-	1.20 (0.32)	0.371
Day 2	-	1.24 (0.39)	0.016
After 1 month	-	1.17 (0.34)	0.849

SD: Standard deviation; IQR: interquartile range; Hb: Hemoglobin; WBC: white blood cell; HCT: Hematocrit; PLT: Platelet; Na: sodium; L: Lymphocyte; N: Neutrophil; K: Potassium; Cr: Creatinine

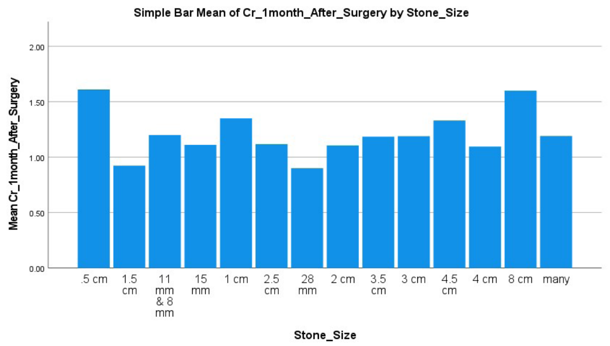

Figure 1. The mean of creatinine 1 month after surgery regarding to the stone size.

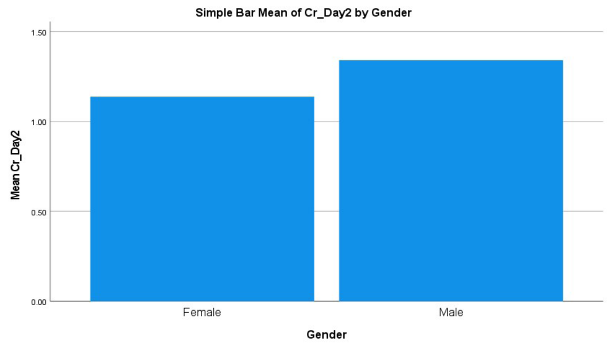

Figure 2. The mean of creatinine 2 days after surgery by gender

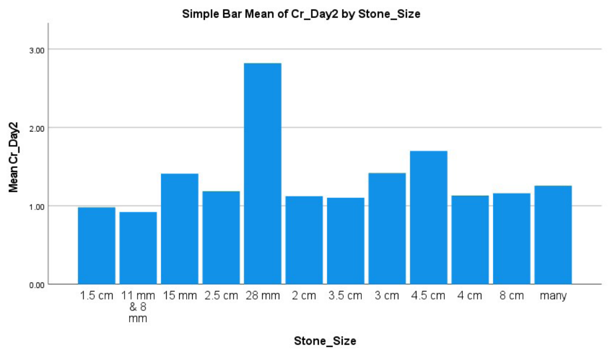

Figure 3. The mean of creatinine 2 days after surgery by stone size.

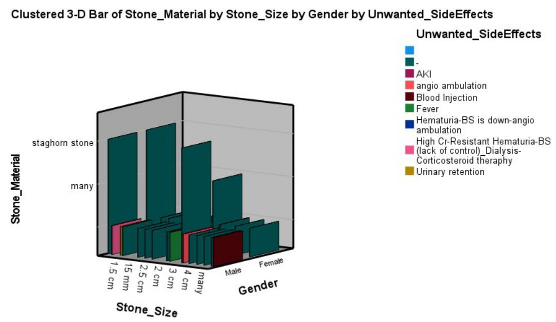

Figure 4. Meaningful relation between second day creatinine and hemoglobin after surgery regarding to the duration of surgery

serum creatinine levels and GFRs calculated by the Cockcroft-Gault equation. The patient's creatinine and GFR levels were compared between the first, and second day, and one month after the surgery. The total amount of patients who stayed at the study and was not excluded or referred 1 month after surgery for the tests was 91 patients. Statistical Analysis was achieved by SPSS software version 24, whereas percentage, frequency, descriptive, and analytical methods were used for qualitative variables, and mean and standard deviation were used for quantitative variables. GFR variations in four measurement times were assessed by recruiting the paired t-test. P-value<0.05 was nominated to declare a significant level of confidence.

