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Predisposing factors of kidney function recovery after postrenal obstruction



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ABSTRACT

Background: Renal function recovery in postrenal acute kidney injury (AKI) patient is not always achieved and risk factor for chronic disease. Factors that affect of kidney function recovery include duration of symptoms, AKI stage and degree of hydronephrosis. The aim of the study is to determine the correlation of predisposing factors of renal function recovery in postrenal AKI patient.

Methods: A prospective observational analytic study with a cross-sectional study approach that involves postrenal AKI with urinary tract stones formers from August to November 2017. Renal function recovery was assessed by comparing creatinine levels before obstruction and after obstruction (3rd and 7th day) and be correlated by the duration of symptoms, AKI stage, and degree of hydronephrosis.

Results: 66 patients were included in the analysis of this study. Renal function recovery was found in 29 patients (43.9%) at 3rd day and 47 patients (71.2%) on the 7th-day post obstruction. There was a significant difference in mean creatinine levels before and after obstruction ($p < 0.0001$). Both duration of symptoms, AKI stage, and hydronephrosis showed correlation on renal function recovery on 3rd and 7th day after obstruction ($p < 0.05$). In logistic regression analysis, hydronephrosis was the most correlated predisposing factor for renal function recovery in 3rd and 7th day after obstruction ($p = 0.0001$).

Conclusion: Factors duration of symptoms, AKI stage, and degree of hydronephrosis significant correlated to renal function recovery after post-renal AKI. Degree of hydronephrosis was the most correlated predisposing factors.

Keywords: post-renal AKI, duration of symptoms, AKI stage, degree of hydronephrosis, renal function recovery.

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INTRODUCTION

Acute kidney injury (AKI) is an abrupt reduction in kidney function and encompasses the entire spectrum of the syndrome including acute kidney failure, acute kidney tubular necrosis, and other less severe conditions.¹⁻³ The cause of AKI is divided into prerenal, renal, and postrenal. Postrenal AKI occurs in 5-10% of all cases and is generally caused by the obstruction of the urinary tract.⁴ Improved renal function in postrenal AKI patients can be determined by assessing a decrease in serum creatinine levels.^{5,6} Renal function recovery in postrenal AKI patient is not always achieved and risk factor for chronic disease. Factors that effect of renal function recovery include the duration of symptoms, AKI stage, and degree of hydronephrosis.⁷⁻⁹ In some studies, creatinine levels will return to normal after 7 days after the obstruction is released.⁶

Some of the studies described above do not take into account how long patients are being diagnosed with postrenal AKI to receive surgical intervention while promptness and prompt action can help improve kidney function and even complete renal function recovery.⁶⁻⁹ Furthermore, We sought to determine the correlation of predisposing factors that affect the renal function recovery of patients

with postrenal obstruction. We hypothesised that the degree of hydronephrosis is most correlated with the length of complaints and the degree of hydronephrosis to renal function recovery in post-renal obstructive patients.

METHODS

This study is a prospective observational analytic study with a cross-sectional study approach done in a Dr. Zainoel Abidin General Hospital, Banda Aceh, Indonesia from June 2017 until December 2017. The study includes all postrenal AKI patients who went for surgical intervention for urinary tract stones during a specified period. The total number of patients assessed during this period was 66.

Sampling was done by consecutive sampling in series on all those who went through surgical intervention for urinary stone. The minimal sample size is calculated by sample size formula for an infinite population. Postrenal AKI patients with sepsis, diabetes mellitus, hypertension, and the patient who received therapy with flucytosine, methyl dopa, levodopa, ascorbic acid (vitamin C), barbiturates, cimetidine, and trimethoprim were excluded. The study was performed after getting approval from the Faculty of Medicine Syiah Kuala University Ethics Committee.

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For each patient included in study demographic data was obtained including age & gender, history was noted for comorbidities like diabetes mellitus, hypertension, and heart disease, the location of the obstruction, duration of symptoms and urology ultrasonography to determine the degree of hydronephrosis that performed by one radiologist

was noted on first registration. Laboratories value includes serum Creatinine (Cr) and Uream (Ur) measurement before and 3rd and 7th days after surgical intervention in all patients.

Serum Cr and Ur were measured by using Jaffe method on Thermo Scientific, made in Finlandia, 2014. All included patients already were diagnosed postrenal AKI with urinary tract stone on ultrasound and or CT abdomen without contrast by the urologist. Lab tests of serum Cr and Ur were repeated 3rd and 7th days after surgical intervention. Acute kidney injury stage was defined by KDIGO criteria.¹⁰ The degree of hydronephrosis was defined by ultrasonography examination performed by one radiologist. Renal function recovery was defined as an improvement when Cr decrease > 20% of initial Cr and constant in when Cr range $\pm 20\%$ from initial Cr.¹¹

Data were analysed with SPSS version 17, frequencies were applied for Categorical data and mean \pm SD was used for defining numeric variables. Bivariate analysis was done by using Kruskal-Wallis test and multivariate analysis was done by logistic regression.

