Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 3
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Efficacy of Flexible Negative Pressure Suction Sheath Combined with Flexible Ureteroscopy Lithotripsy in the Treatment of Upper Urinary Tract Calculi and Its Impact on Postoperative Quality of Life

Zhongcheng Zhu

Wuxi No.2 Traditional Chinese Medicine Hospital, Wuxi 214100, Jiangsu, China

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective*: To evaluate the therapeutic efficacy of Flexible Vacuum Suction Ureteral Access Sheath (FVSUAS) combined with Flexible Ureteroscopy Lithotripsy (FURL) for Upper Urinary Tract Calculi (UUTC). *Methods*: A total of 88 UUTC patients admitted between August 2024 and August 2025 were selected and equally divided using a random number table. The experimental group received FVSUAS combined with FURL treatment, while the reference group received conventional guide sheath combined with FURL treatment. The therapeutic effects of the two groups were compared. *Results*: The stone clearance rate in the experimental group was higher than that in the reference group, with shorter operative time and postoperative hospital stay, and lower postoperative pain scores ($p < 0.05$). The complication rate in the experimental group was lower than that in the reference group, with lower postoperative inflammatory factor levels and higher quality of life scores ($p < 0.05$). *Conclusion*: Implementing FVSUAS combined with FURL treatment for UUTC patients results in a high stone clearance rate, shorter operative time and postoperative hospital stay, alleviation of postoperative pain symptoms, fewer complications, mild postoperative inflammatory response, and a high quality of life.

Keywords: Flexible vacuum suction ureteral access sheath; Flexible ureteroscopy lithotripsy; Upper urinary tract calculi; Postoperative quality of life

Online publication: Apr 2, 2026

1. Introduction

Common causes of urinary system stones include urinary tract infections, metabolic abnormalities, and drug factors, with Upper Urinary Tract Calculi (UUTC) being a highly prevalent type [1]. The disease primarily affects the ureters and kidneys, presenting symptoms such as abnormal urination, lumbosacral and abdominal pain, and hematuria, which can have a long-term impact on patients' physical and mental health. Conservative drug therapy

and surgical treatment are the fundamental approaches for this condition. While these methods can remove stones, surgical techniques like Flexible Ureteroscopy Lithotripsy (FURL) can be employed to fragment the stones, facilitating their subsequent expulsion. The combination with Flexible Vacuum Suction Ureteral Access Sheath (FVSUAS) allows for flexible adjustment of the flexible ureteroscope's direction, precise localization of the stone's position, and efficient suctioning of the stones, thereby enhancing the success rate of the surgery [2]. Additionally, FVSUAS can thoroughly suction out the irrigation fluid and stone fragments during the procedure, ensuring clear visibility of the surgical field and thereby improving surgical safety. Based on this, this study selected 88 UUTC patients to evaluate the therapeutic efficacy of FVSUAS combined with FURL.

2. Materials and methods

2.1. General information

A total of 88 patients with upper urinary tract calculi (UUTC) who were admitted for treatment from August 2024 to August 2025 were selected and equally divided into two groups using a random number table. The experimental group consisted of 44 patients, including 23 males and 21 females, aged between 26 and 68 years with a mean age of (48.65 ± 4.18) years. The stone diameters ranged from 13 to 29 mm with a mean of (19.85 ± 3.57) mm. The stone locations were as follows: 18 cases at the ureteral orifice and 26 cases in the renal pelvis. The reference group also included 44 patients, with 24 males and 20 females, aged between 25 and 69 years with a mean age of (48.71 ± 4.22) years. The stone diameters ranged from 14 to 28 mm with a mean of (19.91 ± 3.50) mm. The stone locations were as follows: 17 cases at the ureteral orifice and 27 cases in the renal pelvis. There were no significant differences in the baseline data between the two groups ($p > 0.05$).

2.1.1. Inclusion criteria

Single stone with a diameter exceeding 10 mm; age under 70 years; first-time lithotripsy surgery; complete basic information; and high awareness of the study.

2.1.2. Exclusion criteria

Presence of surgical contraindications; organ dysfunction; intolerance to the anesthesia protocol; abnormal immune function; concurrent systemic infection; ureteral malformation or obstruction; and presence of consciousness disorders.

2.2. Methods

The reference group underwent conventional guide sheath combined with flexible ureteroscopy lithotripsy (FURL): General anesthesia was administered, and the patient was placed in the bladder lithotomy position. A rigid ureteroscope was inserted through the urethra into the bladder to comprehensively observe the bladder's internal condition, determine the location of the ureteral orifice, and insert a super-smooth guidewire under direct vision. The guidewire was carefully explored upwards to assess its satisfactory placement, determine the stone location, and observe for ureteral stenosis until reaching the renal pelvis. The upper ureteral stones were pushed upwards to the renal pelvis. The guidewire was retained, and the ureteroscope was slowly withdrawn to accurately measure the insertion length of the ureteroscope. A guide sheath of 11/13 Fr or 12/14 Fr was selected based on the lumen diameter and inserted along the guidewire. The inner core was removed, and a flexible ureteroscope was inserted.

