HUE UNIVERSITY

UNIVERSITY OF MEDICINE AND PHARMACY

STUDY IN MORPHOLOGICAL AND FUNTIONAL CHANGES OF THE KIDNEY AFTER SURGERY FOR UNILATERAL URETERAL CALCULI

Major: SURGERY

Code: 972 01 04

THE SUMMARY OF DOCTORAL THESIS IN MEDICINE

Hue, 2023

The study was completed at:
University of Medicine and Pharmacy, Hue University

Scientific supervisor:

Reviewer 1:

Reviewer 2:

Reviewer 3:

The thesis will be defended in front of the doctoral thesis committee of Hue University
Meeting venue:……
Time: the..... day of..... , 2023.

The thesis can be found in:
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PREFACE

1. THE URGENCY OF THE THEME

Ureteral stones can cause infection and affect the morphology and function of the kidney if not promptly monitored and treated. The question of how the morphology and function of the kidney change after ureteral stone surgery has been of interest to many authors. There have been many studies worldwide on the impact of ureteral stones on the morphology and function of the kidney, as well as the ability to improve kidney function after treatment for ureteral stones, such as Kelleher (1991), Lupton (1992), Irving (2000), Gandolpho (2001), Wimpisinger (2014), Marchini and colleagues (2016). Most of these studies evaluate the morphology and function of the kidney using renal scintigraphy and imaging on computed tomography.

In Vietnam, there have also been some studies on the impact on the morphology and function of the kidneys due to ureteral obstruction and the changes in kidney morphology and function after relieving ureteral obstruction, such as Vu Hong Thinh (2008), Truong Minh Khoa (2012), Pham Viet Phong and colleagues (2013). However, methods for assessing the morphology and function of the kidney, such as using ultrasound to assess hydronephrosis or evaluating kidney function using blood urea and creatinine or using radiopharmaceuticals scintigraphy to evaluate renal function which has not been optimized, this is also a limitation of these studies.

In fact, in Vietnam, patients with urinary stones, including ureteral stones, are often treated late due to various reasons such as late presentation, incorrect initial treatment, etc. One of the important

questions that the surgeon must ask before surgery is how much the patient's kidney function has been affected and how much improvement in kidney function can be expected after surgery. Answering these questions will help the surgeon choose the appropriate treatment method. This is also the research question that needs to be addressed.

With the aim of investigating the changes in morphology and function of the kidney after relieving obstruction caused by ureteral calculi, as well as identifying factors affecting kidney morphology and function, in order to contribute more research data on ureteral stones and support clinical practitioners in selecting appropriate treatment methods and timing, we carried out the research topic: “Study in morphological and functional changes of the kidney after surgery for unilateral ureteral calculi” with two objectives:

1. Surveying some clinical and paraclinical characteristics and the outcome of surgical intervention for unilateral ureteral calculi.

2. Evaluating changes in kidney morphology, function, and related factors after 3 months of surgical intervention for unilateral ureteral calculi.

2. Dissertation contribution

Find some factors that affect the degree of hydronephrosis, decrease renal function, and some factors that affect the ability to improve renal function.

The thesis contributes to adding research data on urinary stones as well as providing clinical practitioners with more materials to support the selection of appropriate treatment time and methods.

3. STRUCTURE OF THE THESIS

This dissertation contains 122 pages in length. It is specifically as follows: the Introduction has 2 pages, chapter 1 of Literature Review has 37 pages, chapter 2 of Subjects and Research Methodology has 17 pages, chapter 3 of Research Results has 31 pages, chapter 4 of Discussion has 32 pages, Conclusions has 3 pages. The dissertation presents the statistical and visual information with 38 tables, 6 charts and 8 pictures. There are 123 references, including 8 Vietnamese, and 115 English.

Chapter 1
LITERATURE REVIEW

1.1. Pathophysiology of unilateral ureteral obstruction

According to Martínez-Klimova (2019) The unilateral ureteral obstruction is characterized by tubular dilation, interstitial expansion, loss of proximal tubular mass, hypertrophy, hydronephrosis, infiltration of leukocytes, tubular epithelial cell death and presence of fibroblasts. These alterations are a result of molecular processes such as hemodynamic change by mechanical stretching, epithelial tubular cell apoptosis, oxidative stress and inflammation; which altogether lead to progressive renal tubulointerstitial fibrosis and damage to ultrafiltration.

