

Effect of ultra-mini percutaneous nephrolithotomy and ShuoTong ureteroscopy on the stress response, inflammatory indices, and urokinase level in patients with polycystic kidney disease complicated with renal calculus

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ABSTRACT

This study aimed to explore the effects of ultra-mini percutaneous nephrolithotomy (UMP) combined with ShuoTong ureteroscopy on the stress response, inflammation indicators and urokinase levels in patients with polycystic kidney disease and kidney stones. In this study, 42 patients with polycystic kidney disease and kidney stones diagnosed and treated in our hospital from February 2018 to February 2021 were selected as the research objects. They were randomly divided into the control group and the study group, with 21 cases in each group, and the control group adopted Ultra-mini percutaneous nephrolithotomy treatment; the study group was combined with ShuoTong ureteroscopy on the basis of the control group, and compared and analyzed the stress response, inflammation indexes, urokinase level, renal function, complications and stone clearance rate of the two groups of patients. After treatment, the average operation time, channel establishment time, hemoglobin decline, number of puncture channels, and hospital stay in the study group were significantly shorter than those in the control group ($P < 0.05$); after treatment, the reduction in CRP and PCT in the study group was significantly higher than that in the control group. The increase of Ang I and Ang II in the control group was significantly lower than that in the control group ($P < 0.05$); the improvement of PGE₂, NO, and LPO levels in the study group was significantly higher than that in the control group after treatment ($P < 0.05$); the study group TH, Cys- The levels of C and β 2-MG were significantly lower than those of the control group; the UK levels of the study group were significantly lower than those of the control group ($P < 0.05$); the complication rate of 14.29% in the study group after treatment was significantly lower than that of the control group 33.33%; the study group The stone clearance rate of 95.24% was significantly higher than that of the control group 80.95% ($P < 0.05$). In general, UMP combined with ShuoTong ureteroscopy is used to treat polycystic kidney with kidney stones, accurately determine the tip position of the needle sheath, ensure that the needle sheath enters the collection system to adjust its position, reduce patient stress and inflammation, improve safety and feasibility, and is worthy of clinical practice Promote applications.

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Introduction

Polycystic kidney is a hereditary urological disease, accompanied by autosomal recessive heredity, with an incidence of 0.1%~0.2%. Clinically, 40% of patients are also due to various infections caused by gene mutations. This disease involves more than one body systems, the clinical manifestation of renal cyst, pain, bleeding, renal impairment, etc., later will progress into end-stage renal disease, and with combined

problems such as kidney stones, stone obstruction, will further aggravate the deterioration or systemic immune to cause serious infections, kidney failure or malignant tumor (1, 2). For the clinical treatment of patients with polycystic kidney disease complicated with kidney stones, surgery is an important treatment to remove kidney stones and reduce the damage to the kidney and other normal organs (3, 4). With the development of urology technology, minimally

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invasive endovascular therapy has become a more effective treatment method, among which ultra-mini percutaneous nephrolithotomy (UMP) is performed under the guidance of fluoroscopy or ultrasound. The puncturing process is visible and can effectively puncture the target calcium. Avoid kidney substantial damage and relieve pain (5, 6). However, for patients with polycystic kidney disease complicated with kidney stones, a single treatment with UMP cannot completely remove stones in vivo, so multi-channel surgery combined treatment is needed to improve the effect of one-time stone removal. As a new type of lithotomy in recent years, ShuoTong ureteroscopy is performed with holmium laser lithotripsy through the standard scope and ureteral passage and combined with scabbard in the body. Then the controlled pressure system was used to suction residual lithotripsy to ensure the normal function of the kidney and ureter system, and the residual stone rate was low (7, 8). There are limited samples of ultra-mini percutaneous nephrolithotripsy and macroscopical treatment in foreign countries, and there are few studies on polycystic kidney combined with renal stones (9). In this study, ultra-mini percutaneous nephrolithotripsy combined with ShuoTong ureteroscopy was used to treat 42 patients with polycystic kidney disease combined with renal stones admitted to our hospital, and the effects on the stress response, inflammatory indexes and urokinase levels were observed and analyzed.

