AMLR Asociația de Medicină de Laborator din România

Romanian Journal of Laboratory Medicine 2026;34(2):129–136

ORIGINAL RESEARCH

DOI:10.2478/rrlm-2026-0010

Adjunctive Sanjin Paishi Decoction plus phloroglucinol for enhanced recovery following ureteroscopic holmium laser lithotripsy: Effects on stone expulsion, inflammation, and oxidative stress

Hexiang An[1]*, Penghua Liu[1], Chuanhong Zheng[1], Shengnan Sun[2]

1. Department of Urology, Bao'an Center Hospital of Shenzhen, China
2. Department of Rehabilitation, Shenzhen Nanshan People's Hospital, China

ABSTRACT

Background: Ureteral calculi are common in urological practice, and ureteroscopic holmium laser lithotripsy (HLUL) is the preferred minimally invasive treatment. However, postoperative residual fragments and inflammatory responses remain frequent. This study evaluated the efficacy of Sanjin Paishi Decoction (SJPSD) combined with phloroglucinol in promoting stone expulsion and alleviating inflammation and oxidative stress following HLUL.

Methods: In this prospective randomized controlled trial, 192 patients with ureteral stones were assigned to either phloroglucinol alone (control) or SJPSD plus phloroglucinol (combined). After exclusions, 183 patients (control: 92; combined: 91) were analyzed. Outcomes assessed included stone-free rates at 7 and 14 days, hospital stay, postoperative pain (VAS), inflammatory markers (CRP, TNF-α, IL-6), oxidative stress indices (CAT, GSH-Px, MDA, ROS), and complications.

Results: The combined group achieved higher stone-free rates at 7 and 14 days (87.9% and 98.9%) than the control group (65.2% and 91.3%, $p < 0.05$) and reduced hospitalization time ($p < 0.001$). Patients in the combined group reported lower VAS scores and exhibited significantly decreased inflammatory mediators (CRP, TNF-α, IL-6) and oxidative stress markers (MDA, ROS) at day 7 (all $p < 0.05$). Furthermore, the incidence of complications was lower in the combined group (2.2%) than that in the control group (11.96%) ($p < 0.05$).

Conclusions: Adjunctive SJPSD with phloroglucinol accelerates stone clearance, shortens recovery, relieves pain, and attenuates inflammation and oxidative stress, while reducing postoperative complications in HLUL patients.

Keywords: inflammation, holmium laser lithotripsy, oxidative stress, phloroglucinol, Sanjin Paishi Decoction, ureteral calculi

Received: 13 October 2025; Accepted: 18 January 2026; Published: 2 March 2026.

INTRODUCTION

Ureteral calculi are common urological disorders that frequently cause severe colicky pain and may lead to infection, obstruction, or renal impairment if not treated effectively [1]. Ureteroscopic holmium laser lithotripsy (HLUL) is currently considered a minimally invasive and efficient surgical option, offering high stone clearance rates and rapid recovery [2]. However, postoperative complications, such as residual stone fragments and infection, remain major clinical challenges, while postoperative inflammatory responses and oxidative stress also play important roles in patient recovery. Reported complication rates such as fever, infection, and postoperative shivering range from 4% to 25%, and severe cases may progress to systemic inflammatory response syndrome (SIRS) [3, 4]. Thus, strategies that facilitate postoperative stone expulsion and mitigate inflammation and oxidative stress are urgently needed.

Medical expulsive therapy (MET) has been widely adopted to accelerate the clearance of stone fragments after interventions like shockwave lithotripsy (SWL). Clinical evidence demonstrates that pharmacological agents can shorten expulsion time, improve stone-free rates, and alleviate postoperative pain [5, 6]. Among these, phloroglucinol, a non-papaverine smooth muscle relaxant, has shown favorable outcomes. It selectively targets spastic smooth muscle, reduces ureteral spasms, and promotes the passage of residual fragments while exhibiting minimal side effects [7]. Beyond its spasmolytic activity, phloroglucinol also possesses antioxidant, hepatoprotective, and anti-inflammatory properties, which may further contribute to postoperative recovery [8].