1.2. Assessment of renal filtration function

The most classic method for measuring kidney filtration rate was used by Homer Smith, which involved using inulin to measure the clearance rate in urine and was considered the gold standard for diagnosis. However, it is difficult to perform this method in clinical settings, so some authors have used formulas such as Schwartz, Cockcroft-Gault, MDRD (modification of diet in renal disease), and CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) to estimate kidney filtration rate. But using these formulas only gives us an estimated kidney filtration rate for both kidneys without indicating the filtration rate of each individual kidney. Radionuclide renal scintigraphy determines the filtration rate of each individual kidney.

Chapter 2
SUBJECTS AND METHODS OF RESEARCH

2.1. RESEARCH SUBJECTS

A total of 61 patients with unilateral ureteral stones were treated surgically using one of two methods: semirigid ureteroscopy Laser lithotripsy or retroperitoneal laparoscopic ureterolithotomy.

2.1.1. Selection criteria for the disease

- The patient has one unilateral ureteral stone without any other stones in the urinary system, diagnosed by contrast-enhanced CT scan of the urinary system.

- There will be a 3-month follow-up period after the surgery.

Indications for surgery

- Retroperitoneal laparoscopic ureterolithotomy for upper third ureteral stones with a size >10mm.

- Semirigid ureteroscopy laser lithotripsy:

+ Upper third ureteral stones with a size ≤10mm and meet one of the following conditions: failure of extracorporeal shock wave lithotripsy (ESWL) or infected urinary tract with stable conservative treatment, or hydronephrosis with a degree of 2 or higher, or decreased renal function on the affected side.

+ Middle third and lower third ureteral stones with a size ≥10mm.

+ Middle third and lower third ureteral stones with a size <10mm meet one of the following conditions: hydronephrosis with a degree of 2 or higher confirmed by computed tomography scan or failed trial of medical expulsive therapy after 4 weeks, or infected urinary tract with stable conservative treatment, or decreased renal function on the affected side.

2.1.2. Exclusion criteria

- There are accompanying urinary tract anomalies such as ureteral cysts, duplicated collecting systems, horseshoe kidneys, and causes of urinary tract obstruction such as tumors, ureteral strictures...
- Ureteral stones causing acute pyelonephritis.
- Patients with a history of kidney stones or urinary tract stones whose effect on previous kidney function is unknown due to the stones.
- Single kidney has ureteral stones.
- Pregnant and breastfeeding patients.
- Patients with diabetes.
- Patients allergic to contrast agents are excluded from the study group.

2.1.3. Location and period of research

The study was carried out from January 2019 to April 2022 at Da Nang Hospital.

2.2. RESEARCH METHODOLOGY

2.2.1. Research methodology

Prospective study, longitudinal study, observational study.

2.2.2. Steps of research process

- The patient was examined to assess the clinical symptoms.
- Laboratory tests: red blood cells, white blood cells, urea, creatinine blood, sodium, potassium, calcium blood, total analysis of 10 urine parameters, urine culture, computed tomography urinary system with contrast, 99m Tc-DTPA renal scintigraphy with diuretics
- The patients were treated surgically using one of two methods: semirigid ureteroscopy laser lithotripsy or retroperitoneal laparoscopic ureterolithotomy.

- Care and treatment after surgery.

- Re-examination after 3 weeks to remove the double J if the patients were inserted double J.

- Re-examination after 3 months and do tests: red blood cells, white blood cells, urea, creatinine blood, sodium, potassium, calcium blood, total analysis of 10 urine parameters, computed tomography urinary system with contrast, 99m Tc-DTPA renal scintigraphy with diuretics.

2.2.3. Variable

- Patient demographics data and characteristics (clinical, paraclinical) were collected.

- Outcomes of surgical intervention.

- Change in biochemical, hematological variables, hydronephrosis, renal obstruction and renal function 3 months after surgery.

- According to Miyake (2019) and Kim (2013): hydronephrosis divided into 4 degrees.

- Evaluation of reduced kidney function: According to Gandolpho (2001), it is called a decrease in renal function when the relative function of each kidney decreases below 45%. According to Marchini et al. (2016), when renal function is less than 45% of each kidney is considered to be functionally impaired [8], [25].

- Find factors related to clinical and subclinical variables. Variables associated with improved renal function after surgery.

