Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 7
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Effect of Shiwei Powder Combined with Stone Composition Analysis on Stone Removal Efficiency and Complication Management after Ureteroscopic Holmium Laser Lithotripsy

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Abstract: *Objective*: To analyze the effect of Shiwei Powder combined with stone composition analysis on stone removal efficiency and complication rates after ureteroscopic holmium laser lithotripsy (FURL). *Methods*: Ninety six patients with FURL admitted to the hospital from March 2023 to March 2025 were selected and randomly divided into two groups. The observation group was treated with FURL combined with Shiwei Powder, while the control group was treated with FURL monotherapy. Based on the stone composition of the two groups, the stone removal efficiency, complication rates, recurrence rates, TCM syndrome scores, and inflammatory factor levels were compared. *Results*: The stone removal efficiency of the observation group was higher than that of the control group. The stone composition was mainly calcium oxalate monohydrate and composite stones containing calcium oxalate monohydrate. The incidence of postoperative complications was lower in the observation group than in the control group ($P < 0.05$). After 3–6 months of follow-up, the recurrence rate in the observation group was lower than that in the control group ($P < 0.05$). After treatment, the TCM syndrome scores and inflammatory factor levels in the observation group were lower than those in the control group ($P < 0.05$). *Conclusion*: Based on the results of urinary stone composition analysis, patients treated with Shiwei Powder after FURL have higher stone removal efficiency. The most significant effect is observed in urinary stones composed of calcium oxalate monohydrate and composite stones containing calcium oxalate monohydrate. This treatment can improve stone removal, prevent complications, reduce recurrences, effectively improve disease symptoms, and reduce inflammation.

Keywords: Shiwei Powder; Ureteroscopic holmium laser lithotripsy; Stone removal efficiency; Stone composition analysis; Complications

Online publication: August 4, 2025

1. Introduction

Ureteral stones are a common urological disease with a high incidence, and typical symptoms include hematuria or urinary pain, requiring early surgical treatment [1]. Ureteroscopic holmium laser lithotripsy (FURL) is a

commonly used surgical procedure for this disease. It involves the precise placement of a holmium laser through a ureteroscope to break up and remove stones, effectively clearing them. The removed stones are routinely analyzed for stone composition. However, patients often have residual stones after surgery, and due to factors such as stone irritation and surgical manipulation, they have a high risk of developing secondary infections or postoperative pain, requiring subsequent treatment. In traditional Chinese medicine, ureteral stones are classified as "stone strangury," and the etiology and pathogenesis are believed to be damp-heat descending due to kidney essence deficiency. The treatment principle is to eliminate dampness and heat, and promote urination to remove stones. Shiwei Powder is one of the classic prescriptions for such patients, with effects such as cooling blood to stop bleeding, resolving phlegm and clearing the lungs, promoting urination and clearing heat, and promoting urination to remove stones, which can significantly improve the efficiency of stone removal after FURL [2]. Therefore, in this study, 96 patients with FURL were selected to analyze the impact of Shiwei Powder on postoperative stone removal efficiency and its relationship with stone composition.

2. Materials and methods

2.1. General information

Ninety-six patients with FURL admitted to the hospital from March 2023 to March 2025 are included and randomly divided into two groups using a random number table. The observation group consisted of 48 patients, including 27 males and 21 females, with ages ranging from 38 to 75 years (mean age: 46.53 ± 3.84 years). The duration of the disease is between 0.4 and 5 years (mean duration: 1.99 ± 0.53 years), and the diameter of the stones ranged from 1.05 to 1.95 cm (mean diameter: 1.55 ± 0.43 cm). The control group also consisted of 48 patients, including 28 males and 20 females, with ages ranging from 36 to 73 years (mean age: 46.71 ± 3.68 years). The duration of the disease is between 0.5 and 5 years (mean duration: 2.03 ± 0.61 years), and the diameter of the stones ranged from 1.04 to 1.98 cm (mean diameter: 1.58 ± 0.49 cm). There are no significant differences between the two groups in terms of these characteristics ($P > 0.05$).

