

Original Research Article

Factors predicting renal recoverability after percutaneous nephrostomy in obstructive uropathy

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Abstract: Obstructive uropathy is one of the commonest urological emergencies. The accurate prediction of the recoverability of kidney function after the release of obstruction is of great clinical value to the urologist. The objective is to evaluate the role of percutaneous nephrostomy in relieving obstruction and improvement of kidney function in patients with obstructive uropathy & various predictive factors to assess recoverability of kidney function in seventy two patients of upper tract obstruction for various causes who needed percutaneous nephrostomy. Following admission all patients of the study population underwent complete urine analysis, urine culture and sensitivity, serum creatinine, and complete blood count, followed by ultrasonography Abdominal ultrasonography (US) was carried out in all patients with special interest to renal size, parenchymal thickness and degree of hydronephrosis. Glomerular filtration rate (GFR) was calculated in these study subjects using the “modification of diet in renal disease” (MDRD) formula. Following percutaneous nephrostomy (PCN) GFR & Serum creatinine was recorded on day1, day3, day7, and day 28 & at the end of 3rd month. In our study, serum creatinine level < 1.5 and GFR > 60 was taken as recoverable group. Correlation of continuous and categorical variables with dependent variable (Post op Serum Creatinine level & Post Op GFR after 3 months) was formulated using spearman correlation and Mann–Whitney U test. Multiple linear regression analysis was performed. The study population includes 72 patients with mean age of 44.65 years in male 38 (52.8%) and female 34 (47.2%). In our study renal and ureteric stone is the commonest (29.17%) cause of obstructive uropathy. Co morbidities like diabetes and hypertension were present in 42 and urinary infection in 14 patients. Co morbidities & presence of infection significantly affecting the renal function recoverability having p value 0.032 & 0.049 respectively. There was a significant decline in the mean creatinine level with gross improvement in urine output at each successive follow ups which was statistically significant (P<0.05). Multiple Regression result suggest with 1 unit change of Pre PCN GFR, cortical thickness (CT), hemoglobin (Hb), creatinine at 3 months post PCN changes significantly. (p<0.05) A correlation was plotted between the resistive index (RI) and serum creatinine values before drainage and at the different points after drainage and it showed a good positive result (R=0.334, P<0.05). However RI & other variables like degree of hydronephrosis, time interval between disease onset & intervention lost their statistical significance in predicting renal function recoverability. Percutaneous nephrostomy is a procedure that has significant implications for the treatment of obstruction in the kidneys. Thus, significant predictors like renal CT, Pre Rx GFR, Pre-Rx urine output, Hb, renal size can provide an index to evaluate residual renal function so that the procedure is done in time to prevent further ongoing damage.

Keywords: Creatinine level, cortical thickness, obstructive uropathy, resistive index, renal size.

INTRODUCTION:

Obstructive uropathy is one of the commonest urological emergencies with an overall incidence of 20% [1]. This condition occurs due to any obstruction to urine flow, resulting in increased pressure within the collecting

system which gives rise to pain, infection, sepsis, and loss of renal function. This potentially life threatening condition requires immediate measures to divert the urine from obstructed kidneys [2]. Retrograde stenting, and percutaneous nephrostomy are the commonly used

methods to relieve the obstructive uropathy of the upper tract [1, 3]. However, patients with ureteral stricture, impacted bilateral ureteral stones, extramural diseases and those with malignancy due to the presence of anatomic deformities, where ureteral compression by JJ stenting or retrograde ureteral catheterization is not possible PCN can be performed easily. The accurate prediction of the recoverability of kidney function after the release of chronic partial obstruction is of great clinical value to the urologist. If pre PCN factors which affect the renal recoverability can be determined then renal damage can be prevented by aggressive management but in those with irreversibly damaged kidney function, it may be preferable to apply nonsurgical management or total removal of the disordered system by nephrectomy.

