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The Relationship of Pre- and Post-Operative Kidney Function and The Degree of Hydronephrosis Caused by Stones and Malignancy in Patients who Have Had A DJ Stent Installed

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ABSTRACT

Aim: This study aims to assess the relationships between ureum, creatinine, GFR and the degree of hydronephrosis, both before and after DJ stent installation. This study also assess the association between ureum, creatinine and GFR before and after the DJ stent placement. **Methods:** An analytical observational study with a cross-sectional design was conducted. Patients with hydronephrosis caused by urinary stones in RSUD Ulin Banjarmasin during 1 January 2022 until 31 January 2023 were included. Renal function (ureum, creatinine, GFR) and degree of hydronephrosis data were collected. **Results:** A total of 37 patients were included. Most of them (76,3%) were <60 years old and males (60.5%). There were no significant relationships between ureum, creatinine, and GFR and the degree of hydronephrosis, both before and after DJ stent installation (p> 0.05). There was no significant differences between ureum, creatinine and GFR before and after DJ stent placement. **Conclusion:** There is no significant relationship between kidney function and the degree of hydronephrosis caused by urinary stones.

Keywords: hydronephrosis, ureum, creatinine, GFR, DJ stent.

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INTRODUCTION

The prevalence of nephrolithiasis cases in Asia is around 1–19.1% of the population. The numbers vary based on socio-economic status and geographic location. In Indonesia, the problem of urinary tract stone is still the most common among all urological cases, but there is no national data of the prevalence. Urinary stones that may get stuck in the kidney or urinary tract cause obstruction to the outflow of urine causing an increase in hydrostatic pressure of the collecting system.[1]

Hydronephrosis is a condition that can develop anywhere in the urinary tract, kidney, or meatus urethra. It is caused by anatomical or functional mechanisms that obstruct the flow of urine. Changes in renal blood flow, tubular blood flow, and glomerular filtration

function may result from this rise in ureteral pressure. Most patients with hydronephrosis occur due to small urolithiasis and can be treated by observing and administering acetaminophen. More serious cases with intractable pain may require drainage by placing a Double J nephrostomy or percutaneous stent.[1,2]

Assessment of renal function is important in the treatment of patients with renal disease or pathology affecting renal function. The most used endogenous marker for assessing glomerular function is creatinine. The calculated creatinine clearance is used to provide an indicator of glomerular filtration rate/GFR. The blood urea to creatinine ratio is associated with a decrease in serum creatinine after urinary diversion procedures in obstructive uropathy characterized by hydronephrosis.[1,3]

METHODS

This research was an analytical observational study with cohort retrospective design. The study was conducted following an ethical clearance certificate from Lambung Mangkurat University's Faculty of Medicine and Health Sciences' Health Research Ethics Committee. Thirty-seven patients diagnosed with stones and/or malignancy-induced hydronephrosis in the Surgery Department from January 1, 2022, to January 31 2023 at Ulin Banjarmasin Regional Hospital were included to the study.

The patients used for the study were aged ≥18 years with a diagnosis of hydronephrosis due to urinary tract stones. It was detected using imaging methods (CT-scan and/or USG). Patients had a DJ stent installed and complete examination results data.

Analysis of the relationship between kidney function and degree of hydronephrosis was carried out using the binomial logistic regression test. We used paired t-test in normal distributed data or Wilcoxon test in not normal to analyse the difference of renal function before and after the DJ stent installation. Relative risk and 95% confidence interval 95% were presented. P value less than 0.05 was statistically significant. The statistical analysis was performed using SPSS 26 software.

RESULTS

This study included a total of 37 patients. The majority (76.3%) of patients were <60 years old dan 60.5% were male. The highest degree of hydronephrosis found in patients was grade I (37.8%) (Table 1).

Table 1. Demographic data of research subjects

Variable	n	%
Age		
< 60 years	29	76.3%
> 60 years	9	23.7%
Sex		
Female	15	39.5%
Male	23	60.5%
Degree of hydronephrosis		
I	14	37.8%
II	4	10.8%
III	12	32.4%
IV	7	18.9%

The degree of hydronephrosis before and after DJ stent installation was presented in Table 2. There was a decrease in the proportion of patients with bilateral and unilateral hydronephrosis and an increase in the proportion of patients without hydronephrosis.

Degree of hydronephrosis were regroup to mild (I and II) and severe (III and IV) degree because the number of subjects in each degree was small. Binomial logistic regression test was carried out to analyse the relationship between kidney function and degree of

hydronephrosis before DJ stent installation (Table 3 and 4).