2.1.1. Inclusion criteria

(1) Diagnosis of ureteral stones according to the "Chinese Urological Disease Diagnosis and Treatment Guideline Handbook" [3].
(2) Meeting the indications for FURL treatment.
(3) Adult patients.
(4) Complete clinical data.
(5) Normal mental status.
(6) Good communication skills.
(7) Full knowledge of the study.

2.1.2. Exclusion criteria

(1) Patients with malignant tumors.
(2) Patients with concurrent urinary tract infections or other urological diseases.
(3) Patients with severe complications.
(4) Patients with cardiac or renal insufficiency.

(5) Patients in lactation or pregnancy.
(6) Patients who withdrew from the study.

2.2. Methods

The control group received FURL monotherapy. The patient is placed in a prone position and underwent general anesthesia with endotracheal intubation. A ureteral catheter is slowly placed through the urethra, and ultrasound is used for evaluation. Renal puncture is then performed, a zebra guidewire is placed, and the needle sheath of the puncture needle is withdrawn after effective fixation. Guided by the guidewire, the puncture tract is moderately dilated, and a nephroscope is placed to create a percutaneous nephrolithotomy channel. The nephroscope is used as the operating scope to locate the stones, which are then fragmented using holmium laser. The parameters are set as follows: power is set to 40–60W, laser pulse is set to 2.0–3.0J at 10–20Hz, a 550μm fiber is used, and the pulse frequency is set to 15–20 times/min. A perfusion pump is used to remove the stones with water pressure. The presence of residual stones is evaluated, and if no residuals are found, the ureteral catheter is withdrawn, and a double-J stent and an F14 silicone catheter are placed. The silicone catheter is removed 1 week after surgery, and the double-J stent is removed 4 weeks after surgery. Patients are instructed to take cefotiam orally for 3 consecutive days after surgery to prevent infection.

The observation group received treatment with modified Shi Wei San after FURL surgery. The prescription consisted of: Shi Wei (60g), Hua Shi (150g), Qu Mai (30g), Che Qian Zi (90g), and Dong Kui Zi (60g). If damp-heat was severe, Huang Bai (15g) and Jin Yin Hua (15g) were added. If hematuria was severe, Bai Mao Gen (15g) and Da Ji (15g) were added. The above medicinal herbs are decocted with water, 400ml taken daily, warmly administered after breakfast and dinner. The medication started on the second day after surgery and continued for 2 to 4 weeks.

The method of stone composition analysis is as follows: Take stone samples, observe their properties, colors, and shapes, clean them thoroughly, and then dry them. Take 1.0 to 15mg of the stone sample, place it in an agate bowl, and add 200 to 300mg of potassium bromide. Grind the mixture until it becomes a particle-free powder, then perform tablet pressing. Place one flat scoop of the ground mixture into the tablet pressing mold, ensuring uniform distribution, and apply pressure between 15 and 20Mpa to form a translucent thin slice. Remove the slice and observe its composition in an infrared spectrum automatic analyzer.

2.3. Observation indicators

(1) Stone expulsion efficiency: X-ray examination is performed on patients at 2 and 4 weeks after surgery. Stone expulsion is considered successful if the stone diameter is less than 0.7cm or there was no residual stone, denoted as stone expulsion efficiency.
(2) Incidence of complications: Observe the incidence of postoperative pain, fever, infection, and ureteral orifice injury.
(3) Recurrence rate: Follow-up for 3 to 6 months to observe the recurrence rate of stones.
(4) TCM syndrome score: Before treatment and after 4 weeks, a 4-point scoring system is used, including nausea and vomiting, lumbar and abdominal colic, urgency, and hematuria, each with a score range of 0 to 6, totaling 24 points. Higher scores indicated more severe symptoms.
(5) Levels of inflammatory factors: Before treatment and after 4 weeks, fasting venous blood is collected, and levels of white blood cell count (WBC), procalcitonin (PCT), C-reactive protein (CRP), and interleukin-6

(IL-6) are measured using an automatic blood analyzer with an enzyme-linked immunosorbent assay.