Materials and methods

General Information

Forty-two patients with polycystic kidney disease complicated with renal stones treated in our hospital from February 2018 to February 2021 were selected as the research objects and were randomly divided into control group and study group, with 21 patients in each group. There was no significant difference in general information and stone location between the two groups ($P>0.05$, see Table 1). The study was approved by the Ethics Committee of the hospital, and both patients and their families gave informed consent and signed informed consent.

Inclusion and exclusion criteria

Inclusion criteria :(i) polycystic kidney was confirmed by CT, MRI and other imaging examinations; (ii) Comply with the criteria of kidney stones in the European Society of Urology guidelines for diagnosis and Treatment of Urinary calculi (I) 2006 (10); (iii) Kidney stones were diagnosed by ultrasound, intravenous urography and clinical signs examination; (iv) Complete urinary system structure, no ureteral junction stenosis or atresia; (v) There was no contraindication of ultra-mini percutaneous nephrolithotripsy; (vi) All subjects and their relatives signed informed consent voluntarily.

Exclusion criteria :(i) patients with serious dysfunction of heart, liver, kidney and other important organs; (ii) severe urinary tract infection, urethral inflammation, nephritis and other diseases; (iii) congenital ureteropelvic stricture, malformation, horseshoe kidney, etc.; (iv) people with coagulation disorder, cognitive disorder and mental disorder; (v) women with diabetes, pregnancy or lactation; (vi) Incomplete clinical data and poor compliance.

Research Methods

All patients underwent routine examinations such as CT, MRI and intravenous urography after admission. The control group was treated with ultra-mini percutaneous nephrolithotomy: total anesthesia was performed at the lithotomy site, and 6F ureteral catheter was retrogradely indurated with nephrolithotomy through the dreg tube. In the prone position, normal saline was injected into the previously indwelled ureteral catheter to the predetermined place, and ultrasound was used to locate the puncture site and direction. A 16G puncture needle was used to puncture the target calcium, and the needle core was withdrawn when the renal pelvis and urine were extracted. The 3F ultra-mini nephroscope was inserted into the renal collecting system through the puncture needle sheath. After adjusting the depth and direction of the needle sheath, the zebra guidewire was inserted, and the incision was made 8mm in the skin at the lower edge of the needle. After the guidewire was gradually expanded, a renal lithotomy channel was established. The 13 Fr UMP outer sheaths were inserted, and the inner sheath was placed with a 3.5 Fr nephroscope. The calculi were observed and the best entry point was observed. The calculi were crushed to $< 3.0\text{mm}$ by 20 μm fiber

holmium laser. After the inner sheath was withdrawn from the outer sheath, the detrital stones and blood clots were flushed out by the dredging catheter combined with the outer sheath, and the F6 DJ tube, catheter and renal fistula were retained after completion. On the basis of the control group, the study group was combined with shuotong endoscopic treatment: After the standard lens (F7.5/F11.5) and rigid ureteral channel sheath (F11.5/F13.5) were fixed, the urethra was retrograde to the upper end of the ureter under the guidance of zebra guidewire, the rigid outer sheath was inserted, the standard lens was removed, and a negative pressure absorbent was connected to the end of the rigid outer sheath. The lithotripsy and holmium laser fiber were inserted at the same time, and the stones were continuously crushed to fragments and powder. At the same time using negative pressure aspirator and hard outer sheath suck out stone fragments and powder, hard stone mirror processing less than, can exit mirror rock, adopt the dual-channel soft ureter mirror broken stone to < 2.0 mm, no obvious calculi after observation in the calyces, replacement of soft lens for standard lens, closely connection with rigid outer sheath slowly quit, observation of ureteral mucosa and the damage of the renal pelvis, The F5 double J tube and F 18 double cavity balloon catheter were indwelled. Two groups of patients were given appropriate antibiotics to prevent postoperative infection. KUB or CT examination was performed on the 1st postoperative day to evaluate the calculus clearance. Calculus clearance was defined as the absence of any residual stones or the maximum diameter of residual stones $\leq 3.0\text{mm}$ as shown by imaging examination.