* Corresponding author: Hexiang An, Department of Urology, Bao'an Center Hospital of Shenzhen, China. E-mail: huilan7230hu@163.com

In parallel, Traditional Chinese Medicine (TCM) has attracted increasing attention as an adjunct in urolithiasis management. Sanjin Paishi Decoction (SJPSD) is a classical TCM formulation comprising herbs such as *Lygodium japonicum*, *Lysimachia christinae*, *Pyrrosia lingua*, and *Plantago asiatica*. Modern pharmacological studies suggest that SJPSD exerts diuretic, anti-inflammatory, litholytic, and ureteral peristalsis-enhancing effects [9]. It has been reported to promote residual stone expulsion after surgery, relieve urinary tract obstruction, and reduce the recurrence of calculi, without significant adverse effects [9]. Moreover, SJPSD has demonstrated regulatory effects on inflammatory mediators and oxidative stress pathways, suggesting potential synergy with Western pharmacological agents.

Although both phloroglucinol and SJPSD have demonstrated individual benefits in urolithiasis management, their combined application in the perioperative setting of HLUL has not been systematically evaluated. Oxidative stress, driven by excessive production of reactive oxygen species (ROS), is increasingly recognized as a critical contributor to tissue injury, postoperative inflammation, and delayed recovery [10]. Phloroglucinol has been shown to modulate oxidative stress by elevating enzymatic and non-enzymatic antioxidants [11], while SJPSD may attenuate ROS-mediated damage through its anti-inflammatory herbal constituents. Taken together, their complementary mechanisms suggest a potential synergistic effect on stone clearance, pain relief, and protection against inflammation and oxidative stress. Therefore, this prospective randomized trial was conducted to evaluate the efficacy of SJPSD combined with phloroglucinol in patients undergoing HLUL. We assessed stone-free rates, hospitalization time, pain, inflammatory and oxidative stress markers, and complication rates compared with phloroglucinol alone. To our knowledge, this is the first prospective randomized study to systematically evaluate the perioperative effects of SJPSD combined with phloroglucinol in patients undergoing HLUL. This integration of TCM and conventional therapy may provide new evidence for a potential adjuvant strategy to enhance postoperative stone clearance and attenuate inflammatory and oxidative stress responses in patients with ureteral calculi.

METHODS

Ethics approval

All study procedures were reviewed and approved by the Medical Ethics Committee of our hospital (approval no. 2022117, November 21st 2022). Written informed consent was obtained from all patients after they were informed of the study details.

Sample size calculation

The primary efficacy endpoint was the stone expulsion rate at 7 days postoperatively. According to previous literature [12], the expected expulsion rate with phloroglucinol monotherapy was 64%. We hypothesized that the combination of SJPSD and phloroglucinol would achieve an 85% expulsion rate. Using PASS 15.0 with a two-sided α of 0.05 and 1-β of 0.90, the required sample size was calculated as 86 patients per group. Considering a 10% dropout rate, a minimum of 96 patients per group (192 in total) was planned.

Study subjects

From May 2023 to May 2025, a total of 192 patients with ureteral calculi who underwent HLUL at our hospital were consecutively enrolled. All patients presented with renal colic or hematuria on admission.

Inclusion criteria: (1) Diagnosis of ureteral calculi based on the European Association of Urology Guidelines on the Diagnosis and Treatment of Ureteral Injury [13], confirmed by urinary color Doppler ultrasound; (2) age 18-70 years; (3) Single unilateral ureteral calculi without concurrent renal stones, ureteral stricture, or lower pole renal stones; (4) No prior ureteral surgery; (5) Clear consciousness and stable vital signs; (6) No severe dysfunction of vital organs; (7) Stone diameter 0.8-2 cm; (8) Willingness to participate and provide informed consent.

Exclusion criteria: (1) Severe hydronephrosis preoperatively; (2) Recent regular use of antiplatelet agents; (3) Prior extracorporeal shock wave lithotripsy; (4) Concurrent urinary tract infection; (5) Psychiatric disorders or impaired consciousness; (6) Presence of malignant tumors.

Elimination criteria: (1) Use of more than one type of ureteroscope during the procedure; (2) Use of other lithotripsy modalities besides holmium laser; (3) Incomplete postoperative follow-up data.

Grouping

All eligible patients provided written informed consent before surgery. They were then randomly assigned using a random number table to either the control group (phloroglucinol monotherapy) or the combined group (SJPSD plus phloroglucinol).