2.4. Statistical analysis

Data processing software is SPSS 28.0. Measurement data are tested for normal distribution using the K-S method and expressed as [$\bar{x} \pm s$]. T-values are used for comparison and testing. Count data are expressed as [n/%], and chi-square values are used for comparison and testing. Statistical significance is set at $P < 0.05$.

3. Results

3.1. Comparison of stone expulsion efficiency between the two groups

At 2 and 4 weeks after surgery, the stone expulsion efficiency of the observation group was higher than that of the control group ($P < 0.05$). The main component of the stones was calcium oxalate monohydrate, as shown in **Table 1**.

Table 1. Comparison of stone expulsion efficiency between the two groups [n/%]

Group	Number of cases	2 weeks postoperative	4 weeks postoperative
Observation group (n=48)	48	40 (83.33%)	46 (95.83%)
Control group (n=48)	48	31 (64.58%)	40 (83.33%)
χ^2 value		4.381	4.019
P-value		0.036	0.045

3.2. Analysis of the success rate of stone expulsion after treatment with Shi Wei powder with different stone composition

All 48 patients in the study group were treated with modified Shi Wei San. The analysis of stone composition and the success rate of stone expulsion are shown in **Table 2**.

Table 2. Success rate of stone expulsion after taking Shi Wei powder in patients with different stone compositions

Stone composition	Number of cases	Total proportion (%)	Successful expulsion cases	Success rate (%)
Calcium Oxalate Monohydrate + Dihydrate	8	16.66	6	75.00
Calcium Oxalate Monohydrate	15	31.25	13	86.67
Anhydrous Uric Acid	4	8.33	3	75.00
Calcium Oxalate Monohydrate + Dihydrate + Carbonate Apatite	6	12.50	3	50.00
Calcium Oxalate Monohydrate + Carbonate Apatite	5	10.42	3	60.00
Calcium Oxalate Monohydrate + Anhydrous Uric Acid	4	8.33	2	50.00
Calcium Oxalate Monohydrate + Ammonium Urate	3	6.25	1	33.33
Carbonate Apatite	1	2.08	0	0
Brushite (Calcium Hydrogen Phosphate Dihydrate)	1	2.08	0	0
Cystine	1	2.08	0	0

3.3. Comparison of complication rates between the two groups

The complication rate in the observation group was lower than that in the control group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of complication rates between the two groups [n (%)]

Group	Number of cases	Postoperative pain	Fever	Infection	Ureteral orifice injury	Total incidence
Observation Group (n=48)	48	1 (2.08)	1 (2.08%)	0	0	4.17% (2/48)
Control Group (n=48)	48	2 (6.25)	3 (6.25%)	1 (2.08%)	2 (4.17%)	16.67% (8/48)
χ^2 value						4.019
P-value						0.045

3.4. Comparison of recurrence rates between the two groups

After 3 and 6 months of follow-up, the recurrence rate in the observation group was lower than that in the control group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of recurrence rates between the two groups [n (%)]

Group	Number of cases	2 weeks postoperative	4 weeks postoperative
Observation group (n=48)	48	0	1 (2.08%)
Control group (n=48)	48	4 (8.33%)	7 (14.58%)
χ^2 value		4.174	4.909
P-value		0.041	0.027

3.5. Comparison of TCM syndrome scores between the two groups

Before treatment, there was no difference in TCM syndrome scores between the two groups ($P > 0.05$). After 4 weeks of treatment, the TCM syndrome score in the observation group was lower than that in the control group ($P < 0.05$), as shown in **Table 5**.