2.3. DATA ANALYSIS

Statistical analyses were performed using SPSS 22.0 software: for calculating the mean, median, standard deviation, quartile interval. Student T-test, Mann-Whitney, Chi-square test, Fisher's exact test,

Paired T-test, ROC curve for determining area under curve (AUC), cut-off value, sensitivity, specificity in diagnosis. A p-value < 0.05 is considered statistically significant.

2.4. ETHICS IN RESEARCH

The research was approved by the ethics committee of University of Medicine and Pharmacy, Hue Universit and Da Nang Hospital allows.

Chapter 3
RESULTS

3.1. CHARACTERISTICS OF THE STUDY SAMPLE

From January 2019 to April 2022, there were 61 cases of unilateral ureteral stones that met the sampling criteria and were admitted to the hospital. The average age was 48.5 ± 12.5, with the youngest being 25 and the oldest being 78. Males: 29.5% and females: 70.5%. One patient had hypertension before surgery, and after surgery, this patient's blood pressure did not return to normal.

3.2. Somes clinical and parraclinical characteristics of unilateral ureteral stone

Symptomatic ureteral stones accounted for 95.1%, while asymptomatic ureteral stones accounted for 4.9%. Hydronephrosis was mainly at grade 1 and grade 2, and complete renal obstruction accounted for the highest proportion at 47.5%. The average size of stones was 11.1 ± 4.1mm. The mean glomerular filtration rate of kidneys with ureteral stones was 38.7 ± 11.6 ml/min/1.73m^2. The relative kidney function of those with ureteral stones were decreased 68.9%. Positive urine cultures accounted for 88.6%, while negative ones were 11.4%. *E. coli* was the most commonly identified bacteria among positive cultures.

3.3. Relationship between some clinical and subclinical factors of patients with ureteral stone before surgical intervention

Table 3.11. Relationship between hydronephrosis and the impacted stones, not-impacted stones (n=61)

Hydronephrosis / Characteristics of stones	Grade 1		Grade 2 + 3 + 4		p*
	n	%	n	%	
impacted stones	3	15.0	17	85.0	0.001
not-impacted stones	24	58.5	17	41.5	

p*: Chi-square test

Comment: There was a relationship between hydronephrosis with the impacted stones, not-impacted stones, p = 0.001.

Table 3.12. Relationship between hydronephrosis and the degree of renal obstruction on renal scintigraphy

Degree of renal obstruction on renal scintigraphy	**Not obstruction**		**Obstruction**		**p***
Hydronephrosis on computed tomography	**n**	**%**	**n**	**%**	
Grade 1	4	66.7	21	44.7	0.4
Grade 2 +3+4	2	33.3	26	55.3	

p*: Fisher's exact test

Comment: There was no relationship between hydronephrosis and degree of renal obstruction on renal scintigraphy, $p > 0.05$.

Table 3.13. The correlation between stone size and degree of hydronephrosis on computed tomography urography

Stone size	**≤ 10mm**		**> 10mm**		**p***
degree of hydronephrosis	**n**	**%**	**n**	**%**	
Grade 1	14	51.9	13	48.1	0.02
Grade 2 +3+4	8	23.5	26	76.5	

p*: Chi-square test

Comment: There was a relationship between stone size and degree of hydronephrosis, $p < 0.05$.

3.4. EVALUATION OF THE RESULTS OF SURGICAL INTERVENTION FOR URETERAL STONES

Stone free rate of semirigid ureteroscopy Laser lithotripsy and Retroperitoneal laparoscopic ureterolithotomy were 100%. There were no cases of ureteral stricture after surgery, and only one case of urinary leakage was reported in the retrograde intrarenal surgery group.

Table 3.15. Features of surgical intervention methods

Surgical intervention methods		n	%
Semirigid ureteroscopy laser lithotripsy	**Success**	41	93.2
	Change to retroperitoneal laparoscopic reterolithotomy	3	6.8
Retroperitoneal laparoscopic ureterolithotomy	**Success**	17	100.0
	Failure	0	0

Comment: There were 3 cases in the upper third of the ureteral stones using of ureteroscopy lithotripsy but it could not success and had to be converted to retroperitoneal laparoscopic reterolithotomy, all of which were successful.