Surgical treatment

All patients underwent HLUL. Under general or spinal anesthesia, patients were placed in the lithotomy position, and a 100-W holmium: YAG laser lithotripter (Shanghai, China) was used for stone fragmentation. During the procedure, a guidewire was employed to direct the rigid ureteroscope through the urethra into the bladder to identify the ureteral orifice. A Fr12/14 ureteral access sheath was inserted to establish an operative channel, with con-

tinuous saline irrigation maintained. A 200 µm holmium laser fiber was then introduced through the working channel of the scope, with parameter settings adjusted dynamically based on stone hardness: energy 0.8-1.2 J, frequency 10-15 Hz. The fiber was precisely positioned against the stone surface to achieve dusting. For larger fragments ≥ 2 mm, a stone basket was actively used for retrieval. A double-J stent was routinely placed upon completion of the procedure, and the absence of active bleeding or mucosal injury was confirmed upon scope withdrawal. Postoperatively, vital signs and urine output were monitored for 24 hours. Patients were encouraged to ambulate on the same day and maintain a daily fluid intake of ≥ 2500 mL. Stone clearance was evaluated by CT one month post-surgery. All procedures were performed by the same senior surgeon.

Pharmacological treatment

Control group: On the day of surgery, patients received phloroglucinol (Hubei Wushi Pharmaceutical Co., Ltd., China, No. H20060385) 80 mg + 250 mL of 5% glucose solution intravenously once daily for 7 days.

Combined group: In addition to the control group's regimen, patients were administered SJPSD on the day of surgery. The prescription consisted of *Lysimachia christinae* (15 g), *Semen Lygodii* (15–30 g), *Endothelium Corneum Gigeriae Galli* (5 g), *Pyrrosia lingua* (15 g), *Talcum* (10 g), *Achyranthes bidentata* (12 g), *Aurantii Fructus Immaturus* (15 g), *Alisma orientale* (15 g), *Sparganium stoloniferum* (5 g), *Curcuma zedoaria* (5 g), *Corydalis yanhusuo* (10 g), and *Paeonia lactiflora* (10 g). Adjustments were made according to individual symptoms: for kidney deficiency, add *Codonopsis pilosula* (15 g), *Astragalus membranaceus* (15 g), *Eucommia ulmoides* (10 g), and *Cornus officinalis* (12 g); for yin deficiency, add *Rehmannia glutinosa* (12 g), *Ligustrum lucidum* (12 g), and *Lycium barbarum* (10 g); for hematuria, add *Cephalanoplos segetum* (10 g) and *Sanguisorba officinalis* (10 g). All herbal medicines were supplied by the hospital pharmacy and decocted by the hospital's preparation center. Each patient received one dose per day (250 mL), divided into two servings (morning and evening), for a total treatment period of 7 days.

Evaluation indicators

General data: Baseline characteristics were recorded, including sex, age, BMI, disease duration, operation time, stone diameter and location, affected side, and underlying diseases.

Stone-free rate: Stone clearance at 7 and 14 days was evaluated by urinary system ultrasonography, and CT was used to confirm stone clearance at 1 month postoperatively. The stone-free rate was calculated as (number of patients with stone clearance / total patients in the group) × 100%.

Pain assessment: The Visual Analog Scale (VAS) [14] was used to quantify pain prior to treatment (prior to adjuvant therapy on the day of surgery) and on 7 days postoperatively. VAS scores ranged from 0 (no pain) to 10 (unbearable pain). Scores ≤ 3 indicated mild, tolerable pain; scores of 4–6 indicated moderate pain affecting sleep; and scores of 7–10 indicated severe, intolerable pain.

Inflammatory markers: Fasting venous blood (5 mL) was collected on the day of surgery and on postoperative day 7. After centrifugation at 3000 r/min, serum was isolated for measurement of C-reactive protein (CRP), tumor necrosis factor-α (TNF-α), and interleukin-6 (IL-6) using enzyme-linked immunosorbent assay (ELISA). The Human CRP ELISA Kit (PC190), Human TNF-α ELISA Kit (PT518), and Human IL-6 ELISA Kit (PI330) were all available from Beyotime Biotechnology (Shanghai, China) [15].

Oxidative stress levels: Serum levels of catalase (CAT), glutathione peroxidase (GSH-Px), malondialdehyde (MDA), and reactive oxygen species (ROS) were measured using commercial assay kits according to the manufacturers' instructions. The CAT (A007-1-1), GSH-Px (A005-1-2), MDA (A003-1-2), and ROS (E004-1-1) assay kits were purchased from Nanjing Jiancheng Bioengineering Institute (Nanjing, China).

Complications: Postoperative complications, including urinary tract infection, urine extravasation, hemorrhage, lumbar pain, and ureteral spasm, were recorded during hospitalization and within one month after surgery. The incidence of complications was compared between groups.

