

PROGNOSIS OF OBSTRUCTIVE NEPHROPATHY PATIENTS AFTER PERCUTANEOUS NEPHROSTOMY

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ABSTRACT

Objectives: To determine factors that can predict decrease in creatinine levels after percutaneous nephrostomy (< 2 mg/dl).

Material & methods: This is a retrospective analytic study. We analyzed 117 patients that underwent nephrostomy at Sardjito General Hospital Yogyakarta, from January 2009 to December 2012. The data were analyzed to evaluate the relationship between reduction of serum creatinine level and following variables including etiology, nephrostomy side (unilateral or bilateral), symptom duration (≤ 14 days or > 14 days), comorbid disease (hypertension, diabetes mellitus, heart disease) and degree of hydronephrosis (mild, moderate and severe). The data were analyzed with Chi-square test and multiple logistic regression to obtain predictive factors and predictive scoring equation to measure the possibility of renal function recovery after nephrostomy. **Results:** The relationship between reduction of serum creatinine level and the following variables, nephrostomy (unilateral or bilateral) ($p = 0.000$), symptom duration ($p = 0.000$), hypertension ($p = 0.004$) and degree of hydronephrosis ($p = 0.000$). Whereas etiology of urinary obstruction and other comorbid diseases showed no relationships. Predictive equation result: $P = 1/(1+ey)$, where $y = -0.271 + 1.636$ (degree of hydronephrosis) + $((-2.216)$ unilateral or bilateral nephrostomy) + 1.694 (symptom duration) + $((-0.862)$ hypertension), with sensitivity 74.3% and specificity 70.7% in predicting renal function recovery. **Conclusions:** Bilateral or unilateral nephrostomy, symptom duration, hypertension and degree of hydronephrosis are factors affecting the decrease in serum creatinine level. Their role as independent predictors for recovery of renal function can be considered.

Key words: Obstructive uropathy, percutaneous nephrostomy, multiple logistic regression.

ABSTRAK

Tujuan: Menentukan faktor yang dapat memprediksi pengurangan level kreatinin setelah nefrostomi perkutan (< 2 mg/dl).

Bahan & cara: Penelitian ini adalah studi analitik. Kami menganalisa 117 pasien yang dilakukan nefrostomi sebelumnya di RSU Dr. Sardjito Yogyakarta, dari bulan Januari 2009 sampai Desember 2012. Data dianalisa untuk mengevaluasi hubungan antara reduksi kadar serum kreatinin dan variabel berikut termasuk etiologi, nefrostomi (unilateral atau bilateral), durasi gejala (≤ 14 hari atau > 14 hari), penyakit komorbid (hipertensi, diabetes melitus, penyakit jantung) dan derajat hidronefrosis (ringan, sedang dan berat). Data dianalisa dengan tes Chi-Square dan multiple logistic regression untuk mendapatkan faktor prediktif dan persamaan nilai prediktif untuk mengukur kemungkinan pemulihan fungsi ginjal setelah nefrostomi. **Hasil:** Hubungan antara pengurangan kadar serum kreatinin dan variabel yang mengikuti, nefrostomi (unilateral atau bilateral) ($p = 0.000$), durasi gejala ($p = 0.000$), hipertensi ($p = 0.004$) dan derajat hidronefrosis ($p = 0.000$). Etiologi obstruksi urin dan penyakit komorbid lain menunjukkan tidak ada hubungan. Hasil persamaan prediktif: $P = 1/(1+ey)$, where $y = -0.271 + 1.636$ (derajat hidronefrosis) + $((-2.216)$ nefrostomi unilateral atau bilateral) + 1.694 (durasi gejala) + $((-0.862)$ hipertensi), dengan sensitivitas 74.3% dan spesifisitas 70.7% dalam memprediksi pemulihan fungsi ginjal. **Simpulan:** Nefrostomi bilateral atau unilateral, durasi gejala, hipertensi dan derajat hidronefrosis adalah faktor yang mempengaruhi pengurangan kadar serum kreatinin. Mereka berperan penting sebagai prediktor independen untuk memprediksi pemulihan fungsi ginjal yang dapat dipertimbangkan.