Methods of predicting the recoverability were studied in past too, which had included various parameter, but most of these were retrospective and included a heterogeneous group of patients. Moreover, radioisotope studies are notoriously inaccurate, especially in the case of high-grade obstruction and could not predict the recoverability of renal function. The cost of radioisotope renography and the availability were the other limiting factors.

The present study has been performed in a prospective manner to evaluate correlation between sonographic features of the kidney, clinical profile of the patient, time interval between appearance of symptoms and PCN performed pretreatment renal parameters like GFR, renal resistive index to predict the recoverability.

SUBJECTS AND METHODS:

This is a prospective study done from October 2014 to June 2016. During this period a total of 72 PCN were performed in our department. Patients of obstructive uropathy with moderate to severe hydronephrosis on account of either supravescical obstruction due to stone, stricture, PUJO; malignancy like prostate, bladder, cervix in whom PCN was feasible were included. Patients known to have chronic kidney disease, Patient having previous stents or PCN drainage. Severe coagulopathy and liver or multisystem failure were excluded from this study. Terminal illness in which position for PCN could not be tolerable by patient

All patients of the study population underwent complete urine analysis, urine culture and sensitivity. Relevant blood parameters including serum creatinine, serum sodium (Na), serum potassium (K) and complete blood count, were accounted followed by the imaging

studies consisting of plain X-ray kidney, ureter and bladder region (KUB), abdominal ultrasonography, non-contrast computer tomography (NCCT) scan (in selected cases). Abdominal ultrasonography (US) was carried out in all patients with special interest to renal size, parenchymal thickness and degree of hydronephrosis renal cortical thickness (CT) was measured from renal capsule to the dilated renal calyx and then average was taken. Glomerular filtration rate (GFR) was calculated in these study subjects using the "modification of diet in renal disease" (MDRD) formula.

After obtaining written consent, PCN was performed under sonographic or fluoroscopic guidance in the prone position to decompress the kidney under local anesthesia. Urine was sent for culture and sensitivity. Urine output from nephrostomy tube was recorded on day1, day3, day7, and day28. In our study, serum creatinine level < 1.5 and $GFR > 60$ were taken as recoverable group. Serum creatinine value above 1.5 and GFR below 60 was considered as poor/no recovery

STATISTICAL ANALYSIS

The post procedure (after 3 months) serum creatinine and GFR was taken as a reference variable to which all other variables were compared. Serum creatinine < 1.5 mg/dl and $GFR > 60$ were taken as recoverable. Renal size, CT, PCN output, pre-PCN GFR , pre PCN resistive Index and hemoglobin were taken as continuous variables and its correlation with a reference variable was formulated using scatter plots with Spearman correlation coefficients. Multiple linear regression analysis was performed to evaluate their significance.

RESULTS

The study population includes 72 patients. Male 38 (52.8%) and Female 34 (47.2%) with mean age of 44.65 years (range 12–76). The cause of obstruction was outlined in Table 1.

Higher grades of hydronephrotic changes were associated with stricture & malignancy diseases as compared to stone diseases. However it's no significance was found on renal function recoverability. ($p=0.76$).

Co morbidities were present in 42 patients of which 8 were diabetics, 22 were hypertensives and 12 suffered from both. Presence of infection as suggested by urine culture was there in 14 patients. Categorical variables significantly affecting the renal function recoverability in the form of rise in GFR are presence of co morbidities & urinary tract infection (UTI)

Table 1: Clinical profile of patients with cause of obstruction

Variables	No (%)
Age (years)	44.65(12-76)
Gender	
Male	38(52.8%)
Female	34(47.2%)
Pre PCN creatinine	
<1.5 mg%	55(76.39%)
>1.5 mg%	17(23.61%)
Indication	
Renal or ureteric stone	21(29.17%)
PUJO	13(18.06%)
Cancer	
(Prostate, bladder, cervix)	25(34.7%)
Stricture	13(18.06%)
Time Interval (days)	12.42(2-45)
Cortical thickness (mm)	10.58(7.62-15)
Renal size (cm)	10.21(8.9-11.6)

Table 2: Correlation between categorical variables and increase GFR (renal recoverability)