Results

The final number of 93 patients who underwent PCNL were involved in our research. Most of them were men: 63 males (69.2%) and 28 females (30.8%). The mean age at the time of the surgery was 47.8±4.7 years old. The mean BMI was 26.8, showing most of our patients are obese.

The dominant side of nephrolithotomy was the left side. The alterations of electrolytes and cell blood count (CBC) parameters in pre-and post-operation were meaningful, except for platelets. More details are presented in Table 1.

The mean size of the stones was 2.5mm. The average time of surgery was 2 hours. The mean amount of creatinine before surgery was 1.17±0.26. The mean creatinine values at day1, day2 and day30 were 1.20±0.32, 1.24±0.39, and 1.17±.34, respectively. After the surgery, the creatinine levels rose but returned to their normal baseline in a month (Figure 1, Figure 2, and Figure 3). Generally, merely the second-day rises of the creatinine levels were meaningful (P-value<0.05). GFR variations in four measurement times are presented in Table 2. Additional analysis is presented in Table 3. Meaningful relation between second-day creatinine and hemoglobin after surgery regarding the duration of surgery (Table 4 and Figures 4 and 5).

Discussion

Renal stone disease (nephrolithiasis) is a prevalent illness in basic care practice. Almost 10 to 20 % of all kidney stones mandate interventional disposal or elimination, planned according to the existence of accompanying or possible forthcoming symptoms and the size and magnitude and shape and texture, and location of the stones. Nephrolithiasis may lead to long-lasting or sometimes persistent kidney obstruction, which could result in permanent kidney damage if mistreated or left untreated. If pre-lithiasis infection happens, this urologic

Table 2. GFR alteration pre- and post-operation

Time	Mean (SD)	P-value
Before surgery	82.3 (24.5)	
Day 1	81.9 (26.7)	0.797
Day 2	79.3 (26.1)	0.054
After 1 month	84.1 (29.3)	0.354

emergency mandates urgent or rapid decompression or diversion by either a ureteral stent or a nephrostomy tube. Patients are prone to become septic or enter the CIRC very quickly if left untreated in this situation. Staghorn calculi themselves do not usually and typically lead to produce symptoms unless the stone status leads to urinary tract obstruction or superinfection is the cause of the staghorn calculus. However, they can end in total kidney failure over the years if they remain present bilaterally. One famous study found the calamity of the deterioration in kidney function merged in 28 percent of patients with staghorn calculi left over eight years.

The overall aims of surgical management of nephrolithiasis are ameliorating discomfort, uprooting of infection, and cessation of impairment of kidney function related to kidney or ureteral stones. To prevent renal damage in patients with urinary tract stones, it is very critical to pick up an appropriate suitable method for stone removal. PCNL is generally evaluated as more influential than SWL or URS for the stones. However, compared to SWL and URS, which has a higher rate of complications, PCNL is normally used when SWL and URS fail, or when the stone is big and complicated. PCNL is the recommended treatment for patients who have stones that are larger than 20 mm or staghorn stones. Almost all urologists nowadays deduct Percutaneous nephrolithotomy the most suitable surgical method for removing stones larger than 2 cm near the renal pelvis (1-3). PCNL usually necessitates a one to a three-day inpatient hospital stay with the patient being administered general anesthesia in the prone or supine position. A small skin incision is made in the patient's flank region, and a hollow working sheath is then inserted through the incision to the kidney under fluoroscopic or ultrasound guidance. The working sheath is then inserted to the endoscope to be used, which will allow the stone to be seen and removed. If necessary, the stone can be broken up before being removed using lithotripters or laser lithotripsy. Throughout the procedure, normal saline irrigation is typically used (1).

