



## Reversibility of glomerular filtration rate after surgery for unilateral obstructive Uropathy

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### Article info

#### Article History:

Received: 20 Feb 2015

Accepted: 27 May 2015

ePublished: 20 Aug 2015

#### Keywords:

Unilateral Obstructive Uropathy, Kidney Function Reversibility, Surgical Treatment

### Abstract

**Introduction:** Surgical treatment is increasingly finding a place in the treatment of unilateral obstructive uropathy. This study was designed to investigate the recoverability of renal function following surgical treatment of adult patients with unilateral obstructive uropathy using Lasix 99mTc-diethylenetriaminepentaacetate renography (DTPA-R) for measurement of glomerular filtration rate (GFR) before and after surgery.

**Methods:** This was a prospective study which included 29 (20 males and 9 females) consecutive adult patients with a diagnosis of unilateral renal obstruction and a normal contralateral kidney. The obstruction and malfunction of the contralateral kidney were confirmed with Lasix DTPA-R. For all the patients, surgical treatment of the unilateral kidney obstruction was performed, and post-surgical measurement of the function of the treated kidney was also applied using Lasix DTPA-R.

**Results:** The mean age of the patients was 42.24 years. According to our results, the average of pre-operation GFR was  $17.48 \pm 9.10$  ml/minute/1.73 m<sup>2</sup> and post-operation GFR was  $26.4 \pm 11.2$  ml/minute/1.73 m<sup>2</sup>. It is approved that the GFR increased  $8.92 \pm 6.30$  ml/minute/1.73 m<sup>2</sup> after surgery. The most increased rate of GFR was observed in the group with the impaired kidney with GFR > 20 ml/minute. It is approved that the rate of recovery in the patients with preoperational total GFR > 75 ml/minute and also  $50 < \text{GFR} < 75$  ml/minute was more than that in the other patients.

**Conclusion:** Our findings demonstrated that in unilateral obstructive uropathy if the GFR of the impaired kidney is > 10 ml/minute/1.73 m<sup>2</sup> or total GFR > 25 ml/minute/1.73 m<sup>2</sup> the functional recovery of damaged kidney could be expected following the removal surgery.

**Citation:** Hassanzadeh K, Yavari-Kia P, Gharehpapagh E, Hazhir-Karzar S, Mahmoodi H, Kavandi H, et al. **Reversibility of glomerular filtration rate after surgery for unilateral obstructive Uropathy.** *J Anal Res Clin Med* 2015; 3(3): 143-8.

### Introduction

Obstructive uropathy refers to the condition of obstruction of urine flow from the kidney to the bladder, which might be acute or chronic, complete or partial, and unilateral or bilateral.<sup>1,2</sup> The adverse effects of urinary-

tract obstruction (UTO) on renal function have been investigated in several animal and human studies.<sup>3-7</sup> Severity, duration of obstruction, and being unilateral or bilateral are obvious imperative effective factors which may disturb the function of

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kidneys.<sup>4,6,8,9</sup> Different consequences of UTO are considered, which can decrease the optimal function of involved kidneys.<sup>5,6,10-12</sup> These consequences could be summarized as: decreased glomerular filtration rate (GFR) and renal plasma flow, disorders in renal concentrating ability, renal acid excretion, and renal metabolism.<sup>5</sup> In the adult, obstructive nephropathy is often acquired with ureteral obstruction, usually as a consequence of nephrolithiasis.<sup>13</sup>

Previous reports analyzed several methods of predicting the recovery of renal function after the relief of obstruction.<sup>14-19</sup> Khalaf et al. in a prospective study investigated the recoverability of renal function after treatment of adult patients with unilateral obstructive uropathy and normal contralateral kidney and finally concluded that improvement or stabilization of function can be expected after relief of obstruction of kidneys with a renographic GFR of 10 ml/minute/1.73 m<sup>2</sup> or greater.<sup>20</sup> Afzali et al. approved that treatment of unilateral obstruction reverses heavy and bilateral proteinuria.<sup>21</sup> Lasix (furosemide) <sup>99m</sup>Tc-diethylenetriaminepentaacetate renography (DTPA-R) is a practical and rational method for measuring the function of kidneys with UTO.<sup>22,23</sup>

The aim of this study was to investigate the recoverability of renal function after surgical treatment of adult patients with unilateral obstructive uropathy using Lasix DTPA-R for measuring GFR before and after surgery.