Observation Indicators

(i) Clinical operation indicators: operation time, average channel establishment time, hemoglobin decline value, number of puncture channels and length of hospital stay were monitored and recorded. (ii) Stress-related indicators: Fasting venous blood was extracted from patients before and after surgery, and placed after centrifugation for examination. C-reactive protein (CRP) was detected by immunoturbidimetry, and the kit was provided by Beckman Biological Co., LTD., USA. Procalcitonin (PCT) was quantitatively detected by fluorescence immunochromatography. Angiotensin i (Ang i) and Angiotensin ii (Ang ii) were

detected by enzyme-linked immunoassay (ELISA) with kits provided by Shanghai Xinyu Biotechnology Co., LTD. (iii) Inflammation related indicators: Prostaglandin E2 (PGE2), Nitric Oxide (NO), and Lipid peroxide (LPO) were determined by ELISA kit provided by Jianglai ELISA Institute of Suzhou before and after surgery. (iv) Renal function indexes: Thyroxine (TH) was detected by electrochemiluminescence before and after thyroxine; Urokinase (UK), Cystatin C (CysC) and β 2-microglobulin (β 2-MG) were detected by enzyme-linked immunoassay (ELISA), kit by Shanghai Bayerwei Trading Co., LTD. (v) Complications and stone clearance rate: The incidence of urinary bleeding, infection, hydronephrosis, urinary fistula and stone clearance were monitored and recorded.

Statistical analysis

SPSS 24.0 statistical software was used. The measurement data conforming to normal distribution were expressed as $\pm S$, and t-test was used for comparison between groups. The counting data were expressed as case number (n) and percentage (%). χ^2 test was used for comparison between groups, and $P < 0.05$ indicated statistically significant differences.

Results and discussion

Comparison of basic data

The results showed that there was no significant difference between the basic data of the study group and the control group before treatment ($P > 0.05$) (Table 1).

Table1. Comparison of basic information

Group	Control group (n = 21)	Study group (n=21)	Statistics	P
Gender (Case)	Male	9 (42.86)	0.689	0.119
	Female	10 (47.62)		
Age (year)	43.59 \pm 3.84	47.63 \pm 4.95	0.367	0.106
Stone diameter (cm)	3.36 \pm 0.35	3.19 \pm 0.41	0.823	0.055
Stone position (case)	Left	10 (47.62)	0.364	0.094
	Right	9 (42.86)		
	Both	2 (9.52)		
The stone type (case)	Multiple	6 (28.57)	0.265	0.062
	Part antler shaped	10 (47.62)		
	Completely antler shaped	5 (23.81)		

Comparison of clinical indicators

The results showed that the average operation time, channel establishment time, hemoglobin decrease value, number of puncture channels and length of hospital stay in the study group were significantly shorter than those in the control group after treatment, with statistically significant differences ($P < 0.05$), as shown in Table 2.

Table 2. Comparison of clinical related indicators ($\bar{X} \pm s$)

Group	Control group (n = 21)	Study group (n=21)
Mean operation time (min)	30.69±12.36	26.34±9.83 [#]
Average channel establishment time	7.75±1.03	7.03±0.91 [#]
Hemoglobin decline value (g/L)	14.06±8.25	10.17±4.95 [#]
Number of puncture channels (PCS)	5.24±2.32	1.05±1.36 [#]
Length of hospital stay (D)	1.65±1.14	1.19±0.72 [#]

Note: Compared with the control group, [#] $P < 0.05$.

Comparison of stress indicators

The results showed that there was no statistical significance in stress index levels before treatment between the 2 groups ($P > 0.05$). After treatment, CRP and PCT in the study group were significantly lower than those in the control group, while Ang i and Ang ii were significantly lower than those in the control group, with statistical significance ($P < 0.05$), as shown in Figure 1.