URS can typically be carried out safely and should be thought of as first-line therapy in patients with untreated bleeding disorders or who need ongoing anticoagulation or antiplatelet therapy. (4-6). Patients with untreated bleeding diatheses do not receive SWL or PCNL. Endoscopic procedures like URS or PNL are preferred for

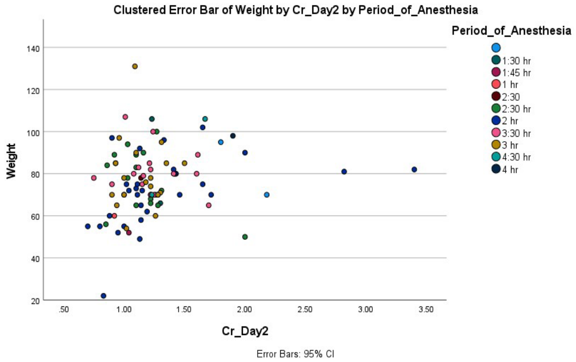

Figure 5.. Correlation between second day creatinine and duration of surgery

treating those with anatomic deformities of the kidney or ureter because they may also make it possible to correct the abnormality. (7). Stones of tougher composition, like calcium oxalate monohydrate stones, brushite stones, cysteine stones, and homogeneous stones with a high density (>900 Hounsfield units) on noncontract CT, are unlikely to be realized by SWL. It is preferable to use PCNL or URS to treat such stones..

PNL is favored as a treatment for patients with struvite (infection) stones. Previous studies showed that PCNL is an appropriate procedure even for elderly patients and patients at high risk for surgery. An extensive multicenter study with 5803 patients that included 1466 (28 percent) staghorn calculi and 940, 956, and 2603 (respectively) upper, interpolar, and lower pole stones described the complications of PNL. Significant bleeding (8%), renal pelvis perforation (3%), and hydrothorax (2%) were the most frequent complications, with a 15% overall complication rate. Larger stones were more likely to experience procedural complications. Following PNL, infectious complications can also happen. For instance, 2.4 percent of patients experienced a septic shock after the method in a big Chinese study. One of the complications following PCNL is its detrimental effects on renal function, due to kidney damage or excessive bleeding during surgery. Therefore, PCNL is one of the most suitable methods with the lowest mortality and complications, due to the short duration of surgery (8, 9).

PCNL can conduct to overload the absorption of irrigation fluid; thus, it is essential to use physiologic irrigation solutions. The irrigate pressure and the duration of the method have the biggest impacts on the amount of fluid absorbed; so, an Amplatz-type open sheath is utilized. In the case of collecting system perforation, greater amounts of fluid can happen. Extravasation typically happens in the retroperitoneal tissue and can be stated by the medial displacement of the kidney during fluoroscopy. While PCNL frequently results in minor perforations, premature termination of the method is typically not required when a low-pressure system (e.g.,

Table 3. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair [1]	HB_Before_Surgery	14.390	137	1.6344	.1396
	HB_After_Surgery	12.582	137	1.8346	·1567
Pair [2]	HB_After_Surgery	12.579	140	1.8415	.1556
	Transfusion	.1143	140	.31930	.02699
Pair [3]	Transfusion	.1220	123	.32857	.02963
	Liquied_OutPut	2949.84	123	1370.136	123.541

Table 4. The ANOVA testing for creatinine day 2, and one month after the surgery. Urea day 2, number of access, and hemoglobin.

		Sum of Squares	df	Mean Square	F	P-value
Cr_Day2	Between Groups	7.965	40	.199	1.559	.066
	Within Groups	6.640	52	.128		
	Total	14.606	92			
Cr_1month_After_Surgery	Between Groups	4.368	46	.095	.904	.641
	Within Groups	8.513	81	.105		
	Total	12.881	127			
Urea_Day2	Between Groups	6280.589	40	157.015	.747	.830
	Within Groups	10925.690	52	210.109		
	Total	17206.280	92			
Number_of_Access	Between Groups	4.459	44	.101	1.043	·433
	Within Groups	6.220	64	·097		
	Total	10.679	108			
HB_After_Surgery	Between Groups	163.706	46	3.559	1.084	.371
	Within Groups	249.420	76	3.282		
	Total	413.126	122			

Amplatz sheath) is in use.