## Methods

This was a prospective study that included 29 (20 males and 9 females) consecutive adult patients admitted to Educational-Medical Centers of Tabriz University of Medical Sciences, Iran, with a diagnosis of unilateral renal obstruction and a normal contralateral kidney. The diagnosis of the unilateral renal obstruction was based on the sonography. The patients were excluded with bilateral obstruction or unilateral obstruction with an abnormal or absent contralateral kidney. The obstruction and malfunction of the

contralateral kidney were confirmed with Lasix DTPA-R. For all the patients, surgical treatment of the unilateral kidney obstruction was performed, and post-surgical measurement of the function of the treated kidney was also conducted using Lasix DTPA-R.

Urine culture (UC) was performed for all of the patients. 25 patients had a negative UC. For 4 of the patients with positive UC, antibiotic therapy started before the surgery. The mean time of the GFR measurement after the surgery was 22.3 days. Nephrectomy was performed in two patients according to the severe pyonephrosis and thin layer of the parenchyma of kidneys. The causes of the unilateral obstruction were: 17 (58.6%) pyelonephritis, 8 (27.5%) ureterolithiasis, 3 (10.3%) ureteropelvic junction (UPJ), and 1 (3.4%) ureterovesical junction (UVJ).

## Results

The mean age of the patients was 42.24 years. The age range of the patients was between 11 and 80 years old. Distribution of the age of the patients in different decades could be seen in table 1.

**Table 1.** Distribution of age in different decades

Age (year) (n = 29)	n (%)
11-20	4 (13.8)
21-30	5 (17.2)
31-40	3 (10.4)
41-50	6 (20.6)
51-60	6 (20.6)
61-70	3 (10.4)
71-80	2 (7.0)

The differences between pre and post-operation total GFR were determined. According to our results, the average of pre-operation GFR was 17.48 ± 9.10 ml/minute/1.73 m<sup>2</sup> and that of post-operation GFR was 26.4 ± 11.2 ml/minute/1.73 m<sup>2</sup>. It was approved that the GFR increased 8.92 ± 6.30 ml/minute/1.73 m<sup>2</sup> after surgery (P < 0.050).

Based on the GFR of the impaired kidney before and after the surgery, the results showed that the most increased rate of GFR observed in the group with GFR > 20

ml/minute (Table 2).

Table 3 shows that 27.5% of the patients were in the group of severe renal insufficiency, and 38.0% were in the group of moderate renal insufficiency. It is concluded that totally 65.5% of the patients had considerable renal insufficiency, and only 34.5% of the patients had optimal total GFR. According to table 3, it is proved that the rate of recovery in the patients with preoperational total GFR > 75 ml/minute and also 50 < GFR < 75 ml/minute was more than that of the other patients.

The results of the present study showed that in 20 (69.0%) of the patients creatinine (Cr) decreased after the surgery while 3 (10.4%) of them had increase in Cr range after the surgery.

Our results showed that 5 of the patients had hypertension before the surgery. However, 4 of them recovered after the surgery, and the blood pressure decreased to the normal range. One of the hypertensive patients did not recover even after surgery.

**Discussion**

50 percent of GFR recovery in the patients with total GFR < 25 ml/minute/1.73 m<sup>2</sup> and substantial increase of the GFR in different groups of the patients with GFR > 25 ml/minute/1.73 m<sup>2</sup>, clarify the important role of removal surgery of the urinary system obstruction in relief of the renal function.

According to the old beliefs if a contralateral kidney has a complete form of hypertrophy the impaired kidney cannot

gain its reversible function.<sup>23</sup> Provoost and Molenaar publication was one of the first works, which confirmed taking place of considerable recovery under incentive of impaired function after removal of the opposite kidney.<sup>24</sup> Witherow and Wickham proved that in 19 patients with Cr clearances < 20 ml/minute nephrolithotomy resulted in significant increase (12.9-25.4 ml/minute). They also reported that no patient required long-term dialysis.<sup>25</sup> Singh et al. reported the acceptable efficacy and good outcome of the surgical intervention in patients with obstructive mild to moderate renal failure. They also showed the reduced need for dialysis/renal replacement therapy.<sup>26</sup>

It is very important to notice that renal calculi and concurrent mild to moderate renal insufficiency warrant aggressive treatment which might result in optimum recovery of renal function.<sup>27-29</sup> The precise prediction of the recoverability of kidney function after the treatment of chronic partial obstruction might be very imperative for the urologists and nephrologists. Apart from the two patients who underwent nephrectomy it is achieved from the findings of this study that the chance of success in recovery of the insufficiency of kidneys is very high when the total GFR is more than 25 ml/minute. However, the chance of success was 50.0% in pre-operation total GFR < 25 ml/minute. Al-Kandari et al. suggested applying nonsurgical treatment or even nephrectomy in patients who are predicted to have irreversible kidney function.<sup>30</sup>

