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Research Article

Evaluation of the Necessity of Ultrasound-Guided Percutaneous Nephrostomy in Upper Urinary Tract Obstruction

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Abstract

Background: Obstructive uropathy is life-threatening condition. we evaluated necessity of percutaneous ultrasound guided nephrostomy as an initial drainage in upper urinary tract obstruction focusing on period required for normalization of serum creatinine and factors affecting it, post procedural complications and how we managed. We also recorded the isolated bacteria from urine samples and antibiotic sensitivity patterns. **Methods:** A prospective clinical study at Nephrology and Urology Minia University Hospital involved insertion of percutaneous nephrostomy in 72 patients presented with upper urinary tract obstruction and serum creatinine level. We recorded any complications appeared and how we managed and focused on factors affected renal recovery. **Results:** In the current research, the outcome of 72 patients underwent sonar guided PCN insertion have been described. 80.6% of patients recovered to normal renal function tests that is highly significant while 19.4%of patients still had impaired renal function tests. Age and baseline creatinine were the only significant predictors to normal renal function. 10 patients suffered from bleeding; two patients needed blood transfusion. Success rate was 100%. The most isolated bacteria were E-coli. **Conclusion:** Obstructive Uropathy is a urological emergency that requires rapid diagnosis and prompt treatment for the purpose of decompression and preservation of renal parenchyma. PCN is a safe and effective procedure in management of acute kidney injury due to post renal pathology. it is Suitable for risky or unfit patients for anesthesia as it requires local anesthesia. The lower pre-creatinine level and rapid intervention have great role in normalization of renal function tests.

Key words: calcular anuria, calcular acute kidney injury, upper urinary tract stones, percutaneous nephrostomy

Introduction

Obstructive uropathy is the structural resistance to the flow of urine and can occur at any level from urethral meatus to the calyceal infundibula. It refers to the pathophysiological effects secondary to this obstruction leading to renal dysfunction [1]. The obstruction may be due to intraluminal, intramural and extramural causes. In young and middle age patients' renal calculi are the main etiological factors of obstruction .

Obstructive uropathy is a potentially life-threatening condition and if the obstruction is present bilaterally, then immediate measures are required to decompress the kidney, otherwise the patient's clinical conditions will deteriorate at a fast pace through uremia, water-electrolyte abnormalities and urinary tract infections with a consequent reduction of alertness and subsequent death [2]. Urinary diversion is one of the ways to manage ureteral obstructions. The various methods of urinary diversions are retrograde double J ureteral stenting, percutaneous nephrostomy and open drainage of kidney .[3]

Percutaneous nephrostomy (PCN) is an established method of upper tract drainage; it

was first described by Goodwin in 1955 and since then has become routine practice [4]. It has the advantages of being fast, can be done in the outpatient setting with minimal need for anesthesia and few complications. There are different methods of image guidance for PCN, which include; fluoroscopy, ultrasound, computed tomography, and magnetic resonance imaging [5]. Ultrasound has the advantages of availability, affordability, absence of radiation exposure [6].

Aim of the work

To evaluate the role of Ultrasound-guided percutaneous nephrostomy for patients suffering from upper urinary tract obstruction.

Patients and Methods

Study Design:

This study was a prospective clinical study at Nephrology and Urology Minia University Hospital to evaluate the role of Ultrasound-guided percutaneous nephrostomy for patients suffering from upper urinary tract obstruction attending our department in the period from January 2021 to December 2021.

Study population:

Patients who had been presented or referred to our outpatient clinic and diagnosed with upper urinary tract obstruction causing hydronephrosis causing acute kidney injury were included in the study. Those patients in need of urgent drainage who were unfit for surgery and or with ineffective distal drainage e.g., obstructed ureteral stent and or those with failed trial for retrograde stenting. Patients who had uncontrolled coagulopathy, infravesical obstruction, Malignant obstruction, prior dialysis, pregnancy were excluded.

Methodology :

All patients were evaluated to diagnose the causes of obstructive uropathy, confirm indication and fitness for the procedure. The patients selected for this procedure had been counseled and written consent was obtained from the patient

For all patients, a comprehensive medical examination, lab investigations, renal US assessment, and non-contrast CT scans of the urinary tract were conducted. Patients who were unfit for anesthesia, those who failed retrograde stenting, and those with persistent fever after DJ stent insertion were assigned to undergo US-guided nephrostomy tube insertion (PCN group).