The procedure should be stopped and nephrostomy drainage is advised for more common perforations. Contrary to retroperitoneal extravasation, intraperitoneal extravasation is a less frequent but possibly more severe complication. While abdominal distention is hard to detect because the patient is prone, the anesthesiologist will typically observe a slight increase in the patient's diastolic blood pressure, which will cause the pulse to become narrower and the central venous pressure to rise. Ventilation may become challenging in progressive cases of a large-volume extravasation event due to increased abdominal pressure. Early realization of the main extravasation is essential. Intraperitoneal extravasation may be treated by vigorous diuresis; alternatively, peritoneal drainage or even laparotomy is needed. When a supracostal puncture is carried out, extravasation of irrigant into the pleural cavity can happen. Because intrarenal pressure is still low, extravasation into this space is typically reduced when using the Amplatz-type access sheath. The chest should be checked after PCNL procedures involving a supracostal puncture. The C-arm and fluoroscopy are typically enough to check for pneumothorax or hydrothorax, but a postoperative chest radiograph may be taken if the surgeon has a high index of suspicion for a thoracic complication. Aspiration might be sufficient in the event of a pneumothorax or hydrothorax due to the rarity of lung injury. A chest tube should be inserted because the pneumothorax returns. Although intraoperative diarrhea, hematochezia, or peritonitis are indications of a potential colonic perforation, colonic injury is an uncommon complication that is frequently diagnosed on postoperative nephrostogram or CT imaging. Since the injury is typically retroperitoneal, peritonitis symptoms and signs are uncommon. If the perforation is extraperitoneal, expectant management can be applied, including the insertion of a double-J stent or ureteral catheter to depressurize the system of collecting and removing of the nephrostomy tube from its intrarenal position to its intracolonic position to serve as a colostomy tube. A nephrostogram or a retrograde pyelogram is used to check for colon-kidney communication, and the colostomy tube is left in place for at least 7 days before being taken away. A sharp and typically reversible decline in the glomerular rate of filtration (GFR) is referred to as acute kidney injury (AKI). BUN, creatinine, and other metabolic waste products that the kidney ususlly excretes are elevated as a result of this. Additionally, fluid retention and volume overload may happen if urine output is also decreased. A common clinical issue is AKI, formerly known as ARF (1-3, 8-11). The 2012 KDIGO Clinical Practice Guidelines for Acute Kidney Injury defined AKI as one or more of three criteria (1). The first two were an increase in serum creatinine of at least 0.3mg/dL (26.5 micromole/L) over 48 hours and/or ≥1.5 times the baseline value within the seven previous days (1). The third criterion was a urine volume ≤0.5 mL/kg per hour for six hours. In a 70kg-man, this could present a urine volume as high as 210 mL in 6 hours, which, if kept, would be 840 mL/day. Some healthy people would meet this criterion if they had restricted fluid intake. Therefore, we, the authors and reviewers of this article never accept with making a realization of AKI based solely on the urine volume. Other definitions and severity staging of AKI have also been represented, as (AKI) is defined as an increase in serum creatinine level equal to or greater than 0.3mg / dL within 48 hours, an increase in creatinine level greater than 1.5 times the baseline level over the past week, or a decrease in urine volume equal or less than 0.5mg/kg per hour for 6 hours (11-13).