Kata kunci: Uropati obstruktif, nefrostomi perkutan, multiple logistic regression.

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INTRODUCTION

Pyonephrosis is a threatening condition in case of urinary tract obstruction and infection with purulent discharge in the kidney. Further complication in untreated conditions is septicemia or septic shock. It is life-threatening condition, especially in patients with comorbid disease. Intravenous antibiotics and immediate decompression is a treatment that should be done.¹

Treatment in acute phase of infected upper urinary tract obstruction is drainage. Definitive treatment can be performed simultaneously. If it is not possible to perform definitive therapy (in case of renal insufficiency, infection, and complete obstruction) the main initial treatment is decompression of upper urinary tract obstruction.² Drainage options are insertion of ureteric stent and percutaneous nephrostomy. In the case of patients who require immediate decompression, percutaneous nephrostomy procedure is an option. Watson reported good results in 315 patients with percutaneous nephrostomy.³

Percutaneous nephrostomy is an important procedure in case of urinary tract obstruction and uremia with septicemia.^{4,5} Nephrostomy procedure is a temporary diversion prior to definitive treatment.^{4,6} Nephrostomy can also be a choice of permanent urinary diversion.⁵ This procedure was first performed in 1955.⁶ Kehinde et al. (1993) reported 106 patients who underwent percutaneous nephrostomy (74 non-malignant and 32 malignant patients) within 1 week 24 patients (22%) had serum creatinine levels decrease to normal (0.6-1.3 mg/dl), 52 patients (49%) improved but not to normal levels, and 5 patients (4%) showed no change or worsened (25 other patients had normal creatinine when performed percutaneous nephrostomy).⁴ Study by Ahmed et al (2002), in 32 patients with post-nephrostomy (mean of 8.4 ± 4.4 pre-nephrostomy creatinine mg/dl) showed a decrease in serum creatinine of 4.7 ± 3.8 mg/dl after 3 days and 3.6 ± 3.7 mg/dl after 7 days. There was no significant decrease 2 and 4 weeks after nephrostomy.⁷

Several factors influencing improvement of renal function after nephrostomy include: patient age, duration of obstruction, contralateral kidney function, pyelolymphatic backflow and compliance of ureter and renal pelvis. Comorbid factors include factors such as infection, nephrotoxic agents and contrast materials.^{7,8} Improvement of renal function is characterized by a decrease in the patient's serum creatinine levels after nephrostomy. Value of serum

creatinine 2 mg/dl are borderline for categorisation of renal insufficiency, so the value is used as a parameter of renal function improvement after treatment.^{9,10}

Percutaneous nephrostomy is a routine procedure in Sardjito General Hospital Yogyakarta. The objective is to assess factors that can predict the decrease in serum creatinine levels (< 2 mg/dl) after percutaneous nephrostomy in obstructive nephropathy patients in 2009-2012. Treatment of upper urinary tract obstruction is an important procedure to preserve renal function. Percutaneous nephrostomy is a therapeutic modality in patients with infected obstructive uropathy with decompression and drainage purposes to prevent septicemia and urosepsis. Previous studies indicate that several factors can affect the improvement of renal function after treatment of obstruction. Study is required to determine the influence of nephrostomy in predicting renal function improvement after treatment.

OBJECTIVE

To determine factors that can predict the decrease in creatinine levels after percutaneous nephrostomy (< 2 mg/dl).

MATERIAL & METHODS

The research design used in this study is a retrospective analytic study with case-control studies from medical records of Sardjito General Hospital Yogyakarta to determine factors that affect improvement of renal function after percutaneous nephrostomy and assess the extent of the role of these factors in predicting improvement in serum creatinine. There were 117 patients who underwent nephrostomy in Sardjito General Hospital Yogyakarta in 2009-2012. Inclusion criteria were patients with complete medical records and percutaneous nephrostomy patients on the indication of obstructive uropathy. Patients with obstructive uropathy who were performed treatments other than nephrostomy (ureteral stent insertion or definitive treatment) were excluded. The analysis used Chi-square and multivariate logistic regression analysis.