RESULTS

A total number of patients included in study were 66. Mean age was 56.41 ± 13.178 with range of 18-87 years. Proportion of male patient was 59.1%. Demographic and baseline data shows frequencies of the bilateral obstruction, >30 days duration of symptoms, AKI stage 3 and grade 4 hydronephrosis were higher. Demographic and baseline data is mentioned in [table 1](#).

Table 1 Demographic and baseline data of study patients

Variable	n=66
Age (Mean \pm SD) (years)	56.41\pm13.178
Sex	
Male	39 (59.1%)
Female	27 (40.9%)
Location of Obstruction	
Unilateral	48 (72.7%)
Bilateral	18 (27.3%)
Duration of Symptoms	
11-20 days	11(16.7%)
21-30days	10 (15.2%)
> 30 days	45 (68.2%)
AKI Stage	
Stage I	13 (19.7%)
Stage II	17 (25.8%)
Stage III	36 (54.5%)
Degree of Hydronephrosis	
Grade 1	0 (0%)
Grade 2	18 (27.3%)
Grade 3	20 (30.3%)
Grade 4	28 (42.4%)

Table 2 Bivariate analysis of predisposing factors of renal function recovery

Predisposing Factors	Renal Recovery		P-value	Renal Recovery		P-value
	3rd day			7th day		
	Improve	Constant		Improve	Constant	
Duration of Symptoms						
11-20 days	9	2	0.0001*	10	1	0.021*
21-30 days	3	6		8	1	
> 30 days	17	29		30	16	
AKI Stage						
Stage I	10	2	0.022*	12	0	0.013*
Stage II	8	13		14	7	
Stage III	11	22		22	11	
Degree of Hydronephrosis						
Grade 2	10	4	0.0001*	12	2	0.001*
Grade 3	11	15		21	5	
Grade 4	8	18		15	11	

*Kruskal-Wallis Test

Table 3 Logistic regression analysis of predisposing factors of renal function recovery

	3rd day	7th day	Logistic Regression (p-value)	
	P value		3rd day	7th day
Duration of Symptoms	0.0001*	0.021*	0.608	0.775
Stage AKI	0.022*	0.013*	0,020 ⁺	0.035 ⁺
Degree of Hydronephrosis	0.0001*	0.0001*	0.0001 ⁺	0.0001 ⁺

*Kruskal-Wallis test (p value <0.05)

+Logistic Regression Model (p value <0.05)

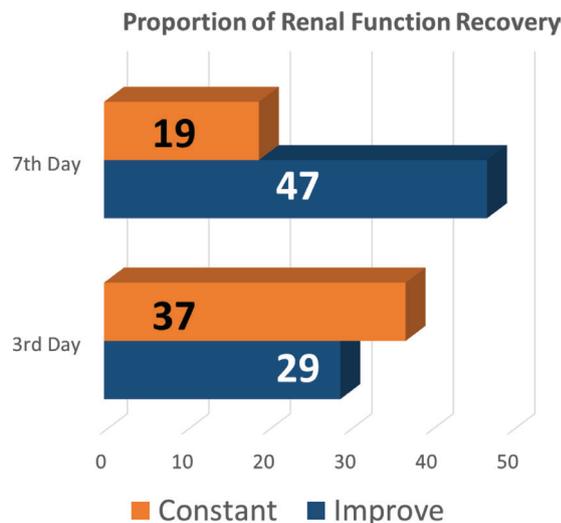


Figure 1 Proportion of renal function recovery

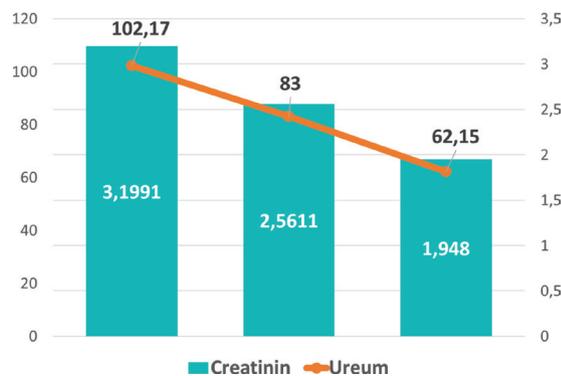


Figure 2 Mean of Creatinine and Ureum Levels

Renal function recovery was found in 29 patients (43.9%) at 3rd day and 47 patients (71.2%) on the 7th-day post obstruction. There was a significant difference in mean creatinine and ureum levels before and after obstruction (p <0.0001). Proportion of renal function recovery and mean creatinine ureum levels is mentioned in figure 1 and 2.