Procedure for percutaneous nephrostomy:

The patients were placed on the ultrasound table in lateral/prone position. Ultrasound scanning was performed using a 5.0 MHz curved array probe to obtain a transverse plane scan through the kidney to identify the degree of hydronephrosis. The ideal puncture site into the kidney was via a posterior calyx. As soon as the initial puncture site was chosen, it was cleaned and draped. Local anesthesia was injected at the puncture site using 10ml of 2% lidocaine.

The skin and fascia were incised and then the scanning head was shifted over the incision to measure the distance between the skin and the calyx. The drainage catheter with puncture needle was inserted through the incision into the collecting system under real-time ultrasound guidance. Once the drainage set was at desired calyx for enough length, the trocar with the inner metallic tubes was removed and the drainage catheter was advanced into the collecting system further. No guide-wire and serial dilatation were undertaken during the procedure.

Urine samples were obtained and sent for culture sensitivity. Broad spectrum antibiotic and anti-hemorrhage drugs were routinely given for one day in post-procedure. Position of PCN pigtail catheter was confirmed by ultrasound with or without saline flush followed by firm suturing to the skin using silk 1-0 and adhesive strapping.

Follow up

Patient who didn't develop any immediate post-procedure complications had been discharged then followed up at our outpatient clinic. Patient were followed up till definitive management for post serum creatinine level and the period required to reach nadir creatinine. Occurrence of fever and or sepsis together with the results of urine culture and antibiotics sensitive to detected organism.

Statistical analysis:

Data were analyzed by SPSS Version 19. (IBM Corp., Armonk, NY). Categorical descriptive data were presented as numbers and

percentages, and continuous descriptive data were showed as mean ± standard deviation (SD) chi-square tests for comparison between categorical variables and t-tests or Mann-Whitney U test for continuous variables. Cox regression analysis was done to assess factors affecting renal recovery.

Ethical consideration:
Our study was done on human participants after well-informed written consent which is a basic requirement of the institutional review board, The Study was done according to ethical consideration of the Helsinki Declaration and local ethical committee approval (IRB NO. 00008718).

Results:
There were 44 males and 28 females, their age ranged from 8 to 75 years and its mean ± SD was 50.49 ± 14.86. The most common comorbidity was hypertension (36.1%) followed by diabetes (Table 1). Most of cases (N=42) (58.3%) presented to us with oliguria, while 23 patients (31.9%) presented with anuria and 7 patients (9.7%) with oliguria and fever (Table 1).

There were 72 patients with 144 renal units, 98 of them are hydronephrotic functioning kidneys. We excluded the kidneys with paper thin cortex from the functioning category. The other kidneys were small sized or previously nephrectomized or medically diseased or congenitally absent. Stones was the most common cause of pathology in the renal units (98), mostly at the level of the ureter (Table 2).

In the current study, 8 patients suffered from post insertion hematuria while 2 patients had mild bleeding and 1 had severe bleeding. Two patients only needed blood transfusion and admitted to our hospital. 6 patients complained from fever, one of them developed septicemia and admitted to our hospital. 5 PCNs had blocked by pus or blood clots and irrigated by saline while one PCN had slipped and replaced by silicon foley's catheter on the same track. There're no cases suffered from organ injury or renal pelvic injury (Table 3).

Table 4: shows the isolation characteristics of bacteria from the urine samples. A total of 30 bacterial isolates were classified as gram-negative bacteria and 1 isolate was gram-positive bacteria. The most bacterial isolates were E. coli with 19 isolates, 7 isolates of Klebsiella pneumoniae, 3 isolates of Proteus mirabilis and 1 isolate of Acinetobacter baumannii for gram-negative bacteria. One isolate for gram-positive bacteria was Staphylococcus aureus.

Table 4 demonstrates the different antibiotics used in urine culture and their sensitivity. The most sensitive antibiotic was aminoglycoside (71%), the others in order; carbapenem (61.3%), quinolones (54.8%), nitrofurantoin (51.6%), Piperacillin/Tazobactam (51.6%), Trimethoprim/Sulfamethoxazole (45.2%), Cephalosporins (32.3%), Linezolid (25.8%), Amoxicillin/Clavulanic acid (16.1%), Penicillin (12.9%), Tetracyclines (9.7%).