Statistical analysis

Data entry was performed using Microsoft Excel, and statistical analysis was implemented using IBM SPSS version 25.0. Normally distributed continuous variables were expressed as mean ± standard deviation (Mean ± SD). Paired sample t-tests were applied for within-group comparisons, while independent sample t-tests were employed for between-group comparisons. Non-normally distributed data were presented as median with interquartile range (IQR) and analyzed using the Mann-Whitney U test. Repeated measures ANOVA was applied for longitudinal continuous data. Categorical variables were described as frequencies (n) and analyzed using the chi-square test. A p value < 0.05 was considered statistically significant.

RESULTS

General data

In total, 192 patients were initially enrolled. During the entire study period, 3 patients (2 in the control group and 1 in the combined group) were lost to follow-up after discharge, and 6 patients (2 control, 4 combined group) were excluded because holmium laser was not

used exclusively. Ultimately, 183 patients completed the trial, including 92 in the control group and 91 in the combined group. No statistically significant differences were noted between the two groups regarding general characteristics such as sex, age, BMI, disease duration, operative time, stone diameter and location, affected side, or underlying diseases ($p > 0.05$) (Table 1).

Stone-free rates, hospital stay, and pain scores

The combined group had a significantly shorter hospital stay than the control group ($p < 0.05$). At day 7, the stone-free rate was 65.22% in the control group and 87.91% in the combined group; at day 14, the rates were 91.30% and 98.90%, respectively. Both time points demonstrated significantly higher clearance rates in the combined group ($p < 0.05$). Baseline VAS scores did not differ between groups ($p > 0.05$). By day 7, pain levels had decreased in both groups, but the reduction was greater in the combined group, yielding significantly lower scores ($p < 0.05$) (Table 2).

Inflammation, oxidative stress, and complications

Before treatment, CRP, TNF-α, and IL-6 levels were comparable between groups ($p > 0.05$). By postoperative day 7, all three markers declined in both groups, with significantly lower values in the combined group ($p < 0.05$) (Table 3).

Baseline levels of CAT, GSH-Px, MDA, and ROS were similar between groups ($p > 0.05$). At day 7, CAT and GSH-Px levels decreased, while MDA and ROS increased in both groups. However, the combined group showed significantly lower MDA and ROS levels ($p < 0.05$), whereas CAT and GSH-Px levels did not differ between groups ($p > 0.05$) (Table 3).

In the control group, complications included bleeding (n = 3), urinary tract infection (n = 1), ureteral spasm (n = 1), extravasation (n = 3), and low back pain (n = 3). The combined group reported only one case of extravasation and one case of low back pain. The overall incidence of complications was significantly lower in the combined group than in the control group (2.20% vs. 11.96%, $p < 0.05$) (Table 3).

DISCUSSION

This prospective randomized trial demonstrated that SJPSD combined with phloroglucinol significantly improved postoperative outcomes in patients undergoing HLUL for ureteral calculi. Compared with phloroglucinol alone, the combined regimen achieved higher early stone-free rates, shorter hospitalization, lower pain scores, reduced systemic inflammation and oxidative stress, and fewer complications. These findings highlight the clinical potential of an integrative therapeutic approach in the perioperative management of urolithiasis.

The enhanced stone-free outcomes observed in the combined group underscore the efficacy of SJPSD as an adjunct. This is consistent with prior evidence that MET, such as α-blockers and PDE-5 inhibitors, accelerates

Table 1 Comparison of general data between the control and combined groups

	Control group (n=92)	Combined group (n=91)	t / C^2	*p* value
Age (years)	42.1 ± 9.6	41.8 ± 10.2	0.201	0.841
Body mass index (kg/m^2)	22.96 ± 1.88	23.12 ± 1.67	-0.609	0.653
Disease duration (months)	8.0 [6.0-10.0]	8.0 [6.5-9.5]	-0.086	0.932
Operative time (min)	82.2 ± 10.6	80.7 ± 11.2	0.933	0.352
Sex (male)	53	46	0.918	0.338
Stone diameter (cm)	1.50 [1.40-1.70]	1.50 [1.30-1.70]	-1.087	0.277
Stone location (upper segment)	17	19	1.271	0.530
Stone location (middle segment)	30	35		
Stone location (lower segment)	45	37		
Affected side (left side)	38	44	0.919	0.338
Affected side (right side)	54	47		
Diabetes	19	15	0.526	0.468
Hypertension	31	26	0.560	0.454
Hyperlipidemia	9	6	0.618	0.432

All patients underwent holmium laser ureteroscopic lithotripsy. The control group was given phloroglucinol i.v. 80mg/day, for seven days. In addition to the control group's regiment, the combined group were administered Sanjin Paishi Decoction two times a day for seven days. Data are presented as numbers (n), mean ± standard deviation, or median with [interquartile range].