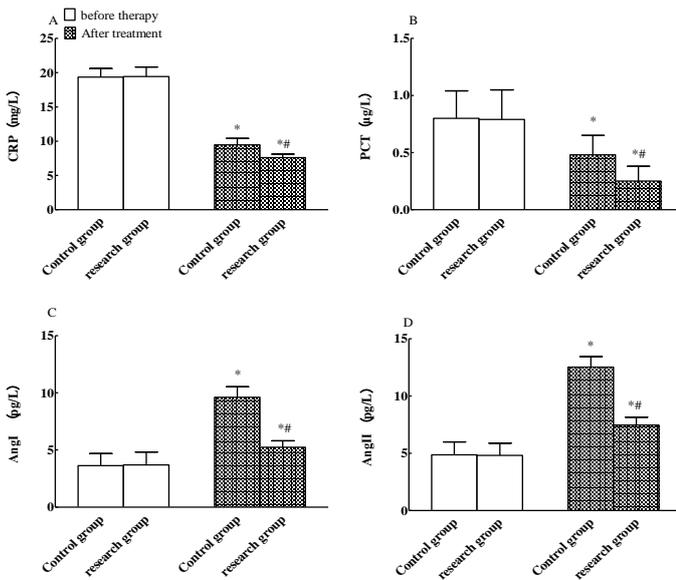


Figure 1. Comparison of stress index levels (A: CRP; B: PCT; C Ang I; D: Ang II, compared with before treatment and control group, [#] $P < 0.05$)

Comparison of inflammatory indicators

The results showed that there was no significant difference in the levels of inflammatory indexes between the 2 groups before treatment ($P > 0.05$). After treatment, the improvement degree of PGE2, NO and LPO levels in the study group was significantly higher than that in the control group, with statistical significance ($P < 0.05$), as shown in Figure 2.

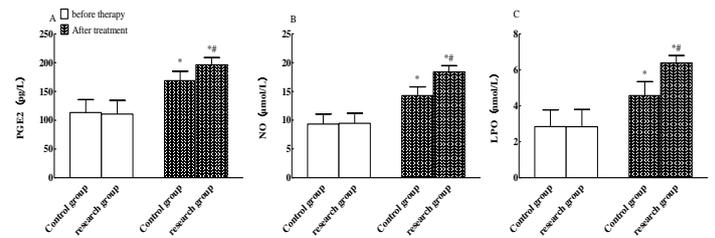


Figure 2. Comparison of inflammation index levels (A: PGE2; B: NO; C LPO, compared with before treatment and control group, [#] $P < 0.05$)

Comparison of renal function indicators

The results showed that there was no significant difference in renal function indexes between the 2 groups before treatment ($P > 0.05$). After treatment, the levels of TH, CYS-C and $\beta 2$ -- MG in the study group were significantly lower than those in the control group. The level of UK in the study group was significantly higher than that in the control group, with statistical significance ($P < 0.05$), as shown in Figure 3.

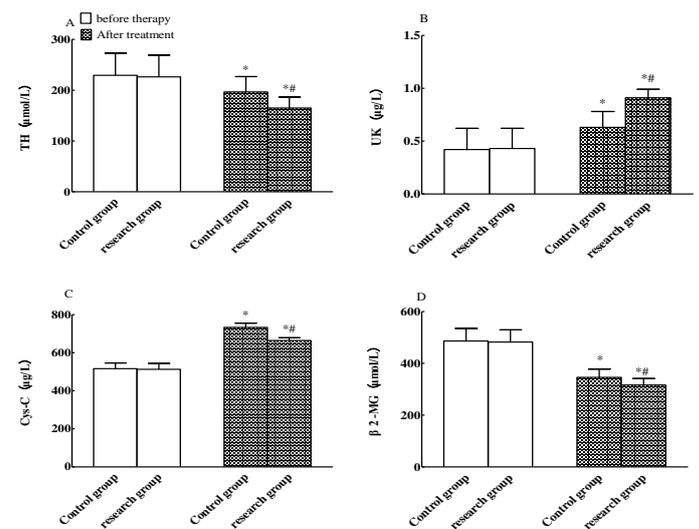


Figure 3. Comparison of renal function index levels (A: TH; B: UK; C Cys-C; D: $\beta 2$ -MG, compared with before treatment and control group, [#] $P < 0.05$)

Comparison of complication rate and stone clearance rate

The results showed that the incidence of complications in the study group (14.29%) was significantly lower than the control group (33.33%). The stone clearance rate of the study group was 95.24%, which was significantly higher than that of the control group (80.95%), and the difference was statistically significant ($P < 0.05$), as shown in Table 3.