Table 5 shows that 58(80.6%) patients recovered to normal renal function tests that is highly significant while 14 (19.4%) patients still had impaired renal function tests. The pre creatinine level ranged from 2.1 to 16 while the post creatinine ranged from 0.5 to 4.2. the time needed to basal creatinine ranged from 1 to 7. 58 patients recovered to normal RFTs in mean survival time 4.75±0.44 days, while the median survival day to recovery is 4.00±0.31.

In table 6, many factors that suspected to affect recovery of RFTS were enlisted, However, age and baseline creatinine were the only significant predictors to normal renal function after PCN where one year less results in 0.9-fold chance for recovery of renal function while one unit decrease in pre PCN renal function results in o.7 more chance in recovery of renal function after PCN

Table1: Demographic and clinical data of the patients

Variables	**Frequency (%)** **Total no (72)**
Age (years) Mean±SD Range	 50.49±14.86 8-75
Sex Males Females	 44 (61.1%) 28 (38.9%)
Hypertension Yes No	 26 (36.1%) 46 (63.9%)
Diabetes Yes No	 25 (34.7%) 47 (65.3%)
Clinical presentation Oliguria Anuria Oliguria and fever	 42 (58.3%) 23 (31.9%) 7 (9.7%)

Table 2: Pathology & Cause of urinary tract obstruction

	Pre-Right Backpressure		**Pre-Left Backpressure**	
	N	**%**	**N**	**%**
No. of Hydronephrotic functioning kidneys A) Mild BP B) Moderate BP C) Marked BP	 15 31 7	 20.8% 43.1% 9.7%	 16 20 9	 22.2% 27.8% 12.5%
No. of Total Cortical Loss Kidneys	6	8.3%	6	8.3%
No. of Small Sized Kidneys	4	5.6%	6	8.3%
No. of Nephrectomized kidneys	4	5.6%	9	12.5%
No. of Medically Diseased Kidneys	5	6.9%	4	5.6%
No. of Congenitally Absent Kidneys	-	-	2	2.8%
Functioning renal unit				
Right only functioning kidney	27		37.5%	
Left only functioning kidney	19		26.4%	
Bilateral functioning kidney	26		36.1%	
Pathological causes	**Right pathology**		**Left pathology**	
	N	**%**	**N**	**%**

a) Stone	55	76.4%	44	61.1%
- Site:				
Renal	20	27.8%	18	25%
Upper third ureter	9	12.5%	5	6.9%
Middle third ureter	10	13.9%	4	5.6%
Lower third Ureter	16	22.2%	17	23.6%
b) Stricture	1	1.4%	3	4.2%
c) Obstructed DJ	1	1.4%	1	1.4%
N.B. Total no. of patients: 72 Total no. of renal units: 144 Total no. of functioning kidneys: 98				

Table 3: Frequency of Complications among the patients:

Complications	**N**	**%**
Bleeding:	**11**	**15.3%**
Post Insertion Hematuria	8	11.1%
Mild bleeding	2	2.8%
Severe bleeding	1	1.4%
No	61	84.7%
Blood transfusion:		
Yes	2	2.8%
No	70	97.2%
Mechanical Dysfunction	**6**	**8.3%**
Blockage	5	6.9%
Slippage	1	1.4%
NO dysfunction	66	91.7%
Infection	**6**	**8.3%**
Fever	5	6.9%
Septicemia	1	1.4%
No infection	66	91.7%
Hospital stays	**3**	**4.2%**
For Blood Transfusion	2	2.8%
Shocked	1	1.4%
No	69	95.8%
Failure to insert		
No	72	100%
Yes	0	0%
Organ injury		
No	72	100%
Yes	0	0%
Renal Pelvic injury		
No	72	100%
Yes	0	0%

Table 4: Type of isolated organism and sensitivity to antibiotics according to urine cultures