The water pressure was appropriately adjusted using the irrigation pump's water inlet method, and the intrarenal pelvic pressure was dynamically monitored to ensure a clear surgical field. Simultaneously, the renal calyx status was observed, the stone location was identified, and the number of stones was recorded. The guidewire was removed, and a holmium laser fiber was inserted through the working channel of the flexible ureteroscope. The energy was set at 0.8–1.6 J, and the fiber frequency was set at 20–30 Hz to fragment the stones into fine particles. A stone basket was used to directly remove large stones, ensuring no large stone residues remained in the renal pelvis and calyces before withdrawing the ureteroscope. A guidewire was inserted using a conventional guide sheath, and after removing the channel sheath, a 5F double-J stent was placed, ensuring the distal end was within the bladder. A urinary catheter was then left in place, and the surgery was completed.

The experimental group underwent flexible vacuum suction ureteral access sheath (FVSUAS) combined with FURL: The patient's position, anesthesia method, and flexible ureteroscope insertion process were the same as those in the reference group. After inserting the flexible ureteroscope, the central negative pressure was connected to the outer end of the software, and the parameters of the negative pressure suction sheath were set to a central negative pressure of 0.01–0.03 MPa. The holmium laser was used to fragment the stones, and the fragments were fully aspirated using the negative pressure sheath. The renal pelvis and calyces were checked for large stones. After withdrawing the negative pressure suction sheath and flexible ureteroscope, a 5F double-J stent was placed, and the surgery was completed.

2.3. Observation indicators

(1) Perioperative indicators

The stone clearance rate was observed (follow-up for 3 months; color Doppler ultrasound showing a colored urinary flow signal at the physiological stenosis of the ureter with a comet-tail sign behind and no stone residue, or a residual stone diameter not exceeding 0.3 cm, was considered clearance), surgical time, postoperative hospital stay, and pain scores on postoperative days 1–3 (using the Visual Analog Scale, with scores ranging from 0 to 10 and higher scores indicating greater pain intensity).

(2) Complication rate

The incidence of complications such as hydronephrosis, hematuria, urinary tract infection, fever, renal function impairment, and perirenal hematoma was observed.

(3) Inflammatory factor level

Before surgery and on postoperative day 3, venous blood (3 mL, fasting) was collected, centrifuged at 3000 r/min for 10 minutes, and the supernatant was taken to measure the levels of C-reactive protein (CRP) and procalcitonin (PCT). Venous blood was also collected to measure the white blood cell count (WBC) using a blood cell analyzer.

(4) Quality of life score

Follow-up for 3 months was conducted using the General Quality of Life Inventory-74 (GQOL-74), which includes dimensions of physical function, psychological function, material life, and social function, each scored out of 100 with higher scores indicating better quality of life.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Continuous variables were compared using the *t*-test, and categorical variables were compared using the chi-square test, χ^2. A statistically significant result was considered

when $p < 0.05$.

3. Results

3.1. Comparison of perioperative indicators between the two groups

The perioperative indicators in the experimental group were superior to those in the reference group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of perioperative indicators between the two groups [n/%, $\bar{x} \pm s$]

Group	Number of cases	Stone clearance rate	Operation time (min)	Postoperative hospital stays (d)	Postoperative pain score (points)		
					Post-op day 1	Post-op day 2	Post-op day 3
Test group	44	39 (88.64)	67.85 ± 4.18	4.88 ± 1.52	3.25 ± 0.41	2.30 ± 0.35	1.04 ± 0.28
Reference group	44	31 (70.45)	97.33 ± 4.27	6.30 ± 1.66	4.37 ± 0.46	3.02 ± 0.37	2.13 ± 0.33
χ^2/t		4.470	32.726	4.185	12.057	9.377	16.706
p		0.035	0.000	0.000	0.000	0.000	0.000

3.2. Comparison of complication rates between the two groups

The complication rate in the experimental group was lower than that in the reference group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of complication rates between the two groups [n/%]

Group	Number of cases	Hydronephrosis	Hematuria	Urinary tract infection	Fever	Renal function impairment	Perirenal hematoma	Incidence rate [n (%)]
Test group	44	0	0	1 (2.27)	1 (2.27)	1 (2.27)	0	6.82 (3/44)
Control group	44	1 (2.27)	1 (2.27)	2 (4.55)	3 (6.82)	2 (4.55)	1 (2.27)	22.73 (10/44)
χ^2 value	-	-	-	-	-	-	-	4.423
p value	-	-	-	-	-	-	-	0.036

3.3. Comparison of inflammatory factor levels between the two groups

Three days after surgery, the inflammatory factor levels in the experimental group were lower than those in the reference group ($p < 0.05$). See **Table 3**.