Reduced blood flow to the kidneys is the main factor in the majority of cases of AKI, which typically affect people who are already ill due to another medical condition. Low blood volume following bleeding, excessive vomiting or diarrhea, severe dehydration, the heart pumping less blood than usual due to heart failure, liver failure, or sepsis, and some medications that lower blood pressure or blood flow to the kidneys, such as ACE inhibitors, some diuretics, or NSAIDs, could be the cause of this reduced blood flow. A problem with the kidney itself, such as inflammation of the kidney's filters (glomerulonephritis), the blood vessels (vasculitis), or other kidney structures, may also be the source of AKI. This can be happened by a reaction to some medications, infections, or the liquid dye used in some types of X-rays. A tumor in the pelvis, such as an ovarian or bladder tumor, or kidney stone may occasionally cause an enlarged prostate if a blockage influencing the kidneys' drainage occurs. One of the practical and appropriate methods to evaluate kidney function is the glomerular filtration rate (GFR). Serum creatinine level is also a biomarker used to assess kidney function. It also depends on the body's muscle mass and protein intake. If kidney function decreases, serum creatinine levels increase, followed by a reduced glomerular filtration rate (13, 14). The two main reasons of AKI that take place in the hospital are prerenal disease and ATN. Together, they account for almost 65 to 75 percent of cases of AKI. The prerenal disease is taken from the following:

True volume depletion – Volume depletion may be caused by gastrointestinal disease (vomiting, diarrhea, bleeding), renal losses (diuretics, glucose osmotic diuresis), skin or respiratory losses (insensible losses, sweat, burns), and third space sequestration (crush injury or skeletal fracture). Hypotension – dramatically decreased blood pressure can result from shock (hypovolemic, myocardial, or septic) and post-treatment of severe hypertension. Edematous states – Heart failure, cirrhosis, Nephrotic syndrome, decreased kidney perfusion, decreased glomerular permeability, and excessive diuresis is among the mechanisms that can lead to AKI. Selective kidney ischemia – Bilateral renal artery stenosis or unilateral stenosis in a solitary functioning kidney is frequently made worse by treatment with angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, or direct renin inhibitors.

Causes of acute tubular necrosis: Kidney ischemia, Bleeding, Surgery, Thrombosis, Severe Heart Ischemia, Sepsis, and Nephrotoxins. The majority of the patients were male, which shows that possibly men intake more predisposing comestible factors for kidney stones, such as consuming increased animal proteins and potassium. like former investigations of The NHANES, nephrolithiasis is more common in men than women (15-17). On the contrary, recent studies show that due to changes in women's lifestyles, the pattern of gender disparity is changing (18, 19).

Different stone-making risk factors are being discussed in previous studies, such as; climate changes, particular lifestyles in different cultures, patterns of physical activities, and obesity. Based on these sources, the commonness of renal stones is higher in obese patients in the current study. In addition, along with other studies, most of our patients have been diagnosed with renal stones in their 50th decade (20, 21). In consistency with Atici Study, PCNL real-time bleeding may lead to GFR reduction caused by renal subsequent ischemia, leading to an imbalance of electrolytes such as sodium and potassium; on the contrary, other studies showed no changes in electrolytes in these patients (5, 22-25). Same voice as studies by Mukherjee et al. and Yadav et al., our results stated an increase in the serum levels of creatinine after the surgery, especially during the first 48 hours post-operational period, which slowly went back to the pre-operative mean value (22, 26-28). GFR declined after 48 hours post-operation, but these changes as the results of Wang et al. did not earn meaningful value (4). We also observed that there were significant differences in hematocrit, white blood cells, and hemoglobin levels except for platelets after the surgery, contrary to the study by Mohta et al. which showed no meaningful differences after surgery (5). According to Chen et al., bleeding during operation is the primary cause of early post-operation hemoglobin and hematocrit changes, consistent with our study. Stable platelet concentration after the surgery could be due to its longer half-life (6, 7). Although some important limitations could have suggested future studies, such as shorter follow-up intervals; anyway, it clarifies alterations in the creatinine and GFR levels. We recommend further evaluating variables in patients harboring increased serum creatinine levels in a larger sample size in forthcoming studies.