Isolated organism		**N**	**%**
No-organism		41	56.9%
Culture of positive organisms Total = 31	**E-coli (Gram -ve)**	19	26.4%
	Klebsiella (Gram -ve)	7	9.7%
	Proteus (Gram -ve)	3	4.2%
	MRSA (Gram +ve)	1	1.4%
	Actinobacteria (G -ve)	1	1.4%
Antibiotic (N=31)	**Sensitive**	**Resistant**	**Missed**
Quinolones	17 (54.8%)	13 (41.9%)	1(3.2%)
Cephalosporins	10 (32.3%)	19 (61.3%)	2(6.5%)
Nitrofurantoin	16 (51.6%)	9 (29.0%)	6(19.4%)
Tetracyclines	3 (9.7%)	13 (41.9%)	15(48.4%)
Penicillin	4 (12.9%)	19 (61.3%)	8(25.8%)
Aminoglycoside	22 (71.0%)	8 (25.8%)	1(3.2%)
Trimethoprim/Sulfamethoxazole	14 (45.2%)	13 (41.9%)	4(12.9%)
Carbapenem	19 (61.3%)	7 (22.6%)	5(16.1%)
Piperacillin/Tazobactam	16 (51.6%)	9 (29.0%)	6(19.4%)
Linezolid	8 (25.8%)	8 (25.8%)	15(48.4%)
Amoxicillin/Clavulanic acid	5 (16.1%)	18 (58.1%)	8(25.8%)

Table 5: Outcome of PCN insertion

Outcome	**Median**	**IQR**	**Range**
Laboratory Investigations Pre-Creatinine Post Creatinine * Time to basal creatinine	 5.95 1.2 3	 3.95 - 8.45 0.92 – 1.4 3 – 4.75	 2.1 – 16 0.8 - 4.2 1– 15
Renal function recovery: Recovered renal function Impaired renal function	58 (80.6%) 14 (19.4%)		

Table 6: Cox regression analysis of different variables affecting recovery of renal function

Factors affecting recovery of RFTs	**Sig. P value**	**Exp(B) HR**	**95.0% CI for Exp(B)**	
			Lower	**Upper**
Age*	**0.04**	**.98**	**.95**	**.99**
Sex	0.09	1.81	.90	3.66

Hypertension	0.12	1.88	.85	4.14
Diabetes mellitus	0.82	.89	.33	2.38
HCV positive	0.58	1.29	.52	3.18
TLC	0.98	1.00	.88	1.14
Functional diagnosis	0.99	1.01	.46	2.22
Pre dialysis	0.53	.68	.20	2.26
Urine culture	0.62	2.16	.11	43.68
Pre-Creatinine*	**0.01**	**0.77**	**.62**	**.95**

Discussion

Acute kidney injury is a major health problem with significant effect on morbidity and mortality. The prevalence of acute kidney injury was estimated to be higher in developing countries [7]. Community awareness about how to avoid it and early referral may minimize the burden of acute kidney injury [8]. Post renal causes are the most common correctable cause of acute kidney injury and account for approximately 10%–12% of all cases of kidney injury. The prevalence of urolithiasis has risen over the last two decades due to metabolic syndromes, global warming in weather and accidental radiological diagnosis [9]. Accordingly, complications associated with stone disease have increased over time as well. Egypt was identified as one of stone forming belt [10].

Regarding demographic data of the patients:

The age of our patients ranged between 8 and 75 years old with mean age 50.5 years old. They comprised 44 males and 28 females with male to female ratio was 1.57:1, which is very much comparable to studies of Naeem M et al, Karim R et al, Memon NA et al and Wang et al who had also found predominance of male patients with obstructive uropathy [11-14]. There were 26 (36%) hypertensive patients and 25 (34%) diabetic patients while in Shoshany O et al study 48% of patients were hypertensive and 25%of them were diabetic and in Zhou et al study 42% of patients are hypertensive and 37%of them are diabetic. [15,16].

Regarding clinical presentation of patients:

The main clinical presentation in our study was as follow; oliguria in (58.3%) of patients, anuria in (31.9%), and fever with oliguria in (9.7%). A study conducted by Halle MP show that the main symptoms at presentation were loin pain (37%), oliguria (33%), anuria (15%), and macroscopic hematuria (7%). Urinary tract infection was present in 33 (15%) patients. the chief symptoms in a study conducted by Gebreselassie, K. H., et al was oliguria (70%) followed by infection (16%). [17,18].