		CREATININE 3 MONTH	P value	GFR 3 MONTH	P value
Co morbidity		Median	0.14	Median	0.032
	Present	1.15		42.27	
	Absent	1.05		78.85	

		CREATININE 3 MONTH	P value	GFR 3 MONTH	P value
Urine Infection		Median	0.481	Median	0.049

Pre PCN Cr mean value in case of stone was 7.58 which reduced to 3.340 on D7, in cases of malignancy Pre PCN Cr mean value reduced from 3.5to 1.7583. Drop in creatinine value in cases of stricture was from 6.0667 to 2.533 and that of PUJO from 3.7 to 1.9.

The mean value of serum creatinine before drainage was 5.18 with std deviation of ± 3.53 which reduced to 4.02 ± 2.92 at post op D1, 3.18 ± 2.33 At post op D3, 2.38 ± 1.63 at post op D7 & $1.34 \pm .60$ at 3 months after drainage showing a significance of $p < 0.05$.

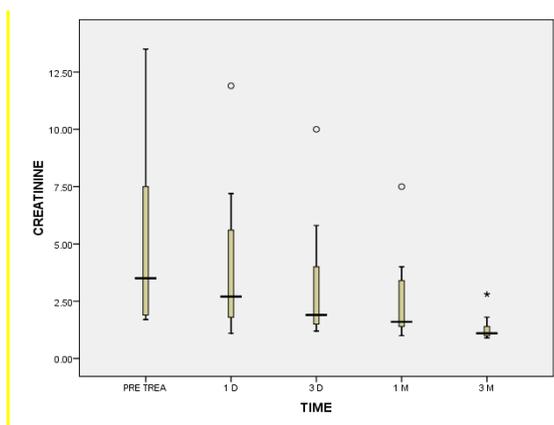


Fig 1: Mean values of serum creatinine and standard deviations before (pre) and at day 1, day 3, day 7 and at 3 months

Following drainage rise in GFR has been from pre-treatment mean value of 19.86 ± 13.85 to 27.03 ± 19.12 on post op D1, 32.51 ± 20.54 on post op D3, 40.41 ± 23.36

on post op D7, 64.36 ± 22.84 on post op 3rd month. Each time there has been significant increment in GFR having p value < 0.05 .

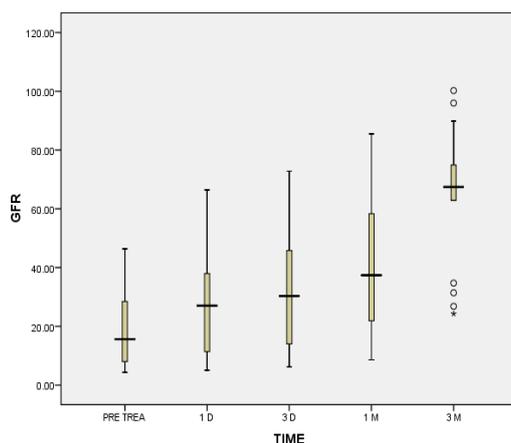


Fig 2: Mean values of serum GFR and standard deviations before (pre) and at day 1, day 3, day 7 and at 3 months

A correlation was plotted between the RI and serum creatinine values before drainage and at the

different points after drainage and it showed a good positive result ($R=0.334$, $P<0.05$)

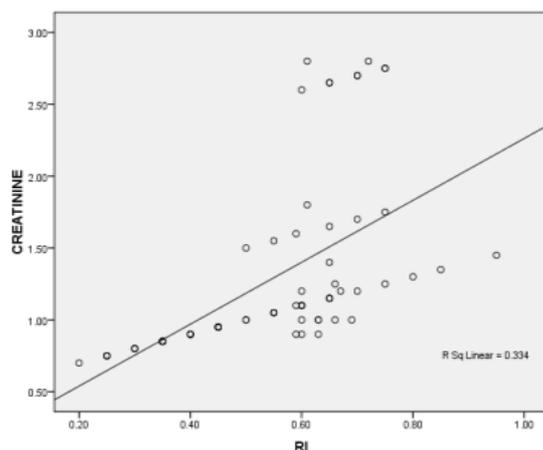


Fig 3: Simple linear regression analysis between RI and serum creatinine ($R=0.334$, $P < 0.05$).