RESULTS

The study included 117 patients with a mean age of 50 years (range 23-74 years). Forty-nine male patients (41.9%) and 68 female patients

(58.1%). The cause of obstruction in 46 patients (39.4%) was benign and 71 patients (60.6%) caused by malignant disease (table 1 and 2).

Table 1. Benign etiology of obstructive uropathy.

Indication	n	(%)
Stone	43	93.5
Ureter stenosis	2	4.3
Pelviureteric junction obstruction	1	2.2

Table 2. Malignant etiology of obstructive uropathy.

Indication	n	(%)
Cervix cancer	40	56.3
Bladder cancer	14	19.7
Prostate cancer	1	1.4
Colon cancer	2	2.8
Ovarian cancer	2	2.8
Rectal cancer	8	11.3
Endometrial cancer	1	1.4
Intraabdominal tumor	3	4.2

Mean serum creatinine before the procedure was 9.34 ± 1.23 mg/dl. After 3 days postnephrostomy serum creatinine decreased significantly to 5.23 ± 0.67 mg/dl ($p = 0.000$). Serum creatinine decreased significantly after 6 days to 4.65 ± 0.67 mg/dl ($p = 0.000$) (table 3 and figure 1).

The decrease in serum creatinine was highest in the first 3 days postnephrostomy, with a mean decrease of 4.19 ± 0.94 mg/dl. After that until the sixth day of the decrease occurred only 0.56 ± 0.43 mg/dl (table 4).

Several variables related to nephrostomy were extracted and analyzed. These variables include: etiology (malignant or benign), nephrostomy side (bilateral or unilateral), duration of symptoms of (≤ 14 days and > 14 days), history of comorbidities (hypertension, diabetes mellitus, heart disease), grade of hydronephrosis (table 5). Analysis was performed on these variables (Chi-square test) to assess the factors that affect the decrease in serum creatinine.

Seven variables were analyzed and four variables showed significant association ($p < 0.05$)

Table 3. Mean serum creatinine values before and after nephrostomy.

	Mean	CI (95%)	p
Pre-nephrostomy (Cre I)	9.34	± 1.23	*
Postnephrostomy day 3 (Cre II)	5.23	± 0.67	0.000
Postnephrostomy day 6 (Cre III)	4.65	± 0.67	0.000

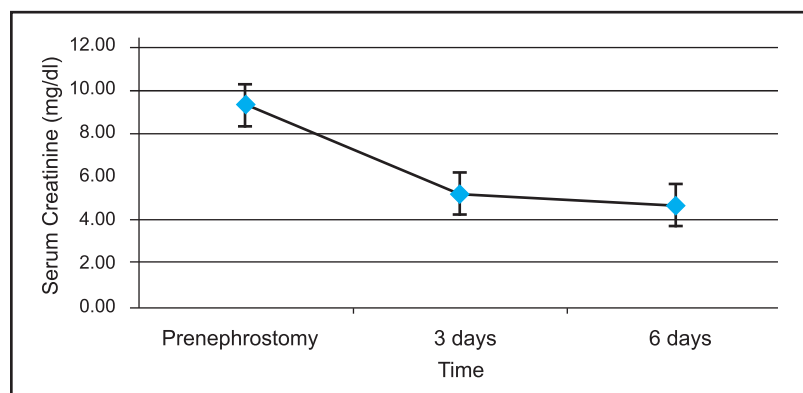


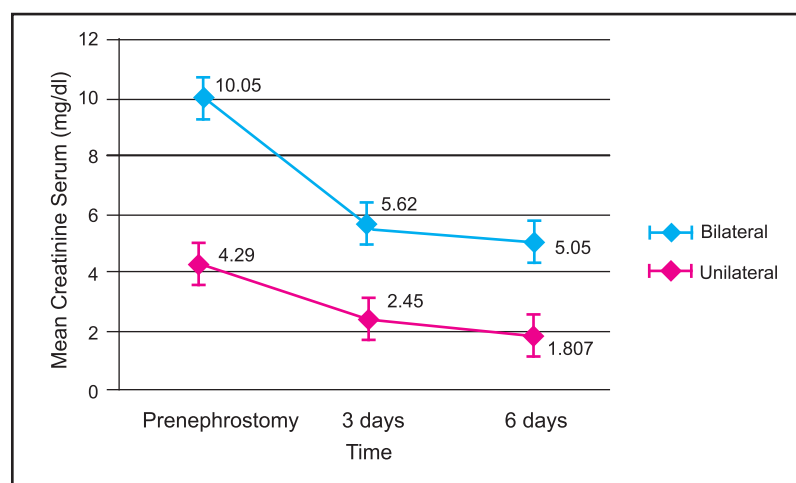
Figure 1. Mean serum creatinine and CI (95%) before and after nephrostomy.