Both duration of symptoms, AKI stage, and degree of hydronephrosis showed correlation on renal function recovery on 3rd and 7th day after obstruction (p <0.05). Bivariate analysis is shown in table 2.

In logistic regression analysis, hydronephrosis was the most correlated predisposing factor for renal function recovery in 3rd and 7th day after obstruction (p =0.0001, respectively). Multivariate analysis is shown in table 3.

DISCUSSION

Urinary tract stones are common and increasing worldwide as shown in a number of studies. Prevalence of stone disease varies from 5-10%.¹² Number of studies has been done earlier to analyse acute kidney injury in stone patients.^{5,6,13-15} This study was done to observe the predisposing factors of renal function recovery in post-renal AKI patients with urinary tract stone and to determine the most correlated the predisposing factor for renal function recovery after surgical intervention.

It will be interesting to note the various pathogenesis contribute to AKI in these patients with urinary tract stones. As a first cause, it is stated that many patients in our study developed stone because of heavy sweating and poor water intake because of logistics at workplace. This may also happen with frequent vomiting with increasing severe episodes of colic. Likewise many continue taking analgesics mostly NSAID under prescription or un-prescribed because of feared loss of labor or again logistics at the workplace being remote or lack of transport availability. The last one refers to the disturbance in pressure dynamics in Bowman’s capsule, activating the cascade of reaction elaborating substances injuring nephron.¹⁶⁻¹⁸

Our results are showing that more unilateral obstruction causes AKI. Post-renal AKI can be caused by various etiologies. One of them is urinary tract stones especially when the stone causes bilateral urinary tract obstruction.¹⁶ Nevertheless, there are several studies that reported decreased renal function in patients with unilateral postrenal AKI.¹⁹⁻²¹

Renal function will gradually improve after surgical intervention by releasing post renal obstruction. In our study, we found that creatinine levels have improved before and the 3rd day and 7th day after the obstruction is released (mean creatinine: 3.1991±1.0401 mg/dL, 2.5611±0.8549 mg/dL, 1.948±0.7419 mg/dL, respectively). This is same as already reports from Mahmud et al. mention that renal function will gradually improve after surgical intervention by releasing post renal obstruction.²²

Our study showed that both duration of symptoms, AKI stage, and hydronephrosis showed correlation on renal function recovery on the 3rd and 7th day after obstruction. But, several studies

that contained the duration of symptoms in patients with postrenal AKI did not evaluate the association of duration of symptoms with renal function recovery.^{23,24} Matsuki et al. reported there was an improvement in renal function (serum creatinine) of 52.89% before and after surgical intervention.²¹ It also mirrors older experimental observations showing that unilateral nephrectomy, a surrogate for loss of nephrons by disease, compromises structural recovery and worsens tubulointerstitial fibrosis after ischemic AKI. Moreover, review of a substantial body of work on the relationships among reduced renal mass, hypertension, and pathology associated with these conditions suggests that impaired myogenic autoregulation of blood flow in the setting of hypertension, the arteriosclerosis that results, and associated recurrent ischemic AKI in microscopic foci play essential roles in the development of progressively increasing tubulointerstitial fibrosis.²⁵

Gillen et al. showed a correlation of degree of hydronephrosis with renal function recovery in patients undergoing percutaneous nephrostomy.²⁶ Another study also showed 56.6% of patients undergoing percutaneous nephrostomy with hydronephrosis experienced improved post-action renal function.²⁷ The study is in line with findings in our study where the degree of hydronephrosis is the most correlated predisposing factor for renal function recovery in post-renal AKI patient after post renal obstruction.

Several studies have shown similar results in this study where changes in renal structure in this case hydronephrosis can be used as predictors of renal function recovery.^{26,28–32} A more massive hydronephrosis degree leads to more inferior renal function improvement and poor functional outcomes in patients with post-renal AKI.

Limitations of the study

It is a single-centre study with relatively less number of patients. This study also did not conduct an assessment of renal function based on estimated glomerulus filtration rate (Cockcroft Gault) so that it can cause bias due to lack of adjustment of kidney function associated with age, weight, and height. This study also did not adjust to several factors that have been known to affect the renal function recovery such as obstruction type (unilateral or bilateral) and stone type. Another limitation of this study is the low level of patient education. This condition makes it difficult for researchers to obtain a more valid primary data based on interview results, especially for the duration of symptoms.

CONCLUSIONS

Factors duration of symptoms, AKI stage, and degree of hydronephrosis significant correlated to renal function recovery after post-renal AKI. Degree of hydronephrosis was the most correlated predisposing factors.

CONFLICT OF INTEREST

The author declares there is no conflict of interest in this study.

FUNDING

The current study doesn't receive any specific grant from government or any private sectors.

ETHICAL CONSIDERATION

This study has been approved by the Ethical Committee Faculty of Medicine Universitas Syiah Kuala/Zainoel Abidin Hospital, Banda Aceh, Indonesia.

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