Table 2 Comparison of stone-free rates, hospital stay, and VAS scores between groups

		Control group (n=92)	Combined group (n=91)	z / C^2	*p* value
Hospital stay (days)		9.0 [8.0-9.0]	7.0 [6.0-8.0]	-8.371	< 0.001
Clearance rate (n, %)	7 days	60 (65.2%)	80 (87.9%)	13.108	< 0.001
	14 days	84 (91.3%)	90 (98.9%)	5.646	0.017
VAS score (points)	Before	5.0 [5.0-6.0]	5.0 [5.0-6.0]	-0.197	0.844
	7 days	2.0 [2.0-3.0]	1.0 [1.00-1.00]	-11.402	< 0.001

All patients underwent holmium laser ureteroscopic lithotripsy. The control group was given phloroglucinol i.v. 80mg/day, for seven days. In addition to the control group's regiment, the combined group were administered Sanjin Paishi Decoction two times a day for seven days. Data are presented as numbers (n) and percentages (%), or as medians with [interquartile range].

stone passage and reduces postoperative discomfort [16]. Contemporary pooled analyses and clinical reviews further confirm that adjunctive pharmacological therapy significantly improves postoperative recovery profiles following ureteroscopic lithotripsy [16]. SJPSD contains herbs with diuretic and spasmolytic properties, such as *Lysimachia christinae* and *Pyrrosia lingua*, which promote urine flow and enhance ureteral peristalsis [17]. By complementing phloroglucinol's selective smooth muscle relaxation, SJPSD may contribute to more efficient fragment expulsion and faster postoperative recovery.

Beyond mechanical fragmentation, HLUL inevitably induces ureteral epithelial disruption, transient ischemia–reperfusion injury, and inflammatory edema due to laser thermal effects and high-pressure irrigation. Recent studies indicate that ureteroscopic Ho:YAG lithotripsy may induce ureteral thermal/contact injury with histologic ureteral wall damage, which can contribute to postoperative ureteral edema/spasm and delayed fragment passage, while high-pressure irrigation–related intrarenal backflow provides a mechanistic basis for infection-related complications [18-20]. A prospective cohort study further confirmed that perioperative inflammatory burden is an independent predictor of delayed stone expulsion and postoperative fever following ureteroscopic lithotripsy [21]. These findings highlight that HLUL alone does not fully prevent postoperative morbidity, thereby reinforcing the clinical necessity of adjunctive perioperative interventions.

Pain relief is a key determinant of recovery after HLUL. In this study, postoperative pain was alleviated to a greater extent in patients receiving integrative therapy, indicating superior analgesic efficacy. This can be attributed to dual anti-inflammatory mechanisms. Phloroglucinol has been shown to suppress cyclooxygenase activity and inhibit proinflammatory cytokine release [11], while SJPSD and its constituents downregulate NF-κB and MAPK signaling [22]. Recent studies also confirm that *Lysimachia christinae* extracts exert antioxidative effects via Nrf2/HO-1 and PI3K/Akt/mTOR signaling [23]. These complementary molecular mechanisms may underlie the enhanced analgesia and improved postoperative recovery observed in the integrative therapy group.

Oxidative stress is increasingly recognized as a central driver of tissue injury and poor outcomes in stone disease [24]. In this study, patients receiving SJPSD plus phloroglucinol exhibited lower serum MDA and ROS levels, indicating improved redox balance. Phloroglucinol has been shown to activate the Nrf2/HO-1 antioxidant pathway, thereby reducing ROS generation and protecting against DNA damage [24, 25]. Systems pharmacology and network analyses have revealed that SJPSD exhibits a multi-target regulatory profile, with its bioactive constituents simultaneously modulating MAPK, NF-κB, PI3K/Akt, and oxidative stress–related signaling pathways, thereby providing coordinated multi-pathway regulation of postoperative inflammation and oxidative injury [9, 17]. These mechanistic insights provide strong biological plausibility for the antioxidant benefits of SJPSD.