Table 3: Continuous variables affecting recoverability of renal function are summarized in Table III Multiple linear regressions for creatinine at 3 months

Model	Standardized Coefficients		Sig.
	Beta		
PRE Rx GFR	-1.097		.033
RS	.205		.397
CT	-.67		.046
Hb	-.802		.010
PRE Rx urine output	-.731		.056
Pre Rx Resist Index	.747		.124
Time Interval	.369		.089

Regression result suggest with 1 unit change of Pre PCN GFR, CT, HB, creatinine at 3 months post PCN changes significantly ($p<0.05$). It is significantly correlated to Pre PCN urine output at 0.1 level but not at 0.05 levels.

DISCUSSION:

PCN is effective as an initial palliative or temporary means of saving renal function in patients with malignant pelvic ureteric obstruction, despite the fact that it is an invasive procedure. However the procedure improves renal function and renders the

patient relatively fit for further therapeutic management, thus improving the patients' outcome, and possible better quality of life. The decision for PCN insertion depends on the physician for timely referrals and thus early intervention.

In our study following PCN insertion renal biochemical parameters were assessed on post op day 1, 3 & 7 and then at the end of 1st month & 3rd month. There was a significant decline in the mean creatinine level with gross improvement in urine output which was statistically significant ($P < 0.05$).

However several factors can affect recovery of renal function after relief of obstruction, such as patient age, duration of obstruction, function of the contra lateral kidney, pyelolymphatic back flow, and compliance of the ureter and renal pelvis. Other confounding factors include the presence or absence of infection and the use of concurrent nephrotoxic agents and contrast materials. Moreover, the component of dysplasia in the kidney has a major influence on the recovery of renal function, particularly in children.

Most investigators have used radionuclide quantification of renal function to assess renal recoverability. If the relative renographic glomerular filtration rate or effective renal plasma flow has fallen to less than 10%, very little recovery of the kidney function can be expected after relief of obstruction; when it is greater than 10%, kidney function can improve considerably [4-9].

However, renography may be misleading in the setting of acute obstruction and in neonates and young children with chronic severe hydronephrosis [4].

Gillenwater [10] stated that the best method to determine the absolute degree of injury and recoverability is by temporary relieving the obstruction with a PCN tube and monitoring the renal function by the creatinine clearance. Surgical exploration of obstructed kidneys in neonates has been suggested by some investigators to predict the recovery of renal function.

In our study we have determined the recoverability of the renal function by calculating the GFR by MDRD formula due to lack of resources & financial constraints.

New non-invasive predictors of recoverability have been recently suggested such as urinary N acetylglucosaminidase and transforming growth factor-beta [12- 14]. Though further studies needs to be done to establish their clinical usefulness

In clinical practice, various factors like duration of obstruction, age, status of contra lateral kidney,

presence of infection, compliance of renal pelvis can adversely affect the renal function [11].

Obstructive uropathy is not the only cause of RI elevation; it can also increase in cases of renal medical disease [7]. Our study aimed at establishing various factors affecting renal function recoverability so that we can provide the optimum treatment to the desired candidates in a setting with limited resources and also reduce the number of patient procedures overall.

In our study result demonstrated that CT, RS, Pre Rx GFR, Hb, Pre Rx , urine output presence of infection and co morbidity can considerably predict the renal function while other variables like degree of hydronephrosis, time interval between disease onset & intervention did not have any statistical significance.

CONCLUSION:

Percutaneous nephrostomy is a procedure that has significant implications for the treatment of obstruction in the kidneys. Thus, significant predictors like renal CT, Pre Rx GFR, Pre-Rx urine- output, Hb, RS can provide an index to evaluate residual renal function so that the procedure is done in time to prevent further ongoing damage.

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CONFLICT OF INTEREST: Nil

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