Table 4. Mean decrease in serum creatinine before and after nephrostomy.

Difference	Mean (mg/dl)	CI (95%)	p
Cre I – Cre II	4.19	3.25 – 5.13	0.000
Cre I – Cre III	4.75	3.78 – 5.72	0.000
Cre II – Cre III	0.56	0.13 – 0.99	0.008

Table 5. Factors that might affect the decrease in serum creatinine after nephrostomy.

Variable		Postnephrostomy creatinine		p
		< 2 mg/dl	≥ 2 mg/dl	
Etiology	Malignant	18	53	0.151
	Benign	17	29	
Side of nephrostomy	Bilateral	24	79	0.000
	Unilateral	11	3	
Duration of symptoms	≥ 14 days	31	52	0.000
	> 14 days	4	30	
History of hypertension	Yes	10	50	0.004
	No	25	32	
History of diabetes mellitus	Yes	0	4	0.575
	No	35	78	
History of heart disease	Yes	1	4	1.000
	No	34	78	
Grade of hydronephrosis	Mild	10	4	0.000
	Moderate	18	34	
	Severe	7	44	

**Figure 2.** Mean decrease of serum creatinine based on side of nephrostomy.

with decrease in serum creatinine levels after nephrostomy (creatinine < 2 mg/dl), among others: bilateral or unilateral nephrostomy ($p = 0.000$), duration of symptoms ($p = 0.000$), history of hypertension ($p = 0.004$) and pre-nephrostomy grade of hydronephrosis ($p = 0.000$). While the etiology and comorbidities (diabetes and heart disease) have no role in the decrease of serum creatinine.

Bilateral nephrostomy patients with initial creatinine mean value 10.05 mg/dl decreased on the

sixth day to 5.05 mg/dl. But the value never goes down < 2 mg/dl. The opposite occurs in patients with unilateral nephrostomy (Figure 2). Duration of symptoms experienced by patients until time of nephrostomy was also associated with a decrease in serum creatinine after nephrostomy. Patients with symptom duration ≤ 14 days was found to experience a significant drop from the mean value 8.13 mg/dl to 3.82 mg/dl (day 6 post-nephrostomy). Whereas in patients with symptom duration > 14 days, the mean

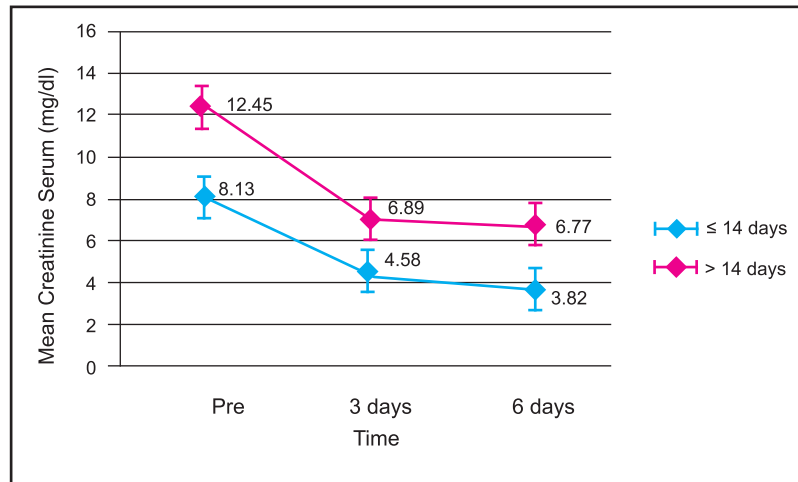


Figure 3. Mean decrease of serum creatinine based on duration of symptoms.