Safety is a crucial consideration in endourological procedures. Contemporary narrative reviews indicate that postoperative complications, particularly infection-related events, remain clinically relevant despite advances in

Table 3 Comparison of inflammatory status, oxidative stress, and complication rates between groups

			Control group (n=92)	Combined group (n=91)	t / C^2	*p* value
C-reactive protein (mg/L)		Before	26.54 ± 5.63	26.23 ± 5.65	0.373	0.710
		7 days	12.66 ± 2.32	5.69 ± 2.15	21.065	< 0.001
Tumor necrosis factor-α (μg/L)		Before	6.42 ± 1.08	6.53 ± 1.12	-0.664	0.508
		7 days	3.06 ± 0.71	1.36 ± 0.41	19.794	< 0.001
Interleukin-6 (pg/mL)		Before	16.54 ± 2.31	16.21 ± 2.52	0.930	0.353
		7 days	12.87 ± 1.66	10.53 ± 1.26	10.729	< 0.001
Catalase (× 10^3 U/L)		Before	26.32 ± 2.24	26.52 ± 2.32	-0.584	0.560
		7 days	17.76 ± 1.81	17.53 ± 1.65	0.915	0.361
Glutathion peroxidase (mg/L)		Before	260.56 ± 18.87	258.67 ± 19.33	0.667	0.506
		7 days	174.38 ± 15.56	170.26 ± 13.57	1.909	0.058
Malondialdehyde (U/L)		Before	18.21 ± 1.74	17.96 ± 1.58	1.000	0.318
		7 days	24.28 ± 1.23	20.56 ± 0.88	23.510	< 0.001
Reactive oxygen species (μmol/L)		Before	210.57 ± 20.37	212.27 ± 19.82	-0.574	0.567
		7 days	256.47 ± 15.67	248.44 ± 17.59	3.262	0.001
Complications (n)	Hemorrhage		3	0		
	Urinary tract infection		1	0		
	Ureteral spasm		1	0		
	Extravasation		3	1		
	Lumbago		3	1		
	Total incidence (n, %)		11 (11.9%)	2 (2.2%)	6.500	0.011

All patients underwent holmium laser ureteroscopic lithotripsy. The control group was given phloroglucinol i.v. 80mg/day, for seven days. In addition to the control group's regiment, the combined group were administered Sanjin Paishi Decoction two times a day for seven days. Data are presented as numbers and percentages, or mean ± standard deviation.

ureteroscopic techniques [22, 26, 27]. The reduced complications may reflect synergistic effects of SJPSD and phloroglucinol in suppressing inflammation, decreasing oxidative injury, and alleviating ureteral spasm. These findings support the safety of integrative therapy and suggest that combining herbal and conventional agents may improve perioperative tolerance.

The findings of this study align with previous research demonstrating the efficacy of adjuvant therapies in improving stone expulsion and reducing postoperative complications in patients undergoing HLUL. Recent cohort analyses further suggest that optimized perioperative management and improved patient compliance contribute to enhanced stone clearance and recovery outcomes following endourological procedures [28]. Collectively, these data support the role of integrative therapy as a complementary strategy to optimize perioperative recovery in ureteral calculi.

Despite encouraging results, several limitations should be acknowledged. First, this was a single-center trial with a moderate sample size, which may restrict generalizability. Second, the follow-up period was short, preventing evaluation of long-term recurrence, renal function, or stone-related morbidity. Third, herb–drug interactions and individual variability in herbal response were not systematically assessed, which may influence reproducibility. Finally, while we measured systemic biomarkers, mechanistic validation at the molecular level—such as pathway activity of MAPK or Nrf2/HO-1 in human tissues—was not performed.

CONCLUSIONS

In conclusion, SJPSD combined with phloroglucinol improved stone expulsion, shortened recovery, relieved pain, and reduced inflammatory and oxidative stress markers, leading to fewer complications after HLUL. This integrative regimen offers a safe and effective adjunctive therapy, bridging traditional herbal medicine with modern pharmacology. Future multicenter randomized controlled trials with larger cohorts and longer follow-up are warranted to confirm long-term efficacy and recurrence prevention. Mechanistic studies are also needed to further elucidate the synergistic pathways involved, ultimately contributing to evidence-based personalized integrative management of ureteral calculi.

ABBREVIATIONS

CAT – catalase

CRP – C-reactive protein

GSH-Px – glutathione peroxidase

HLUL – holmium laser ureteroscopic lithotripsy

IL-6 – interleukin-6

IQR – interquartile range

MDA – malondialdehyde

ROS – reactive oxygen species

SJPSD – Sanjin Paishi Decoction

TCM – Traditional Chinese Medicine

TNF – α- tumor necrosis factor-alpha

VAS – Visual Analog Scale for pain

ACKNOWLEDGEMENT

None.

AUTHORS' CONTRIBUTION

HA: conceptualization, investigation.

PL: methodology, investigation.

CZ: methodology, formal analysis.

SS: software, writing.

All authors have read and approved the final version of the manuscript.

CONFLICT OF INTEREST

None to declare.