Conclusions

PCNL is an effective and safe method regarding renal function to treat small renal stones with no meaningful decrease in renal function.

Authors' contributions

MR designed the study, BK and FG wrote the manuscript, RK and FE provided references, LOR revised and edited the manuscript, HZ and AKH analyzed the data.

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Conflict of interest

All authors declare that there is no conflict of interest.

Funding

There was no funding.

Ethics statement

The Ethical committee approval of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1398.1033). Written consent form was obtained from patient.

Data availability

Data will be provided on request.

Abbreviations

ARF	Acute renal failure
ATN	Acute tubular necrosis
BUN	Blood urea nitrogen
CBC	Cell blood count
DM	Diabetes mellitus
HRS	Hepatorenal syndrome
HTN	Hypertension
KDIGO	Kidney Disease: Improving Global Outcomes
PCNL	Percutaneousnephrolithotomy
UTI	Urinary tract infection

References

1. El-Nahas AR, Taha D-E, Ali HM, Elshal AM, Zahran MH, El-Tabey NA, et al. Acute kidney injury after percutaneous nephrolithotomy for stones in solitary kidneys. Scandinavian journal of urology. 2017;51(2):165-9.
2. Sainsbury B, Łącki M, Shahait M, Goldenberg M, Baghdadi A, Cavuoto L, et al. Evaluation of a virtual reality percutaneous nephrolithotomy (PCNL) surgical simulator. Frontiers in Robotics and AI. 2020;6:145.
3. Fakhr Yasseri A, Taheri D. Measuring Stone Free Rate after Mini Percutaneous Nephrolithotomy: Radiography, Ultrasound, or CT scan? Translational Research in Urology. 2020;2(2):48-50.
4. Wang M-R, Wang Q, Hu H, Lai J-H, He Y-X, Xiong J, et al. Long-term analysis of safety and efficacy of standard percutaneous nephrolithotomy in patients with solitary kidneys. Beijing da xue xue bao Yi xue ban= Journal of Peking University Health Sciences. 2020;52(4):663-6.
5. Khoshrang H, Falahatkar S, Ilat S, Akbar MH, Shakiba M, Farzan A, et al. Comparative study of hemodynamics electrolyte and metabolic changes during prone and complete supine percutaneous nephrolithotomy. Nephro-urology monthly. 2012;4(4):622-8.
6. Chen Z-Y, Wu H-Z, Zhu P, Feng X-B. Postoperative changes in hemoglobin and hematocrit in patients undergoing primary total hip and knee arthroplasty. Chinese medical journal. 2015;128(14):1977-9.
7. Aghamir SMK, Elmimehr R, Modaresi SS, Salavati A. Comparing bleeding complications of double and single access totally tubeless PCNL: is it safe to obtain more accesses? Urologia internationalis. 2016;96(1):73-6.
8. Pillai S, Kriplani A, Chawla A, Somani B, Pandey A, Prabhu R, et al. Acute kidney injury post-percutaneous nephrolithotomy (Pnl): Prospective outcomes from a university teaching hospital. Journal of Clinical Medicine. 2021;10(7):1373.
9. Aghamir SMK, Salavati A, Hamidi M, FallahNejad A. Primary report of totally tubeless percutaneous nephrolithotomy despite pelvi-calyceal perforations. Urology journal. 2017;14(4):4020-3.
10. Proietti S, Giusti G, Desai M, Ganpule AP. A critical review of miniaturised percutaneous nephrolithotomy: is smaller better? European urology focus. 2017;3(1):56-61.
11. Reeves T, Pietropaolo A, Gadzhiev N, Seitz C, Somani BK. Role of endourological procedures (PCNL and URS) on renal function: a systematic review. Current urology reports. 2020;21:1-11.
12. Kumar S, Keshavamurthy R, Karthikeyan VS, Mallya A. Complications after prone PCNL in pediatric, adult and geriatric patients–a single center experience over 7 years. International braz j urol. 2017;43:704-12.
13. Zia H, Khatami F, Rahimi MR, Aghamir SMK. Combined Direct Visual and Imaging Guided Percutaneous Nephrolithotomy: A Novel Technique. Translational Research In Urology. 2021;3(1):4-9.
14. Jafari Shahdani MR, Fattahi B, Mohseni MG, Aghamir SMK. Comparison of Mini-perc and retrograde intrarenal surgery in residual stone fragments with hounsfield unit after percutaneous nephrolithotomy. Translational Research In Urology. 2021;3(2):40-4.
15. Ziemba J, Matlaga B. Epidemiology and Economics of Nephrolithiasis. Investigative and Clinical Urology, 58, 299-306. 2017.
16. Shoag J, Tasian GE, Goldfarb DS, Eisner BH. The new epidemiology of nephrolithiasis. Advances in chronic kidney disease. 2015;22(4):273-8.
17. Mohammadi Sichani M, Vakili MA, Khorrami MH, Izadpanahi M-H, Gholipour F, Kazemi R. Predictive values of neutrophil to lymphocyte ratio and platelet-to-lymphocyte ratio for systemic inflammatory response syndrome after percutaneous nephrolithotomy. Translational Research in Urology. 2021;3(4):154-60.
18. Cicerello E, Mangano MS, Cova G, Ciaccia M. Changing in gender prevalence of nephrolithiasis. Urologia Journal. 2021;88(2):90-3.
19. Mohammadi A, Nikoobakht MR, Hosseini SR. Urolithiasis in Renal Transplantation Patients: An Update of the Literature. Translational Research in Urology. 2021;3(4):149-53.
20. Romero V, Akpinar H, Assimos DG. Kidney stones: a global pic-