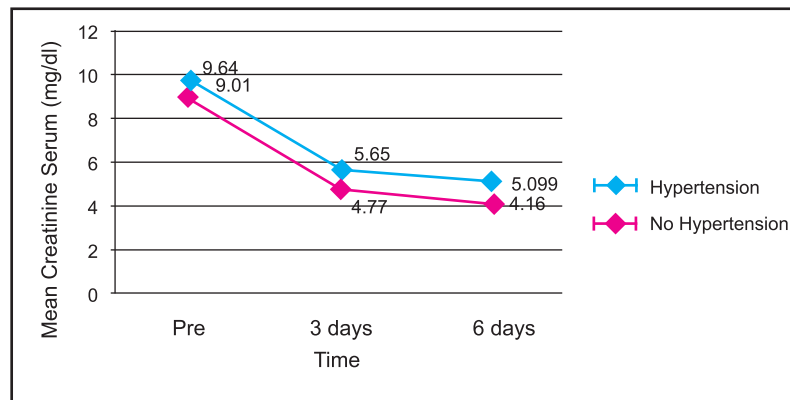


Figure 4. Decrease of serum creatinine based on history of hypertension.

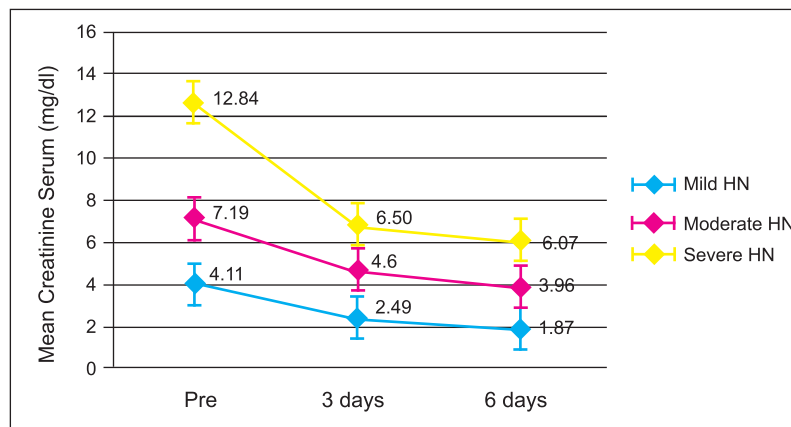


Figure 5. Decrease of serum creatinine based on grade of hydronephrosis.

value decreased from 12.45 mg/dl (prenephrostomy) to 6.77 mg/dl (day 6 postnephrostomy) (Figure 3).

History of hypertension had a relationship with a decrease in serum creatinine. Patients with a history of hypertension tend to show decrease in

serum creatinine relatively longer compared with no history of hypertension. On the sixth day mean serum creatinine of patients with a history of hypertension of 5.09 mg/dl, while patients without hypertension 4.16 mg/dl (Figure 4).

Pre-nephrostomy patients with mild grade of hydronephrosis the mean serum creatinine decreased to 1.87 mg/dl on the 6th day. Whereas in patients with moderate and severe grade mean serum creatinine decreased to 3.96 mg/dl and 6.07 mg/dl. This may also be affected by high levels of pre-nephrostomy creatinine in patients with moderate and severe grade of hydronephrosis (mean 7.19 mg/dl and 12.84 mg/dl) so it takes a longer time to reach the levels of creatinine < 2 mg/dl (Figure 5).

The significant factors were then analyzed with multiple logistic regression to see their role in decreasing serum creatinine if these factors exist either all or some of the factors.

Results of multiple logistic regression test produces a prediction formula, $P = 1 / (1 + e^y)$, where $y = -0.271 + 1.636$ (degrees of hydronephrosis) + $((-2.216)$ nephrostomy unilateral or bilateral) + 1.694 (duration of symptoms) + $((-0.862)$ hypertension) with sensitivity 74.3% and specificity 70.7%.