Publisher's Note: The Editorial Office stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

REFERENCES

1. You C, Li JX, Li G, Dun R, Fang M, Zhu Q. Urinary calculi successfully expelled in a patient through traditional Chinese exercise: A case report. Medicine. 2024 Nov 22;103(47):e40641. DOI: 10.1097/MD.0000000000040641
2. Yuan Q, Guo J, He L, Chen Q, Zou X, Yang S, et al. Retrospective Analysis of the Risk Factors and Drug Resistance of Pathogenic Bacteria in Systemic Inflammatory Response Syndrome After Ureteroscopic Holmium Laser Lithotripsy for Impacted Ureteral Calculi. International journal of general medicine. 2022;15:3923-31. DOI: 10.2147/IJGM.S356540
3. He Y, Feng YG, He J, Liang B, Jiang MD, Liu J, et al. Effects of irrigation fluid temperature during flexible ureteroscopic holmium laser lithotripsy on postoperative fever and shivering: a randomized controlled trial. BMC urology. 2021 Apr 27;21(1):72. DOI: 10.1186/s12894-021-00841-4
4. Guan Y, Ai X, Li Z, Teng J, Ma C, Zhang G. Early Warning Effect of CHR, NLR and U-HBP on SIRS in Patients with Upper Urinary

Tract Calculus After Flexible Ureteroscopic Lithotripsy. Alternative therapies in health and medicine. 2024 Jun;30(6):196-202.