Table 2. Degree of hydronephrosis before and after DJ stent installation

Degree of hydronephrosis	Before DJ stent N(%)	After DJ stent N(%)
Without hydronephrosis	0 (0.0)	10 (27.0)
I	14 (37.8)	4 (10.8)
II	4 (10.8)	14 (37.8)
III	12 (32.4)	7 (18.9)
IV	7 (18.9)	2 (5.4)

Table 3. Ureum, creatinine and GFR levels are based on the degree of hydronephrosis before DJ stent installation

Independent Variable	Mild HN Median (min-max)	Severe HN Median (min-max)
Ureum (mg/dl)	36 (17-56)	39 (24-131)
Creatinine (mg/dl)	1.37 (0.42-3.21)	2.2 (0.5-13.35)
GFR (ml/min1/73 m^2)	47.84 (19.35-125.23)	32.58 (4.92-118.17)

Before DJ stent installation, the creatinine level tends to be higher in patients with severe compared to mild HN degree. On the contrary, the GFR tends to be lower in patients with mild HN degree.

Table 4. Relationship between urea, creatinine and GFR levels with the degree of hydronephrosis before DJ stent installation

Independent Variable	RR	95%CI	p
Ureum (mg/dl)	1.03	0.99-1.07	0.11
Creatinine (mg/dl)	1.77	0.98-3.18	0.06
GFR (ml/min1/73 m^2)	0.98	0.96-1.00	0.07

Before to DJ stent installation, an increase in urea and creatinine levels of 1 mg/dl was associated to an increase in the likelihood of severe HN. A 2% decrease in the incidence of severe HN was associated to a 1 mL/min increase in GFR prior to DJ stent installation. However, these association were not statistically significant (Table 4).

The relationship between kidney function and the degree of hydronephrosis after DJ stent installation was analyzed using a multinomial binomial logistic regression test. These relationships and the results of the analysis are shown in Table 5 and 6.

After DJ stent installation, the levels of ureum and creatinine tend to be higher in patients with severe HN compared to mild HN. In contrast, GFR tends to be lower in patients with severe HN.

Table 5. Ureum, creatinine and GFR levels are based on the degree of hydronephrosis after DJ stent installation

Independent Variable	Without HN Median (min-max)	Mild HN Median (min-max)	Severe HN Median (min-max)
Ureum (mg/dl)	22 (14-29)	23 (14-55)	36.5 (18-98)
Creatinin (mg/dl)	1.14 (0.23-1.23)	1.19 (0.67-3.56)	1.32 (0.65-8.08)
GFR (ml/min1/73 m^2)	69.38 (48.90-228.41)	58.92 (22.46-104.48)	41.36 (8.13-90.90)

Table 6. Relationship between urea, creatinine and GFR levels with the degree of hydronephrosis after DJ stent installation

Independent Variable	RR	95%CI	p
Mild HN vs Without HN			
Ureum (mg/dl)	1.05	0.92-1.20	0.45
Creatinine (mg/dl)	7.04	0.46-107.91	0.16
GFR (ml/min1/73 m^2)	0.97	0.94-1.01	0.11
Severe HN vs Without HN			
Ureum (mg/dl)	1.12	0.98-1.29	0.09
Creatinine (mg/dl)	12.73	0.79-203.86	0.07
GFR (ml/min1/73 m^2)	0.94	0.90-0.99	0.01

After DJ stent installation, an increase in GFR of 1 ml/minute increased risk of mild HN by 3% and a 6% risk reduction of severe HN compared to without hydronephrosis (Table 6). Urea, creatinine and GFR levels did not show significant differences before and after DJ stent installation ($p > 0.05$) based on the Wilcoxon test results (table 7).

Table 7. Comparation of urea, creatinine and GFR levels before and after DJ stent installation

Variable	Before	After	P Value
Urea (mg/dl)	40.84±24.51	42.81±26.69	0.57
Creatinine (mg/dl)	2.55±2.55	2.30±2.56	0.38
GFR (ml/min/1.73 m^2)	48.21±33.04	51.04±28.82	0.32

DISCUSSION

In this study, the majority of patients were <60 years old and male. The highest degree of hydronephrosis found in patients was grade I (37.8%). Hydronephrosis is more common in women aged 20-60 years due to pregnancy and gynecological malignancies. For the age group over 60 years, this disease is more common in men due to prostate disease and its complications.[1,9]

Four categories comprise the Society of Fetal Urology's (SFU) categorization scheme for hydronephrosis; Level 1: only the renal pelvis enlarged. Dilation of the main calyces and renal pelvis is grade 2. Major and minor calyces, as well as the renal pelvis, are enlarged in grade 3. Grade 4: weakening of the renal parenchyma and expansion of the renal pelvis and whole calyx. According to a study at Yemen's Amran Hospital by Alshoabi SA et al., 44.64% of HN was found in the left and 55.36% in the right kidney. Grade 2 HN affected 58% of patients, followed by grade 3 (21.5%), grade 1 (11.6%), and grade 4 (8.2%).[2,9,10]