**Table 2.** Classification of the patients based on pre and post-operation GFR (glomerular filtration rate) of impaired kidney

GFR of impaired kidney	Total [n (%)]	Patients with increased GFR	Patients with decreased or fixed GFR	Increase in GFR (%)
< 10 ml/minute/1.73 m <sup>2</sup>	10 (34.5)	6	4	60
10-20 ml/minute/1.73 m <sup>2</sup>	9 (31.5)	8	1	88
> 20 ml/minute/1.73 m <sup>2</sup>	10 (34.5)	9	1	90

GFR: Glomerular filtration rate

**Table 3.** Classification of patients based on pre and post-operation total GFR (glomerular filtration rate)

Total GFR before surgery	Frequency	Recovered patients	Patients without recovery or decreased GFR
	n (%)	n (%)	
> 75 ml/minute/1.73 m <sup>2</sup>	2 (7.0)	2 (100)	-
50-75 ml/minute/1.73 m <sup>2</sup>	8 (27.5)	6 (75.0)	2*
25-50 ml/minute/1.73 m <sup>2</sup>	11 (38.0)	11 (100)	-
< 25 ml/minute/1.73 m <sup>2</sup>	8 (27.5)	4 (50.0)	4

GFR: Glomerular filtration rate

\*In (one) patient nephrectomy was performed because of pyonephrosis and (one) patient underwent nephrolithotomy

According to our findings, the function of damaged kidney in 60.0% of the patients with the GFR < 10 ml/minute/1.73 m<sup>2</sup> presented improved GFR after the obstruction removal surgery. However, Khalaf et al. reported that kidneys with a GFR < 10 ml/minute/1.73 m<sup>2</sup> are irreversibly injured, therefore, should be followed up with nonsurgical management.<sup>20</sup>

Long-term follow-up of the patients may result in valuable findings. This is one of the study limitations of this work that may be improved in further studies. It could be of great value if we analyze several kidney-function-related factors during a 2 years follow-up after surgery.

Decreased Cr has been observed in 69.0% of the patients after surgery. Although serum Cr is not an exact evidence of the renal function status, and it is dependent on muscle mass and activity, among other things, and may be distorted in patients with obstructive uropathy.<sup>31</sup> The reduced Cr after surgery is a satisfactory finding which augments the indication of obstructive uropathy surgery.

Our results showed that the number of the patients < 40 years old is almost equal to the number of patients between 40 and 60 years old. The distribution of the patients with obstructive uropathy in fifth and sixth decades of their age is more than that of the other decades. According to the age of initiation of the vascular disease and exacerbating effect of obstructive uropathy on hypertension, considering surgery for kidney function recovery seems pivotal in these groups. The most frequent age group of the patients with chronic renal failure (CRF) in Iran is 61-75 years (38.3%) and obstructive uropathy is the third cause of CRF in Iran,<sup>32</sup> therefore, sufficient attentions must be paid to the patients between 40 and 60 years old with obstructive uropathy to prevent CRF for

these group of the patients.

One of the important findings of this work was the recovery of the hypertension of the four out of five patients who underwent surgery. The relation between hypertension and impaired kidney has been shown. Recent hypotheses proposed the fact that even primary hypertension has its origin in the kidney.<sup>33</sup> The patients that recovered from hypertension after the surgery had the chance to save their kidneys from progressive damages, and it seems that the status of their kidneys was reversible. According to our findings, emergency removal of the uropathy obstruction in the hypertensive patients may help the treatment of hypertension. Further studies in this regard may elucidate all aspects of the initiation, progression, and end-stage of hypertension in the patients with obstructive uropathy.

### Conclusion

The findings of this investigation revealed that in unilateral UTO if the GFR of the impaired kidney is > 10 ml/minute/1.73 m<sup>2</sup> or total GFR > 25 ml/minute/1.73 m<sup>2</sup> it can be a considerable chance to recovery of damaged kidney function after surgery for removal of the obstruction. The relief of obstruction is expected to stabilize or improve renal function. The recovery of UTO related hypertension is also expected after the surgical treatment. Further long follow-up investigations may result in outstanding findings in this regard.

### Conflict of Interests

Authors have no conflict of interest.

### Acknowledgments

This study was supported by Tabriz University of Medical Sciences.

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