Table 3. Comparison of complication rate and stone clearance rate (cases, %)

Group	Control group (n=21)	Study group (n=21)	χ^2	P
	2 (9.52)	1 (4.76)	-	-
Infection	3 (14.29)	2 (9.52)	-	-
Kidney seeper	1 (4.76)	0 (0.00)	-	-
Urinary fistula	1 (4.76)	0 (0.00)	-	-
Complication rate	33.33%	14.29%	0.591	0.021
Stone clearance rate	18 (80.95)	19 (95.24)	0.648	0.006

Polycystic kidney disease (POLYcystic kidney disease) is common hereditary kidney disease. The disease is affected by upper respiratory tract infection, urinary tract infection, intestinal tract infection, resulting in abnormal changes in the body's internal and external environment. The increased activity of the cyst gene promotes the development of the cyst site and further damages the renal collecting system. With the progression of the disease, renal and urinary duct distortion intensifies, and the probability of urinary stasis causing stones increases significantly (11). The causes of kidney stones include urinary stasis or infection, changes in urinary pH, reduction of substances in urine that inhibit crystal formation and aggregation, and abnormal accumulation of oxalic acid or cysteic acid. At the early stage of the clinic, it is found that most patients suffer from severe abdominal pain. Failure to make timely diagnosis and treatment will seriously affect patients' renal function and accelerate infection and deterioration. Polycystic kidney is prone to cyst rupture and coagulation dysfunction, which increases the difficulty of clinical surgical treatment of polycystic kidney with renal stones (12, 13). Ultra-mini percutaneous nephrolithotripsy is widely used in patients with polycystic kidney disease complicated with renal stones, but its safety and feasibility need to be further improved. ShuoTong lens can establish the working channel of the soft and hard lens, integrate gravel and

stone removal, increase stone clearance rate, avoid stone escape, and achieve ideal clinical efficacy. Currently, the application of ShuoTong in the treatment of polycystic kidney disease complicated with kidney stones is rarely seen, and further research is still needed (14, 15). The purpose of this study was to use UMP combined with ShuoTong ureteroscopy in the treatment of polycystic kidney stones and to explore the effects of different treatment methods on the stress response, inflammatory factors and urokinase in patients with polycystic kidney stones.

In the process of kidney stone surgery, too long a puncture time and excessive amount of blood loss may cause stress reaction of the body, and urethral bleeding caused by stone fragmentation or residual and urethral duct infection will aggravate stress reaction of the body and seriously affect the prognosis (16). As an acute-phase protein of the body's non-specific immune mechanism, CRP can effectively identify the pathogenesis, activate complement and mononuclear phagocytic system, and effectively reflect the degree and progress of infection in the body. PCT is abnormally elevated in severe bacterial or viral infection and multiple organ failure, which reflects the active degree of stress level. Renal disease in renal blood flow, promotes the juxtaglomerular apparatus juxtaglomerular cell-secreted renin, prompted the blood hydrolysis angiotensin original directly or indirectly to Ang I, Ang II, vasoconstriction, blood pressure effect, the body's stress response can stimulate the renin-angiotensin system, biosynthesis and release of a large number of Ang I, Ang II (17, 18). Jiao et al. (19) studied the treatment of renal and proximal ureteral stones by soft ureteroscopic lithotripsy and UMP, and UMP effectively shortened the operation time, etc. Soft ureteroscopic lithotripsy had less blood loss and shortened the recovery time. The results showed that the average operation time, channel establishment time, hemoglobin drop value, number of puncture channels and length of hospital stay in the study group were significantly shorter than those in the control group. CRP and PCT decreased significantly in the study group compared with the control group, while Ang I and Ang II increased significantly. This is consistent with Jiao's results. Different operation modes will cause varying degrees of stress reaction, the UMP party joint Pegatron mirror treatment,

quickly establish a channel and reduce the puncture channel number, reduce polycystic kidney cysts larger oppression of cardiovascular system, etc, effectively shorten the operation time, avoid intraoperative bleeding and postoperative blood transfusion rate increase, reduce the body's stress response, control the incidence of postoperative adverse reaction (20).