The prediction formula helps in calculating probability of patient to achieve post-nephrostomy serum creatinine < 2 mg/dl. In the particular case when all four factors were present (patients with mild hydronephrosis grade, unilateral nephrostomy, duration of symptoms ≤ 14 days and no hypertension), the probability to experience a decrease in serum creatinine to < 2 mg/dl is 50.47%.

DISCUSSION

Several factors influence the improvement of renal function after nephrostomy including patient age, duration of obstruction, the contralateral kidney function, pyelolymphatic backflow, ureter and renal pelvis compliance. Other factors that may affect are infections, nephrotoxic agents and contrast materials.^{7,8} Recently, there is no single best method that can evaluate the improvement of renal function after treatment of obstruction.

In this study, the clinical parameters studied were side of nephrostomy, duration of symptoms, comorbidities (hypertension, diabetes mellitus, heart disease) and grade of hydronephrosis. Analysis of the data obtained significant results on the relationship between the decrease in serum creatinine levels (< 2 mg/dl) with side of nephrostomy, duration of symptoms, hypertension and grade of hydronephrosis.

In the group of unilateral nephrostomy, the improvement in renal function is more significant

than bilateral nephrostomy. This is due to improvement in renal function was also affected by the condition of the contralateral kidneys.¹⁸ In unilateral obstruction, when the contralateral kidney has undergone compensatory hypertrophy it is believed that the function of obstructed kidney will not return. But the latest research results prove that improvements can occur despite severely impaired renal function.^{8,11} It is also influenced possibly by pre-nephrostomy serum creatinine in unilateral nephrostomy group where the value is lower than the group of bilateral nephrostomy.

Improvement of renal function is inversely proportional to the length of obstruction.⁸ The longer the obstruction the worse the renal function. In this study, the duration of symptoms is defined as the time when the alleged onset of obstruction until nephrostomy. In patients who underwent nephrostomy ≤ 14 days of symptoms showed a significant decrease in serum creatinine and better than nephrostomy performed > 14 days after onset of symptoms. That fact proves that nephrostomy will have effect on the immediate improvement of renal function. Human studies on the effect of the duration of the obstruction on renal function is still not known. Studies in dogs showed after 40 days of obstruction resulted in irreversible renal function impairment. Other studies have shown renal function can return after 150 days of complete obstruction. This may be due to differences in renal pelvic anatomy of humans that is extrarenally located and also lymphatic and venous flow differences so that the kidneys are better protected from obstruction.¹²

Hypertension is an independent risk factor for chronic kidney disease.¹³ In this study significant relationship was found between decrease in serum creatinine and previous history of hypertension. Serum creatinine values in post-nephrostomy patients without history of hypertension are better than patients with history of hypertension. These results indicate hypertension affects renal function improvement. There has been no previous studies that assess the role of hypertension to the decrease in serum creatinine after treatment of urinary tract obstruction.

Hydronephrosis is used to assess the degree of obstruction and the extent of kidney tissue damage (parenchymal thickness).⁸ The mean serum creatinine of < 2 mg/dl were obtained from patients with mild hydronephrosis on the sixth day. While patients with moderate and severe hydronephrosis

did not achieve the desired value. The degree of obstructive uropathy with grade of hydronephrosis parameters affect renal function improvement after nephrostomy. Obstructive uropathy affect glomerular filtration, renal blood flow and renal tubules, the longer the obstruction the greater its effect on renal function improvement after nephrostomy.¹⁴ The thickness and echogenicity of renal parenchyma can assess the severity of disease experienced. The thicker the renal parenchyma, the better improvement of function after treatment.⁸

The objective of this study is to predict the improvement of postnephrostomy renal function by using clinical parameters of patients. So the physician can estimate of how well the kidney may function after several days of treatment. Other specific factors that may influence the outcome must be considered.

CONCLUSION

Percutaneous nephrostomy in patients with obstructive nephropathy has a role in the improvement of renal function. Factors influencing the decline in serum creatinine postnephrostomy are thickness of the renal parenchyma, the duration of obstruction, a history of hypertension and grade of hydronephrosis.

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