Table 5. Comparison of TCM syndrome scores between groups [Mean±SD, points]

Group	Cases	Nausea/ Vomiting		Abdominal/ Renal colic		Urinary Urgency		Hematuria	
		Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx
Observation	48	3.72 ± 0.58	2.35 ± 0.29	3.43 ± 0.46	1.64 ± 0.27	4.10 ± 0.41	2.11 ± 0.51	3.21 ± 0.41	1.70 ± 0.28
Control	48	3.74 ± 0.61	3.02 ± 0.37	3.45 ± 0.50	2.16 ± 0.31	4.12 ± 0.43	2.62 ± 0.55	3.23 ± 0.44	2.21 ± 0.35
t-value		0.165	9.874	0.204	8.764	0.233	4.711	0.230	7.883
p-value		0.870	0.000	0.839	0.000	0.816	0.000	0.818	0.000

3.6. Comparison of inflammatory factor levels between the two groups

Before treatment, there was no difference in inflammatory factor levels between the two groups ($P > 0.05$). After 4 weeks of treatment, the inflammatory factor levels in the observation group were lower than those in the control group ($P < 0.05$), as shown in **Table 6**.

Table 6. Comparison of inflammatory factor levels between groups [Mean±SD]

Group	Cases	WBC (×10⁹/L)		PCT (μg/L)		CRP (mg/L)		IL-6 (ng/L)	
		Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx
Observation	48	16.95 ± 2.74	9.71 ± 1.55	3.72 ± 0.66	1.24 ± 0.33	20.71 ± 3.23	10.76 ± 1.74	19.63 ± 2.15	10.42 ± 1.78
Control	48	16.91 ± 2.83	12.43 ± 1.68	3.75 ± 0.64	1.86 ± 0.37	20.19 ± 3.16	14.56 ± 1.77	19.60 ± 2.19	13.93 ± 1.81
t-value		0.070	8.244	0.226	8.664	0.797	10.607	0.068	9.579
p-value		0.944	0.000	0.822	0.000	0.427	0.000	0.946	0.000

4. Discussion

The pathogenic factors of ureteral stones include poor dietary structure, excessive life pressure, and emotional disorders, which can occur at any age, and the incidence rate is higher in males than in females. The main symptoms of the disease are hydronephrosis, hematuria, and lumbar and abdominal colic. For small stones, they may be expelled spontaneously after drinking a large amount of water daily or taking oral stone expulsion medications. If the stone is large, surgical intervention is required [4]. FURL has a high surgical success rate for this disease, as it allows clear visualization of the surgical field with a nephroscope and maintains clarity through repeated irrigation, enabling precise stone fragmentation and removal. However, FURL may cause inflammatory reactions postoperatively, which are related to various factors such as stone diameter, surgical duration, and urinary tract infection, and can simultaneously damage renal function. Additionally, small stones may remain after FURL, which can develop into larger stones over time, thereby increasing the recurrence rate and requiring additional treatment for stone fragmentation and expulsion, which is not conducive to long-term prognosis.

Ureteral stones are categorized under “sand strangury” and “stone strangury” in traditional Chinese medicine. The etiology is attributed to excessive consumption of fatty and sweet foods, external contraction of dampness, and internal generation of damp-heat. The coexistence of dampness and heat can damage the bladder, leading to bladder Qi transformation disorders, which in turn cause symptoms such as painful urination, known as heat strangury. In the early stages of ureteral stones, they belong to the category of excess syndromes. Continuous damage to blood vessels caused by damp-heat in the body can lead to blood strangury, which obstructs the vessels and hinders the flow of qi and blood, evolving into a syndrome of blood stasis [5]. Under these pathological changes, impurities distributed in the urine can coagulate into small pieces that accumulate in the urethra and bladder, known as sand strangury. Thus, the pathogenesis of ureteral stones involves Qi transformation disorders, accumulation of damp-heat, and kidney essence deficiency. The treatment principles include promoting stone expulsion and strangury, dispelling dampness and clearing heat, combined with promoting blood circulation, regulating Qi, nourishing essence, and tonifying the kidneys [6].