Regarding cause and laterality of obstruction:

In our study, the commonest cause of obstructive uropathy observed was stone disease (renal or ureteric) as was also found by with Lodh et al, Richter S et al , Elbatanouny et al and Naeem M et al., and this could be explained by the fact that our study showed male predominance with age mean about 50.49 ± 14.86 SD associated with high incidence of urolithiasis, on the other hand many literatures showed that most cases are secondary to lower urinary tract pathologies which are primarily malignant.[11,19-21]

Yang, J., et al. demonstrated that the most common causes of obstructive uropathy in adults undergoing PCN were malignancy (55.6%), followed by urolithiasis (28.7%), and other causes (15.2%). [22]

Regarding the bi-laterality of OU in patients who were candidates for PCN was variable in most studies, ranging from 35 to 55%. [23-25] . Gebreselassie, K. H., et al study conducted at two urologic centers in Ethiopia showed that 77 (60%) of the studied patients presented with involvement of both kidneys and all of them were diagnosed with AKI, which is explained by the finding that >80% of their patients had pelvic malignancies, such as cervical, bladder and rectal cancers, which increase the

likelihood of the involvement of both renal systems.[18]
In our study bilateral obstruction was found in 26 patients while unilateral obstruction was found in 46 patients, and this is consistent with that the main cause of OU in our study was due to urinary stones, our results were also in agreement with Elbatanouny et al study as 76% of cases had unilateral obstruction. About sixty three percent of patients in our research had an only functioning kidney due to contralateral absent, nephrectomized or non-functioning kidneys.[21]

Regarding the Success Rate of Insertion:
In the SIR (Standard Society of Interventional Radiology Practice) guideline, overall success rate ranged between 84-99% irrespective of the imaging modality used, while success rates for procedures realized for cases with non-dilated, and dilated collecting systems were reported as 82-96%, and 96-100%, respectively.[26]

Naeem M et al , Wah TM et al , Chalmers et al , Dinic et al and Mokhmalji H et al had success rate as 96.05% , 98.0% ,99 %, 100 % and 100 % respectively which is comparable with our study and this can be explained by the fact that all cases had dilated pelvicalyceal systems and majority of them was moderate hydronephrosis which is coherent with many literatures which previously stated that successful outcome of emergency PCN is directly proportional to the grade of pelvicalyceal dilatation.[11,25,27-29].

Regarding Post-operative Complications:
1-Bleeding:
The most common complication of percutaneous nephrostomy (PCN) was bleeding, which occurred in 4.2% patients in our study. That hematuria was mild with no effect on recovery period and only two patients received blood transfusion. Naeem M et al, Jalbani MH et al, Romero FR et al and Ahmed I et al had come across this rate as 4.0%, 5.0%, 3.5% and 4.5%respectively which is very much comparable to our study. [11,30-32]
However, our results contradicted Karim R et al and Olivera ST et al studies that reported a much higher rate of bleeding i.e. 9.5% and 21.5% respectively. [3,12]

2- Mechanical Dysfunction:
Blockage or dislodgment of the nephrostomy tube observed in different studies range from 04-37% [11,25,30,33], while in our study it was found in 8.3% patients as 5 tubes had been blocked and only one slipped in the fifth day then replaced by silicon catheter on the same track. PCN slippage is especially in fatty patients, so we tried to avoid this problem by fixing the PCN properly by suturing it well to the skin.

3- Infection:
In our research fever occurred in 5 (6.9%) patients, and septicemia in one patient. We noticed that those patients had positive urine culture. All patients were managed conservatively by IV fluids, injectable antibiotics and anti-pyretic except patient developed septicemia and was admitted at our department for conservative management.
The incidence of septicemia after PCN may occur in 4% of cases and reach 7% in the setting of pyonephrosis in Bahu et al study. Firas et al reported higher incidence of septicemia 5%. On contrast, Harraz et al reported that septic shock occurred more frequently in 6 (11.5%), while Dinic et al and Naeem M et al reported a similar incidence of septicemia 1.3% and 2% respectively [11,29,34-36]

4- Organ Injury:
There's no injury to the adjacent organs during insertion of PCN which is similar to results of Ahmed I et al study [32].

Regarding Positive Urine C/S:
Urosepsis-related mortality was reported to be 2.5-times higher in patients with urinary obstruction. Since effective antimicrobial therapy must be initiated as early as possible when sepsis is suspected, empiric intravenous therapy should be initiated immediately after sampling for microbiological tests. After identifying the pathogenic bacteria, the use of antibiotics should be adjusted accordingly.[37]
In our study 31 patients (43%) had positive urine culture, 30 bacterial isolates of them were classified as gram-negative bacteria. The most bacterial isolates were E. coli with 19 isolates, 7 isolates of Klebsiella pneumoniae, 3 isolates of Proteus mirabilis and 1 isolate of Acinetobacter baumannii for gram-negative bacteria. One isolate for gram-positive bacteria was Staphylococcus aureus.
There're many studies with results comparable to our results as in Steven et al 's study, a total of 121 patients, underwent percutaneous