3.5. CHANGES IN MORPHOLOGICAL AND FUNCTIONAL KIDNEY AFTER 3 MONTHS OF SURGICAL INTERVENTION FOR URETERAL STONES

3.5.1. Changes in kidney morphology after surgical intervention for ureteral stones

Table 3.22. The improvement of renal hydronephrosis on computed tomography after surgical intervention

Timing / Hydronephrosis	Pre-operative		Pos-operative		
	n	%	**Hydronephrosis**	n	%
Grade 1	27	44.3	**Normal Hydronephrosis**	25	92.6
			Grade 1	2	7.4
Grade 2	22	36.1	**Normal Hydronephrosis**	13	59.1
			Grade 1	6	27.3
			Grade 2	3	13.6
Grade 3	10	16.4	**Normal Hydronephrosis**	4	40.0
			Grade 1	4	40.0
			Grade 2	1	10.0
			Grade 3	1	10.0
Grade 4	2	3.2	**Grade 3**	2	100.0

Comment: The improvement of hydronephrosis was 90.2%, no improvement was 9.8%.

Table 3.23. Change in the degree of renal obstruction on renal scintigraphy before and after surgical intervention (n=61)

Degree of renal obstruction	Pre-operative		Pos-operative		p*
	n	%	n	%	
Not obstruction (a)	6	9.8	44	72.1	-
Partial obstruction (b)	18	29.5	7	11.5	p (a)&(b) <0.001
Complete obstruction (c)	29	47.5	7	11.5	p (a)&(c) <0.001
Not assessment (d)	8	13.1	3	4.9	p (a)&(d) <0.001

*: Chi – square test

Comment: There was an improvement in the degree of obstruction on renal scintigraphy, which was statistically significant with $p < 0.001$.

3.5.2. Changes in kidney function after surgical intervention for ureteral stones

Table 3.26. Improvement in mean glomerular filtration rate of each kidney on postoperative renal scintigraphy (n=61)

GFR (ml/min/ 1.73m^2)	Pre-operative	Pos-operative	p*
	Mean ± SD	Mean ± SD	
Kidney with ureteral stones	38.7 ± 11.6	45.0 ± 12.5	0.001
Contralateral kidney	58.2 ± 11.6	56.5 ± 14.2	0.130
p	< 0.001	< 0.001	

*: Paired T-test

Comment: Glomerular filtration rate of kidney with ureteral stones have improved from preoperatively to 3 months postoperatively, $p = 0.001$.

Table 3.27. Change in relative function of each kidney after surgery

Relative function (%)	**Pre-operative**	**Pos-operative**	**p***
	Mean ± SD	**Mean ± SD**	
Kidney with ureteral stones	39.7 ± 8.6	44.3 ± 8.6	0.001
Contralateral kidney	60.3 ± 8.6	55.7 ± 8.6	0.001
P*	< 0.001	< 0.001	

*: Paired T-test

Comment: There was a statistically significant change in the relative function of each kidney after surgery p = 0.001.

Table 3.28. Relative frequency of functional improvement of kidneys with ureteral stones after surgery (n=61)

Timing / **Relative function (%)**	**Pre-operative**		**Pos-operative**		
	n	**%**	**Relative function**	**n**	**%**
Decrease	42	68.9	**Decrease**	21	50.0
			Normal	21	50.0
Normal	19	31.1	**Decrease**	2	10.5
			Normal	17	89.5

Comment: The relative recovery rate of kidney with ureteral stones is 50%.

3.5.3. Relation of some clinical, subclinical and postoperative factors with the improvement of renal function

Table 3.35. Cut-off points for some clinical factors with improved renal function after surgery

Variable (unit)	Cut off	Se (%)	Sp (%)	AUC	p*
Age (yr)	≤ 34	38.1	95.2	0.695	0.017
Duration of obstruction (weeks)	≤ 4	76.2	71.4	0.689	0.027
Operative time (min)	≤ 7	100.0	9.5	0.501	0.990
Pos-operative time (day)	> 2	76.2	33.3	0.524	0.789
Hospital stay (day)	≤ 7	57.1	71.4	0.579	0.381
Size stones (mm)	≤ 10	57.1	52.4	0.533	0.718

*: Chi – square test

Se: Sencitivity, Sp: specificity, AUC: Areas under the curve

Comment: At the value cut-off point ≤ 34 years of age and the duration of obstruction ≤ 4 weeks, there was a predictive value for improvement in renal function after surgery, with AUC: 0.695 and 0.689.