Shi Wei San is a frequently used decoction for stone expulsion. Among its ingredients, Shi Wei (*Pyrrosia lingua*) has the effect of promoting strangury, dispelling dampness, and clearing heat; Talc (Hydrated Magnesium Silicate) can promote strangury, dissolve stones, and open orifices; Qu Mai (*Dianthus superbus*) has the effect of promoting menstrual flow, breaking blood stasis, and clearing the heart to promote strangury; Plantago Seed (*Plantago asiatica*) can promote urination and clear heat; and Dong Kui Zi (*Malva verticillata*) can smooth the orifices and dredge bladder congestion. The combined use of these herbs can promote urination, expel stones, clear heat, and promote strangury [7].

The results showed that the stone expulsion efficiency of the observation group was higher than that of the

control group. The stone components were mainly calcium oxalate monohydrate and its composite components. The proportion of calcium oxalate monohydrate in the stone components was the highest, accounting for 33.33% of the total 48 cases in the study group. Patients whose stone components did not include calcium oxalate monohydrate accounted for only 11.24%. Patients whose main stone component was calcium oxalate monohydrate showed significant effects on stone expulsion after taking Shi Wei San, with a successful stone expulsion rate of 86.67%. Patients whose stone components included calcium oxalate monohydrate also had a higher stone expulsion rate. However, patients with calcium hydrogen phosphate dihydrate, carbonate apatite, and cystine stones did not expel stones after taking Shi Wei San. Due to the small amount of data, there was no comparative value for the study. The incidence of complications in the observation group was lower than that in the control group.

After 3 to 6 months of follow-up, the recurrence rate in the observation group was lower than that in the control group, and the scores of traditional Chinese medicine syndromes and inflammatory factor levels were lower than those in the control group ($P < 0.05$). The reason for this is that Shi Wei can significantly enhance the phagocytic function of phagocytes, reduce the effective synthesis of prostaglandins, and exert an antibacterial mechanism [8]. Talc contains components such as hydrated magnesium silicate, which can increase urine volume and exert a flushing effect on the urinary tract, thereby expelling residual stones after surgery. Its silicate component has strong adsorbability to components such as calcium phosphate in the urine, which can prevent stone recurrence. Qu Mai contains components such as *Dianthus saponins*, which can inhibit calcium ion channels and improve spasmodic pain symptoms [9]. Plantago Seed can improve urine flow dynamics, regulate urine viscosity, and exert a mucus flushing effect. Dong Kui Zi contains phenolic acids and polysaccharides, which can increase urine lubrication and improve the peristaltic state of the ureter, thereby assisting in stone expulsion. Based on this, the efficiency of stone expulsion after treatment with Shi Wei San is increased, and it is less likely to cause complications. The symptoms of patients are significantly reduced, and the risk of recurrence is lower [10].

Infrared spectroscopy was used to analyze the components of the stones. The stone samples were mixed with potassium bromide, pressed into tablets, and scanned in the first phase. The absorption peak characteristics presented in the infrared region were used to determine the stone components, which facilitated the analysis of the relationship between stone components and stone expulsion effects. Additionally, Shi Wei can reduce the release of proinflammatory factors, Qu Mai can inhibit various pathogenic bacteria, Plantago Seed has antibacterial and anti-inflammatory mechanisms, and can down-regulate patients' inflammatory factor levels.

5. Conclusion

In summary, the modified Shi Wei San treatment for patients after FURL surgery has a better effect, especially for stones composed of calcium oxalate monohydrate and composite stones containing calcium oxalate monohydrate. It also has a good effect on stone expulsion for patients with anhydrous uric acid stones and a poor effect on stone expulsion for patients whose stone components do not include calcium oxalate monohydrate. The modified Shi Wei San can accelerate post-surgical stone expulsion, and combining it with stone component analysis can maximize the safety of the surgery.

Disclosure statement

The authors declare no conflict of interest.

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