ture of prevalence, incidence, and associated risk factors. Reviews in urology. 2010;12(2-3):e86.
21. Khalili P, Jamali Z, Sadeghi T, Esmaeili-Nadimi A, Mohamadi M, Moghadam-Ahmadi A, et al. Risk factors of kidney stone disease: a cross-sectional study in the southeast of Iran. BMC urology. 2021;21:1-8.
22. Mukherjee S, Sinha RK, Jindal T, Sharma PK, Mandal SN, Karmakar D. Short-term alteration of renal function and electrolytes after percutaneous nephrolithotomy. Urology journal. 2019;16(06):530-5.
23. Bayrak O, Seckiner I, Erturhan SM, Mizrak S, Erbagci A. Analysis of changes in the glomerular filtration rate as measured by the cockroft-gault formula in the early period after percutaneous nephrolithotomy. Korean Journal of Urology. 2012;53(8):552-5.
24. Xu S, Shi H, Zhu J, Wang Y, Cao Y, Li K, et al. A prospective comparative study of haemodynamic, electrolyte, and metabolic changes during percutaneous nephrolithotomy and minimally invasive percutaneous nephrolithotomy. World journal of urology. 2014;32:1275-80.
25. Atıcı Ş, Zeren S, Arıboğan A. Hormonal and hemodynamic changes during percutaneous nephrolithotomy. International urology and nephrology. 2001;32:311-4.
26. Nouralizadeh A, Sichani MM, Kashi AH. Impacts of percutaneous nephrolithotomy on the estimated glomerular filtration rate during the first few days after surgery. Urological research. 2011;39:129-33.
27. Yadav R, Agarwal S, Sankhwar S, Goel A, Kumar M, Singh M, et al. A prospective study evaluating impact on renal function following percutaneous nephrolithotomy using Tc99m ethylenedicysteine renal scan: Does multiplicity of access tracts play a role? Investigative and Clinical Urology. 2019;60(1):21-8.
28. Saxby MF. Effects of percutaneous nephrolithotomy and extracorporeal shock wave lithotripsy on renal function and prostaglandin excretion. Scandinavian journal of urology and nephrology. 1997;31(2):141-4.

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