Table 3.36. The relationship between some clinical factors to improve renal function after surgery intervention

Renal function / Variable (unit)		Improvement (n=21)		Not improvement (n=21)		P*	OR	95%CI
		n	%	n	%			
Gender	Male	7	50.0	7	50.0	1.000	1.00	0.28 – 3.61
	Female	14	50.0	14	50.0		1.00	
Age group	≤ 34	8	88.9	1	11.1	0.02	12.31	1.37 – 110.30
	> 34	13	39.4	20	60.6		1.00	
Duration of obstruction (weeks)	≤ 4	15	68.2	7	31.8	0.013	5.00	1.35 – 18.56
	> 4	6	30.0	14	70.0		1.00	
Surgical intervention methods	Semirigid ureteroscopy laser lithotripsy	14	51.9	13	48.1	0.747	0.81	0.23 – 2.88
	Retroperitoneal laparoscopic ureterolithotomy	7	46.7	8	53.3		1.00	
Symptoms of ureteral stones	Symptomatic ureteral stones	21	52.5	19	47.5	-	-	-
	Asymptomatic ureteral stones	0	0.0	2	100.0		-	

*: Chi-square test

Comment: There was a better improvement in kidney function in the age group 34 than in the age group older than 34 years and the duration of stones 4 weeks improved kidney function better than the duration of stones greater than 4 weeks after surgery, $p < 0.05$.

Chapter 4
DISCUSSION

4.1. SOME CLINICAL AND PARACLINICAL SYMPTOMS OF UNILATERAL URETERAL STONES

The patients' average age was 48.5 ± 12.5, with the youngest patient being 25 years old and the oldest being 78 years old. The male was 70.5%, female was 29.5%, respectively. Our study results were similar in terms of the incidence of ureteral stone symptoms with the authors Marchini (2016) and Wimpissinger (2007).

Mishra et al. (2020) found that the positive bacterial culture rate of urine was 22%, and the negative rate was 78%. *Escherichia coli* is a common bacterium in urinary tract infections. Zhang et al. (2020) reported that *Escherichia coli* was the most commonly found bacterium in blood and urine cultures. Our study recorded, the negative urine culture rate was 88.6%, and the positive rate was 11.4%. In cases of positive bacterial culture, *E. Coli* was still the most commonly found bacterium.

According to Song et al. (2016), 89.1% of the kidneys had hydronephrosis and 10.9% had no hydronephrosis. Marchini et al. (2012) reported that the degree of hydronephrosis was moderate in 48.1% and severe in 33.3% of cases. In our study, hydronephrosis was mainly concentrated in grades 1 and 2, and complete renal obstruction demonstrated that completely obstructive stones accounted for a high proportion of 47.5% and tended to be similar to previous studies.

Wimpissinger et al. (2014) showed a correlation between the degree of renal obstruction and the size of the stone with $p < 0.02$. Yan Song et al. (2016) also found that stone size was related to the

degree of hydronephrosis with $p < 0.001$. Our study presented in Table 3.13 also yielded similar results to those authors, there was a relationship between the size of the ureteral stone and the degree of hydronephrosis, $p = 0.02$. There was a relationship between impacted and non-impacted ureteral stones with the degree of renal hydronephrosis with $p = 0.001$ as shown in Table 3.11. We also observed in Table 3.12 that there was no relationship between the degree of hydronephrosis and the degree of renal obstruction on the renal scintigraphy, with $p > 0.05$.

Kelleher et al. (1991) performed renal scintigraphy with 99mTc-DTPA on 76 patients with acute obstruction due to stones and found a 18% reduction in function on the renal obstructed side. Irving et al. (2000) reported a 28% reduction in renal function in patients with symptomatic unilateral ureteral stones, Gandolpho et al. (2001) reported 68%, and Marchini et al. (2016) reported 77%. In our study shows that the average GFR before surgery was 38.7 ± 11.6 ml/min/1.73m^2 and the relative reduction in renal function with ureteral stones was 68.9%. Therefore, we observed a similar trend in decreased GFR compared to the aforementioned authors.

The European Association of Urology (2020) recommends two methods for surgical treatment of ureteral stones based on stone size: ureteroscopy with laser lithotripsy or extracorporeal shock wave lithotripsy. However, in Asia, Sharma Pawan et al. (2016) and Wang Yunyan et al. (2017) still use the retroperitoneal laparoscopic reterolithotomy. In our study, we performed ureteroscopic Laser lithotripsy for 44 out of 61 cases, with a success rate of 93.2%. Three cases with upper ureteral stones that were converted to retroperitoneal laparoscopic ureterolithotomy after failed attempts, and all 20 cases were successful.