nephrostomy and had their culture and bacterial resistance tested, were classified as gram-positive bacteria (16.5%) and 101 isolates were gram-negative bacteria (83.5%). The most bacterial isolates were E. coli with 42 isolates, 22 isolates of Pseudomonas aeruginosa and 20 isolates of Klebsiella pneumoniae for gram-negative bacteria. Ten isolates for gram-positive bacteria were Staphylococcus aureus. In the gram-negative group, the antibiotics with the best sensitivity were meropenem and amikacin.[38]
In Wang et al study, 85% of cases had positive urine culture. E. coli was the common isolated organism then Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus in that order.[14]. In Zhou et al study, the most common bacterium in the urine culture was E. coli. (53%) followed by Klebsiella spp., Proteus spp., and then Gram-positive organisms as staphylococci spp. [37].

Steven and Safriadi F. et al reported that culture and antibiotic sensitivity to gram-negative bacteria examination showed that meropenem and amikacin antibiotics have the best sensitivity to gram negative bacteria as much as 83.2%. Gentamicin and ceftazidime had a fairly good sensitivity, reaching 59.4% and 49.5%, respectively. The antibiotic that was least sensitive to gram negative bacteria was ciprofloxacin, which was only 19.8% sensitive to gram-negative bacteria based on the results of the urine culture of patients who had percutaneous nephrostomy.[38]

In our study The most sensitive antibiotic was aminoglycoside (71%), the others in order; carbapenem (61.3%), quinolones (54.8%), nitrofurantoin(51.6%),Piperacillin/Tazobactam(51.6%),Trimethoprim/Sulfamethoxazole(45.2), Cephalosporins (32.3%), Linezolid(25.8%), Amoxicillin/Clavulanic acid (16.1%), Penicillin (12.9%) , Tetracyclines (9.7%).

Regarding Renal Recovery:
We considered that returning to normal serum creatinine is an indicator for complete recovery, so in our study we had 58(80.6%) patients recovered to normal renal function tests that is highly significant while 14 (19.4%) patients still had impaired renal function tests this could be due to history of uncontrolled HTN and DM and long period of anuria. We referred those patients to the nephrology department to investigate and manage the cause. Savić et al confirmed that recovery of renal function was poorer in patients with longer duration of anuria.[39] The duration and severity of obstruction has a significant influence on renal recovery according to Rajadoss et al study [40]. The same result was reported by Mittal et al and Harraz et al studies. [41,42]

Another randomized study, carried out in pediatric patients by El gammal et al., 2009, reported a more rapid return of serum creatinine to normal level with PCN tubes in 54 children within 72–120 hours [43]. In Elbatanouny et al' study, the recovery period for normalization of serum creatinine after PCN insertion was 2 +- 1 days.[21]
In our study the pre creatinine level ranged from 2.1 to 16 while the post creatinine ranged from 0.5 to 4.2. the time needed to basal creatinine ranged from 1 to 7 days with mean survival time 4.75±0.44 days, while the median survival day to recovery is 4.00±0.31. We noticed in our study that factors that can significantly affect renal recovery were the age and the pre creatinine level. There was inverse relationship between pre creatinine level and renal recovery which could be calculated as one unit decrease in pre PCN renal function results in o.7 more chance in recovery of renal function after PCN and this is comparable with the results of study done by Metcalfe et al.[44] Regarding the age we reported that younger patients had better chance for renal recovery ; one year less results in 0.9 fold chance for recovery of renal function and many studies had supported this results like Rajadoss, M. P., et al. , Saucier, N. A., et al.[40,45]

Conclusion
• Obstructive Uropathy is a urological emergency that requires rapid diagnosis and prompt treatment for decompression, preservation of renal parenchyma, and restoration of renal function.
• Ultrasonic-guided percutaneous nephrostomy insertion is a safe and effective procedure in the management of acute kidney injury due to post-renal pathology. It is Suitable for patients at risk or unfit for anesthesia, as it requires only local anesthesia with minimal complications.
• Infected hydronephrosis with highly resistant organisms represented an add-on problem to obstructive uropathy but PCN can lead to a decrease in antibiotic requisites.

• The lower pre-creatinine level and age represented the most important factors that affects renal recovery after nephrostomy.

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