The inflammatory response is a common complication after clinical surgical treatment. Inflammatory indicators can effectively reflect the level of inflammatory factors, among which PGE₂, NO and LPO are important inflammatory indicators. PGE₂, a metabolite of arachidonic acid cyclooxygenase, affects local renin regulation and has immunosuppressive and inflammatory regulatory effects through parangular cells of the renal parangular organ. NO can effectively inhibit the tricarboxylic acid cycle and DNA synthesis in mitochondria of target cells, which plays an important role in immune regulation and inflammatory injury. As a product of the reaction between oxygen free radicals and polyunsaturated fatty acids, LPO can effectively reflect the oxygen free radicals in the body and liver function (20, 21). The results showed that the improvement of PGE₂, NO and LPO levels in the study group was significantly higher than that in the control group. Different operation modes will cause varying degrees of inflammation, including UMP party joint pegatron mirror treatment, pass through expanded surgical field lens, recognize accurately position the calculi, shorten the puncture channel, efficient clean stone, avoid damage to normal renal parenchyma tissue, reduce polycystic kidney cyst part of the collection system of oppression, reduce inflammation, Improve prognosis (22).

Polycystic kidney disease is often accompanied by diffuse fluid-filled cysts in the renal cortex and medulla that grow progressively and eventually impair renal structure and function, leading to renal failure. Patients with polycystic kidney disease complicated with renal stones are more likely to suffer from renal function damage. After clinical surgical treatment, complications such as urinary tract bleeding, infection and hydronephrosis are common, which seriously affect the prognosis and quality of life. TH is synthesized and secreted by thyroid follicular epithelial cells, regulating the balance of calcium and phosphorus, and relative increase of calcium ions in

patients with kidney stones. The UK can reflect the severity of kidney stone patients, kidney stone patients in vivo significantly reduced; Cys-c is cleared only by glomerular filtration in the body, which is an endogenous marker reflecting the change of glomerular filtration rate and can be used to assess the degree of early renal impairment with high sensitivity. β 2-Mg was filtered freely from the glomerulus, and 99.9% was absorbed in the proximal renal tubules, and decomposed and destroyed in the tubular epithelial cells, reflecting the degree of impaired absorption and filtration of renal function (23). Cabrera et al. (24) used UMP surgery to treat 10-20mm lower extreme kidney stones, effectively controlling the incidence of patients with high success rates. Li et al. (25) treated 1.5~3.5 cm extreme renal calculi with retrograde intrarenal surgery and UMP, and UMP surgery retained the ureteral access sheath, improved surgical efficiency, maintained renal low-pressure perfusion, and had no calculi rate, with significant therapeutic effect. The results showed that the levels of TH, CYS-C and β 2 -- MG in the study group were significantly lower than those in the control group after treatment. The level of UK in study group was significantly higher than that in control group. The incidence of urinary bleeding, infection, hydronephrosis and urinary fistula in the study group was significantly lower than that in the control group. The calculi clearance rate in the study group was significantly higher than that in the control group. The results were consistent with those of Cabrera and Li. These results indicate that UMP combined with shuotong lens can effectively improve renal function, reduce the incidence of postoperative complications, and improve the stone clearance rate in patients with polycystic kidney disease and renal stones, with significant clinical efficacy. Among them, UMP can adopt the smallest puncture channel to avoid additional expansion channel, with a larger operation range of renal pelvis, and reduce the damage to renal parenchyma and blood vessels. At the same time, by expanding the operating field of vision and using soft and hard mirrors and a negative pressure absorption system, ShuoTong ureteroscopy can establish a safe channel, clean and discharge gravel, reduce the damage to renal calyceal and organs, reduce the residual stone rate, improve safety and operability.

In conclusion, UMP combined with ShuoTong ureteroscopy in the treatment of patients with polycystic kidney disease complicated with renal stones can minimize operational injury during surgery. Reduces stress inflammation and improves kidney function. Reduce the incidence of complications and increase the rate of stone removal.

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Interest conflict

The authors declare no conflict of interest.

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