According to this study, before DJ stent installation, an increase of 1 ml/min GFR was associated with a 2% reduction in the risk of experiencing grade 3 and 4 HN, but this relationship was also not statistically significant. A study by Shehab et al. study split the patient into two groups: group 1 received ureteral stent placement, while group 2 received other forms of care. Prior research has demonstrated the utility of renal GFR as a gauge for improved renal function following ureteral stenting. Compared to 61 kidneys (66.3%), 56 (71.8%) in group 1 had much

better kidneys. The statistically significant association were found in group 2 between renal perfusion and renal recovery as well as between parenchymal thickness and recovery in both groups. The association between degree of corticomedullary differentiation and recovery and hemoglobin levels between presentation and recovery were also found to be statistically significant.[3,8,11]

A study at Cipto Mangunkusumo Hospital in Jakarta reported a statistically significant correlation between the success of DJ stent implantation and the ratio of blood urea to serum creatinine, where there was a decrease in both parameters. In cases of obstructive uropathy with hydronephrosis, the blood urea to creatinine ratio is associated to a decrease in serum creatinine following urinary diversion treatments. Changes in the blood urea and creatinine ratio, which is used to gauge the severity of renal impairment in patients, could be the result of treatment delays in presenting patients. In addition, Renal parenchymal thickness and blood urea were found to have a statistically significant relationship with serum creatinine in good surgical outcomes as evidenced by a decrease in postoperative creatinine.[4,12,13] This study found that the increase of urea and creatinine level and decrease of GFR associated with HN risk, however the results were not statistically significant.

Prior research reported increase GFR following obstruction removal.[5,19,20] Meanwhile, there was no significant association between kidney function and the degree of HN, before and after DJ stent installation in this study. This may because of the difference time when the ultrasound was performed and the kidney function samples were taken. That may also because of the differences in the homogeneity and distribution of data.

Study by Goertz and Lotterman[20] reported a correlation between the size of ureteral stones on CT scan and the degree of HN seen on focused emergency ultrasonography.[14,15] Sasmaz et al.[19] found that a higher percentage of ureteral stones larger than 5 mm was associated to higher degree of HN on ultrasonography.[19] The majority of study participants had mild or non-existent HN; these individuals also typically had larger ureteral stones. When used in the emergency room, ultrasonography had a specificity of 78.5% for detecting no or mild HN and an 87.6% negative predictive value for ureteral calculi ≤5 mm. The requirement for CT would be reduced by 73% if it were not done in all patients without or with mild HN, as stones <5 mm usually pass naturally.[16,17,18]

Not significant result in this study might also due to confounding factors such as diabetes nephropathy as comorbid disease. Diabetic nephropathy, one of diabetes mellitus complication, affects the normal function of the kidneys in removing waste products and extra fluid from the body. Diabetic nephropathy slowly damages the kidney's filtering system. Faster treatment can prevent or slow this condition and lower the chance of complications. Diabetic kidney disease can cause kidney failure. This is also called end-stage renal disease.[6,21,22]

Serum creatinine is currently one of the most significant indicators of renal function. Creatinine can be filtered through the glomerulus because of its small size and rarely absorbed in the renal tubules. The majority of creatinine is eliminated through urine. When a person has renal failure, their body builds up creatinine, which can be harmful. Kidney function is reflected in the estimated glomerular filtration rate, or eGFR. This measure of the glomerulus's filtering capacity in milliliters per minute is used to evaluate the kidneys' capacity to eliminate metabolic waste

from the body. Serum creatinine has certain limitations as an indication, nevertheless. Serum creatinine, in particular, is not a timely or reliable indicator of renal function. Only when a significant portion of the kidney is pathologically damaged and the glomerular filtration rate is decreased by more than 50% does an increase in serum creatinine become clinically apparent. As a result, in the early stages of the disease, serum creatinine does not accurately represent changes in renal function.[8,25]

CONCLUSION

There is no relationship between kidney function and the degree of hydronephrosis caused by stones in hydronephrosis patients who have had DJ stents installed. There is no significant difference between urea levels, creatinine levels, and GFR before and after DJ stent installation in patients with hydronephrosis due to stones.

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DISCLOSURE

There were no known competing financial interests or interpersonal ties that would have seemed to have an impact on this paper's work report.

This article have the ethical clearance from The Health Research Ethics Commission of the Faculty of Medicine at Lambung Mangkurat University in Banjarmasin, Indonesia, has deemed this study to be ethically feasible. (UP–KTI No. 046/KEPK-FK ULM/EC/IV/2024.

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