Retroperitoneal laparoscopic ureterolithotomy for large upper ureteral stones has shown high stone-free rates. Abdel et al. (2021) and Eslahi et al. (2021) reported good outcomes, and Hu et al. (2014) reported a stone-free rate of 98.5%. Our study showed a stone-free rate of 100% for both ureteroscopic lithotripsy and retroperitoneal laparoscopic ureterolithotomy. Postoperative urinary leakage rate was 5.0% of patients who underwent retroperitoneal laparoscopic ureterolithotomy.

4.2. MORPHOLOGICAL AND FUNCTIONAL CHANGES OF KIDNEY AFTER 3 MONTHS OF SURGICAL INTERVENTION

Marchini et al. (2012) reported an 86% improvement in renal obstruction and stabilization of renal obstruction (70% showed improvement in the degree of obstruction, while 26% showed no change in the degree of obstruction after surgery). Truong Minh Khoa et al. (2012) demonstrated an 85.7% improvement in renal obstruction after the release of ureteral stone obstruction and the placement of a JJ stent. Our study found a 90.2% improvement in the degree of renal obstruction and 9.8% with no improvement. The degree of obstruction decreased after surgery, and there was a statistically significant improvement in the degree of renal obstruction on the renal scintigraphy, with a p-value of < 0.05 as shown in Table 3.22 and Table 3.23.

Some authors have shown improvement in renal function after surgery to relieve ureteral obstruction. Kelleher et al. (1991) reported a renal function recovery rate of 86%, with no recovery in 14.3% of cases. Gandolpho et al. (2001) demonstrated an improvement in renal function from 25 ± 12% to 29 ± 12% after surgery, with individual patient improvement ranging from 1% to 30%. Our study also found that the improvement rate of renal function was 50%,

while the non-improvement rate was 50%, as shown in Table 3.28. The average improvement of glomerular filtration rate of the kidney with ureteral stones before surgery was 38.7 ± 11.6 ml/min/1.73m^2, and after surgery was 45.0 ± 12.5 ml/min/1.73m^2, with a significance of p = 0.001 as shown in Table 3.26, Table 3.27 shows that the relative average function of the kidney with ureteral stones also improved, with 39.7% ± 8.6% before surgery and increased to 44.3% ± 8.6% after surgery, with a significance of p = 0.001.

Some studies on chronic ureteral obstruction or asymptomatic ureteral stones show no improvement in renal function, such as Lupton et al. (1992), Marchini et al. (2012), Marchini et al. (2016), and Low et al. (2021) also reported no improvement in function after surgery. In our study, we observed three cases of asymptomatic ureteral stones, of which two cases showed a decrease in renal function. Follow-up at 3 months after surgery did not show any improvement in renal function for these two cases.

Several studies have shown that factors such as age, duration of obstruction, renal tissue thickness, and urinary tract infection can affect the improvement of renal function after obstruction is resolved. Some studies, such as Bassiouny (1992), Koff et al. (1994), and Li et al. (2018), have shown that in children, renal function recovers well after obstruction is released. In adult patients, Zhang et al. (2015) found that the group under 35 years old had better improvement in renal function than the group over 35 years old. Our study in Table 3.35 and Table 3.36 showed that the group under or equal to 34 years old had a better improvement in renal function than the group over 34 years old with OR = 12.31, 95% confidence interval: 1.37-110.30, p = 0.02. Therefore, it can be seen that the younger the age, the better the likelihood of improvement in renal function compared to older patients.

The degree of recovery of renal function after the release of unilateral urinary tract obstruction is related to the duration of obstruction. Shokeir et al. (1999) reported rare cases of complete recovery of renal function after the release of unilateral urinary tract obstruction that lasted for 40 days. Irving et al. (2000) also reported cases of urinary tract obstruction due to stones, and after one month of treatment, the obstruction of the urinary tract was relieved, and renal function improved in cases where the duration of obstruction was within the first week. In our study, as shown in Tables 3.35 and 3.36, a duration of obstruction of less than or equal to 4 weeks showed better improvement in renal function than a duration of obstruction over 4 weeks, with an odds ratio of 5.00, 95% confidence interval: 1.35 -18.56, p= 0.013.