5. Amer ML, Elkholefy ME, Dawoud H, Gaber M, El-Gamal OM, Gameel T. Safety and efficacy of Silodosin as medical expulsive therapy after shock wave lithotripsy in paediatric patients with renal stones. Urolithiasis. 2025 May 20;53(1):95. DOI: 10.1007/s00240-025-01760-x
6. Su H, Zhou W, Chen W, Yang K, Yang M, He H, et al. PGE2 binding to EP2 promotes ureteral stone expulsion by relaxing ureter via the cAMP-PKA pathway. BMC urology. 2024 Jun 8;24(1):117. DOI: 10.1186/s12894-024-01504-w
7. Li C, Guo L, Luo M, Guo M, Li J, Zhang S, et al. Risk factors of uterine contraction after ureteroscopy in pregnant women with renal colic. International urology and nephrology. 2021 Oct;53(10):1987-93. DOI: 10.1007/s11255-021-02932-5
8. Ha Y, Lee WH, Kim JK, Jeon HK, Lee J, Kim YJ. Polyopes affinis Suppressed IFN-gamma- and TNF-alpha-Induced Inflammation in Human Keratinocytes via Down-Regulation of the NF-kappaB and STAT1 Pathways. Molecules. 2022 Mar 11;27(6). DOI: 10.3390/molecules27061836
9. Tian Y, Zhao J, Chen L, Zhang C, Chu X, Xia Y. Sanjin Paishi Decoction improves the imbalance of gut microbiota and regulates MAPK signaling pathway to inhibit calcium oxalate stones in rats. International urology and nephrology. 2023 Oct;55(10):2421-9. DOI: 10.1007/s11255-023-03641-x
10. Piras F, Sogos V, Pollastro F, Rosa A. Protective Effect of Arzanol against H(2)O(2)-Induced Oxidative Stress Damage in Differentiated and Undifferentiated SH-SY5Y Cells. International journal of molecular sciences. 2024 Jul 5;25(13). DOI: 10.3390/ijms25137386
11. Drygalski K, Siewko K, Chomentowski A, Odrzygozdz C, Zalewska A, Kretowski A, et al. Phloroglucinol Strengthens the Antioxidant Barrier and Reduces Oxidative/Nitrosative Stress in Nonalcoholic Fatty Liver Disease (NAFLD). Oxidative medicine and cellular longevity. 2021;2021:8872702. DOI: 10.1155/2021/8872702
12. Dellabella M, Milanese G, Muzzonigro G. Randomized trial of the efficacy of tamsulosin, nifedipine and phloroglucinol in medical expulsive therapy for distal ureteral calculi. The Journal of urology. 2005 Jul;174(1):167-72. DOI: 10.1097/01.ju.0000161600.54732.86
13. Nisen H, Erkkila K, Ettala O, Ronkainen H, Isotalo T, Nykopp T, et al. Intraoperative complications in kidney tumor surgery: critical grading for the European Association of Urology intraoperative adverse incident classification. Scandinavian journal of urology. 2022 Aug;56(4):293-300. DOI: 10.1080/21681805.2022.2089228
14. Astrom M, Thet Lwin ZM, Teni FS, Burstrom K, Berg J. Use of the visual analogue scale for health state valuation: a scoping review. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation. 2023 Oct;32(10):2719-29. DOI: 10.1007/s11136-023-03411-3
15. Hornbeck PV. Enzyme-Linked Immunosorbent Assays. Current protocols in immunology. 2015 Aug 3;110:21-23. DOI: 10.1002/0471142735.im0201s110
16. Sun F, Liu H, Wu G, Liu M, Liu S, Wang L, et al. Pooled-analysis of tadalafil and tamsulosin for ureteral calculi. Frontiers in pharmacology. 2024;15:1351312. DOI: 10.3389/fphar.2024.1351312
17. Jiang C, Wang L, Wang Y, Xu R, Yang H, Peng J. Therapeutic effects of Chinese herbal medicines for treatment of urolithiasis: A review. Chinese herbal medicines. 2023 Oct;15(4):526-32. DOI: 10.1016/j.chmed.2023.09.001
18. Liang H, Liang L, Yu Y, Huang B, Chen J, Wang C, et al. Thermal effect of holmium laser during ureteroscopic lithotripsy. BMC urology. 2020 Jun 15;20(1):69. DOI: 10.1186/s12894-020-00639-w
19. O'Meara S, Sheehan K, Fay J, O'Grady T, Croghan SM, Cunnane EM, et al. Characterisation of iatrogenic human ureteral laser injury - results from ex vivo testing with a Ho: YAG laser at commonly used lithotripsy settings. World journal of urology. 2025 Jun 4;43(1):354. DOI: 10.1007/s00345-025-05713-2
20. Hong A, du Plessis J, Browne C, Jack G, Bolton D. Mechanism of urosepsis: relationship between intrarenal pressures and pyelovenous backflow. BJU international. 2023 Nov;132(5):512-9. DOI: 10.1111/bju.16095
21. Southern JB, Higgins AM, Young AJ, Kost KA, Schreiter BR, Clifton M, et al. Risk Factors for Postoperative Fever and Systemic Inflammatory Response Syndrome After Ureteroscopy for Stone Disease. Journal of endourology. 2019 Jul;33(7):516-22. DOI: 10.1089/end.2018.0789
22. Bhojani N, Eisner B, Monga M, Paranjpe R, Cutone B, Chew BH. Sepsis prevalence and associated hospital admission and mortality after ureteroscopy in employed adults. BJU international. 2023 Aug;132(2):210-6. DOI: 10.1111/bju.16029
23. Zheng X, Lv S, Wang W, Zhu L, Lin L. Lysimachia christinae Hance aqueous extract ameliorates renal injury in kidney stone rats and calcium oxalate crystal-induced oxidative stress in HK-2 cells via inhibiting the PI3K/Akt/mTOR pathway. Histology and histopathology. 2025 Jul 10:18964.
24. Park C, Cha HJ, Hwangbo H, Ji SY, Kim DH, Kim MY, et al. Phloroglucinol Inhibits Oxidative-Stress-Induced Cytotoxicity in C2C12 Murine Myoblasts through Nrf-2-Mediated Activation of HO-1. International journal of molecular sciences. 2023 Feb 27;24(5). DOI: 10.3390/ijms24054637
25. Park C, Cha HJ, Hong SH, Kim GY, Kim S, Kim HS, et al. Protective Effect of Phloroglucinol on Oxidative Stress-Induced DNA Damage and Apoptosis through Activation of the Nrf2/HO-1 Signaling Pathway in HaCaT Human Keratinocytes. Marine drugs. 2019 Apr 13;17(4). DOI: 10.3390/md17040225
26. Punga AM, Ene C, Bulai CA, Georgescu DA, Multescu R, Georgescu DE, et al. Complications of Single-Use Flexible Ureteroscopy vs. Reusable Flexible Ureteroscopy: A Narrative Review. Cureus. 2024 Dec;16(12):e76256. DOI: 10.7759/cureus.76256
27. Bhojani N, Miller LE, Bhattacharyya S, Cutone B, Chew BH. Risk Factors for Urosepsis After Ureteroscopy for Stone Disease: A Systematic Review with Meta-Analysis. Journal of endourology. 2021 Jul;35(7):991-1000. DOI: 10.1089/end.2020.1133
28. Li CC, Zhang ZW. Effect of Precision Health Education on Compliance Behavior after Extracorporeal Shock Wave Lithotripsy. Computational and mathematical methods in medicine. 2022;2022:3306036. DOI: 10.1155/2022/3306036