Table 3. Comparison of inflammatory factor levels between the two groups [$\bar{x} \pm s$]

Group	Number of cases	CRP (mg/L)		PCT (μg/L)		WBC ($\times 10^9$/L)	
		Before surgery	After surgery	Before surgery	After surgery	Before surgery	After surgery
Experimental group	44	12.05 ± 1.36	4.51 ± 1.06	9.06 ± 1.74	0.29 ± 0.04	9.44 ± 1.65	9.59 ± 1.94
Reference group	44	12.08 ± 1.41	6.50 ± 1.17	9.10 ± 1.78	0.71 ± 0.12	9.47 ± 1.62	11.34 ± 1.98
t		0.102	8.361	0.107	22.025	0.086	4.188
p		0.919	0.000	0.915	0.000	0.932	0.000

3.4. Comparison of quality-of-life scores between the two groups

Three months after surgery, the quality-of-life scores in the experimental group were higher than those in the reference group ($p < 0.05$). See **Table 4**.

Table 4. Comparison of quality-of-life scores between the two groups [$\bar{x} \pm s$, points]

Group	Number of cases	Physical function		Psychological function		Material life		Social function	
		Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op
Experimental group	44	71.38 ± 6.84	88.72 ± 7.31	70.24 ± 6.52	89.16 ± 7.05	72.66 ± 6.93	90.28 ± 7.12	69.81 ± 6.47	87.53 ± 6.98
Reference group	44	70.92 ± 6.79	83.67 ± 7.26	69.87 ± 6.48	81.35 ± 6.94	72.14 ± 6.88	85.41 ± 7.08	69.32 ± 6.42	80.64 ± 6.91
t		0.317	3.251	0.267	5.237	0.353	3.217	0.357	4.653
p		0.752	0.002	0.790	0.000	0.725	0.002	0.722	0.000

4. Discussion

Upper urinary tract calculi (UUTC) is a prevalent urinary system disease, primarily composed of calcium oxalate stones. These stones can cause urinary tract bleeding or mucosal congestion, leading to urinary flow obstruction and increasing the risk of urinary tract infections. Surgery is a common treatment modality for this condition, aiming to remove stones, alleviate disease symptoms, and thereby improve urinary function [3,4].

Flexible ureteroscopy lithotripsy (FURL) is a novel endoscopic surgical procedure that allows the insertion of a flexible ureteroscope through the urethra to reach the renal pelvis. Subsequently, holmium laser fibers are utilized for lithotripsy, and stone baskets are employed to extract the stone fragments. This surgical approach leverages the body's natural cavities, offering strong minimally invasive characteristics. It reduces surgical trauma, minimizes intraoperative blood loss, and thereby protects renal function [5]. However, during the procedure, the stone removal channel is relatively narrow, and the impact water flow velocity is slow, making it difficult to immediately clear stone debris and blood, which can reduce surgical clarity and subsequently affect surgical precision. Flexible vacuum suction ureteral access sheath (FVSUAS) connects the distal end of the flexible ureteroscope to a negative pressure pump, creating an intrarenal negative pressure environment. It utilizes negative pressure suction to aspirate stone fragments, ensuring their complete evacuation and enhancing surgical efficiency. The FVSUAS tip is flexible, allowing for angle adjustments in coordination with the flexible ureteroscope to slowly and precisely enter the renal calyces and pelvis [6]. Additionally, the sheath opening can be positioned close to the stones, enabling complete removal of stone fragments under negative pressure suction, preventing them from obstructing the surgical field, and thereby improving the smoothness of surgical operations.

The results demonstrated that the perioperative indicators in the experimental group were superior to those in the reference group, and the complication rate was lower in the experimental group ($p < 0.05$). The reason for this is that the combined treatment approach enables accurate lithotripsy and stone removal under the guidance of FVSUAS, minimizing excessive manipulation of the stones. This shortens the overall surgical procedure time, avoids damage to surrounding tissues, and thereby reduces postoperative recovery time [7]. The highly flexible tip of FVSUAS matches the anatomical characteristics of the urinary tract, reducing the limitations of flexible ureteroscopy treatment and improving stone localization efficiency. Performing lithotripsy under negative pressure

prevents stone displacement, thereby enhancing the stone clearance rate [8]. Furthermore, negative pressure suction can regulate intrarenal pelvic pressure, preventing extravasation of irrigation fluid and promptly aspirating stone debris to avoid irritation to the urinary tract mucosa, thereby preventing adverse events such as hematuria and reducing the risk of complications, enhancing surgical safety. Three days after surgery, the inflammatory factor levels in the experimental group were lower than those in the reference group ($p < 0.05$). The reason for this is that FVSUAS can flexibly adjust its angle according to the anatomical structure of the ureter, reducing surgical stress responses and preventing urinary tract mucosal damage during stone removal. Its strong minimally invasive advantage helps alleviate postoperative inflammatory responses [9].