Therefore, in our study, the factor of age younger than or equal to 34 years and obstruction duration of less than 4 weeks showed better improvement in renal function compared to those older than 34 years and obstruction duration of over 4 weeks, $p < 0.05$.

CONCLUSION

From January 2019 to April 2022, we conducted a study on the morphological and functional changes of the kidney in 61 patients with unilateral ureteral stones who met the selection criteria and underwent surgical intervention. We have the following conclusions:

1. Some clinical, paraclinical and surgical intervention outcomes of unilateral ureteral stones

- The average age was 48.5 ± 12.5 years, the oldest patient was 78, the youngest was 25, males accounted for 29.5%, females accounted for 70.5%, and the average body mass index was 22.2 ± 1.8. One patient had hypertension before surgery, and their hypertension did not return to normal after surgery. Symptomatic ureteral stones accounted for 95.1% and asymptomatic ureteral stones accounted for 4.9%. Patients were admitted to the hospital mainly with flank pain.

- The degree of hydronephrosis on computed tomography was mainly grade 1 and grade 2, with an average stone size of 11.1 ± 4.1 mm. The degree of renal obstruction on renal scintigraphy was the highest in the complete obstruction group. Negative urine culture accounted for 88.6%, positive urine culture accounted for 11.4%, and Escherichia coli had the highest proportion.

- The average glomerular filtration rate of both kidneys before surgery was 96.9 ± 16.6 ml/min/1.73m^2. The glomerular filtration rate of the kidney with ureteral stones was 38.7 ± 11.6

ml/min/1.73m^2, and the contralateral kidney was 58.2 ± 11.6 ml/min/1.73m^2. The relative function of the kidney with ureteral stones decreased by 68.9%, the other cases were normal in 31.1%.

- There was a relationship between stone size and hydronephrosis, p =0.02. There was a relationship between hydronephrosis and with the impacted stones, not-impacted stones, p = 0.001. There is a relationship between the degree of hydronephrosis with decreased renal function, p = 0.011.

- Surgical intervention method for unilateral ureteral stones: Application of semirigid ureteroscopy Laser lithotripsy in 44/61 patients, and application of retroperitoneal laparoscopic ureterolithotomy in 17/61 patients. The success rate of ureteroscopy laser lithotripsy is 93.2%, and the success rate of retroperitoneal laparoscopic ureterolithotomy is 100%. The stone-free rate of both methods is 100%, with 1 case of urinary leakage after retroperitoneal laparoscopic ureterolithotomy.

2. Results of morphological and functional changes of the kidney and related factors after 3 months of surgical intervention for unilateral ureteral stones

- There was 90.2% improvement in hydronephrosis after surgical intervention, and 81.8% improvement in the degree of renal obstruction on the renal scintigraphy, p < 0.001.

- The relative functional recovery rate of kidneys with unilateral ureteral stones after surgery intervention was 50%. There was an improvement in the average glomerular filtration rate of kidney with

ureteral stones before and after surgical intervention, p = 0.001. Relative renal function significantly improved from preoperatively to 3 months postoperatively, p = 0.001.

- Patients who were younger than or equal to 34 years old had better renal function improvement than those who were older than 34 years old (OR = 12.31, 95% confidence interval: 1.37 - 110.30, p = 0.02). Patients who had duration of obstruction for less than or equal to 4 weeks had better renal function improvement than those who had duration of obstruction for more than 4 weeks (OR = 5.00, 95% confidence interval: 1.35 - 18.56, p = 0.013).

PUBLICATIONS OF RESEARCH RESULTS OF THE THESIS

Dang Van Thang, Pham Tran Canh Nguyen, Do Van Hieu, Truong Quang Binh and Le Dinh Khanh (2021). "Study in morphological and functional changes of the kidney after surgery for unilateral ureteral calculi", Journal of Medicine and Pharmacy, Hue University of Medicine and Pharmacy, Special Issue, 01/2021, pp. 205-209.

Van Thang, Pham Tran Canh Nguyen, Do Van Hieu, Truong Quang Binh and Le Dinh Khanh (2022) . "Evaluating prognostic factors for the recovery of kidney function after ureteral stone surgery", Journal of Clinical Medicine, Hue Central Hospital,79, pp. 128-133.