Three months after surgery, the quality-of-life scores in the experimental group were higher than those in the reference group ($p < 0.05$). The reason for this is that FVSUAS offers high operability, with a tip capable of large-angle bending and a small-diameter suction sheath, providing a wide observation range. This significantly improves surgical efficiency, promotes rapid patient recovery, and thereby avoids long-term impacts of the disease on daily life, enhancing the patient's quality of life [10].

5. Conclusion

In conclusion, FVSUAS combined with FURL offers significant therapeutic effects for patients with UUTC. It accelerates postoperative recovery, reduces inflammatory responses and postoperative complications, and improves the patient's postoperative quality of life.

Disclosure statement

The author declares no conflict of interest.

References

[1] Li Y, Bao P, 2025, Study on the Application Effect of Flexible Vacuum Suction Ureteral Access Sheath in Flexible Ureteroscopy Lithotripsy for Upper Urinary Tract Stones Larger Than 2 cm. Zhejiang Trauma and Orthopedics, 30(4): 618–620 + 768.

[2] Fu L, 2025, Flexible Ureteroscopy Lithotripsy Assisted by a Flexible Vacuum Suction Ureteral Access Sheath for the Treatment of Elderly Patients with Upper Urinary Tract Stones. Clinical Research, 33(11): 123–125.

[3] Xie H, Huang J, Fu Z, et al., 2024, Feasibility and Safety of Tubeless Discharge After Flexible Ureteroscopy Lithotripsy Assisted by a Flexible Vacuum Suction Ureteral Access Sheath with a Bendable Tip. Chinese Journal of Urology, 45(8): 614–618.

[4] Gao X, 2025, Discussion on the Clinical Advantages of Flexible Vacuum Suction Ureteral Access Sheath Combined with Disposable Flexible Ureteroscopy Lithotripsy for the Treatment of Upper Urinary Tract Stones. Modern Medicine and Health Research (Electronic Edition), 9(21): 83–86.

[5] Jiang X, Li Y, Jin M, et al., 2024, Observation on the Efficacy of Tubeless Treatment After Flexible Ureteroscopy Lithotripsy Combined with a Flexible Vacuum Suction Ureteral Access Sheath for Upper Urinary Tract Stones Larger Than 2 cm. Journal of Jiangsu University (Medical Edition), 34(4): 301–306.

[6] Tang Q, Wang D, Liu F, et al., 2024, Efficacy of Flexible Vacuum Suction Ureteral Access Sheath Combined with Disposable Flexible Ureteroscopy Lithotripsy for the Treatment of 2–3 cm Upper Urinary Tract Stones. Journal of

Modern Urology, 29(10): 859–864.
[7] Lin J, Ye Z, Tu J, et al., 2023, Comparison of the Efficacy Between Flexible Vacuum Suction Ureteral Access Sheath and Conventional Sheath Combined with Disposable Flexible Ureteroscopy for the Treatment of Upper Urinary Tract Stones. Chinese Journal of Minimally Invasive Surgery, 23(9): 652–656.
[8] Wu X, Tian W, Zheng D, et al., 2023, Clinical Study on Flexible Vacuum Suction Ureteral Access Sheath Combined with Flexible Ureteroscopy Holmium Laser Lithotripsy for the Treatment of Upper Urinary Tract Stones with a Diameter of 2–3 cm. Chinese Journal of General Practice, 21(9): 1516–1519.
[9] He X, 2024, Observation on the Application of Flexible Vacuum Suction Ureteral Access Sheath Combined with Flexible Ureteroscopy in Patients with Upper Urinary Tract Stones (≥ 2 cm). Practical Journal of Integrated Traditional Chinese and Western Medicine Clinical, 24(23): 60–62 + 124.
[10] Zhan L, Liu B, Zhao J, et al., 2024, Flexible Ureteroscopy Holmium Laser Lithotripsy Assisted by a Flexible Vacuum Suction Ureteral Access Sheath. Chinese Journal of Endourology (Electronic Edition), 18(3): 271–276.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.