WHIOCE PUBLISHING PTE. LTD.
PROVIDING
FIRST-CLASS SCIENTIFIC INFORMATION
FOR TOP SCHOLARS

2025 Volume 6, Issue 4
Cell Biology Research
ISSN: 2529-7627 (Online)

Exploration and Analysis of the Efficacy of Tubeless Percutaneous Nephroscopy in Treating Upper Urinary Tract Stones

Liang Zhu, Wenchao Zhao*
Department of Urology, Taizhou People's Hospital Affiliated to Nanjing Medical University, Taizhou 225700, Jiangsu, China

**Author to whom correspondence should be addressed.*

Abstract: *Objective:* To explore the clinical efficacy of tubeless percutaneous nephrolithotomy (PCNL) in the treatment of upper urinary tract stones. *Methods:* 100 patients with upper urinary tract stones and concurrent PCNL surgery who were treated in Taizhou People's Hospital Affiliated to Nanjing Medical University from September 2023 to September 2025 were randomly divided into two groups using a random number table method according to whether a nephrostomy tube was left in place after surgery, with 50 cases in each group, namely the observation group (without pyelostomy tube) and the control group (with pyelostomy tube). The two groups of patients were compared in terms of clinical data, perioperative indicators, renal function test indicators and surgical complications. *Results:* There was no statistical difference in clinical baseline data between the two groups ($P > 0.05$). However, in terms of length of hospitalization, VAS score, postoperative urinary catheter indwelling time, frequency of analgesic drug use, and postoperative recovery levels of Scr and BUN, the observation group showed significant improvement compared to the control group, with statistical significance ($P < 0.05$). There was no statistical difference in the incidence of complications between the two groups ($P > 0.05$). *Conclusion:* Both tubeless and standardized PCNL can effectively break lithotripsy, but tubeless technology has the advantages of lower postoperative pain, faster postoperative recovery, and shorter hospitalization time, and has practical clinical application value.
Keywords: Tubeless; Percutaneous nephrolithotomy; Upper urinary tract stones; Complications

Online publication: December 26, 2025

1. Introduction

At present, the incidence of urolithiasis is on the rise, especially among young adults [1]. In the urinary tract stone system, upper urinary tract stone attacks are more severe and often cause sudden, severe pain in the waist or flank, which can radiate to the groin or perineum. In severe cases, symptoms such as nausea and vomiting may also occur [2]. Upper urinary tract stones include kidney and ureteral stones. Kidney stones are more common, with an incidence rate of 6% to 14%, mostly in men [3]. At present, the main method for treating upper urinary tract stones is percutaneous nephrolithotomy (PCNL). PCNL has a series of advantages, such as small trauma, fast recovery, and a high stone clearance rate. However, after routine surgery, a pyelostomy tube will be left at the renal puncture port. Postoperative pain, bleeding, infection,

urinary extravasation, and other conditions that may affect the patient's postoperative recovery process may occur [4]. Relevant studies have shown that tubeless technology has many advantages, such as shortening the length of hospital stay and relieving postoperative pain [5]. This article aims to conduct a comparative analysis of the clinical effects of tubeless and tubed PCNL in patients with upper urinary tract stones, to provide a certain reference value for subsequent clinical research.

2. Materials and methods

2.1. General information

Statistics were conducted on inpatients with upper urinary tract stones in our hospital from 2023.09.01 to 2025.09.01, and 100 patients who underwent PCNL were selected and divided into two groups according to whether nephrostomy tubes were placed during the operation, namely the observation group (no nephrostomy tubes placed) and the control group (nephrostomy tubes placed). 50 cases in each group. In the observation group, there were 27 males and 23 females; the average age was 50.78 ± 13.26 years old; the diameter of the stones was about 1.81 ± 0.58; there were 33 cases of kidney stones and 17 cases of ureteral stones. In the control group, there were 31 males and 19 females; the average age was 51.12 ± 13.39; the diameter of the stones was about 1.66±0.53; there were 28 cases of kidney stones and 22 cases of ureteral stones. After the calculation, statistical analysis was performed between the two groups, as shown in **Table 1**. *P* was all > 0.05. The difference was not statistically significant and was comparable. This study was approved by the hospital ethics committee, and all patients participated voluntarily.

Table 1. Comparison of baseline data between the two groups (n, mean ± SD)

Group	Gender (male/female)	Age (years)	Stone diameter (cm)	Stone type (kidney/ureter)
Observation group (50)	27/23	50.78±13.26	1.81±0.58	33/17
Control group (50)	31/19	51.12±13.39	1.66±0.53	28/22
χ^2/t	0.657	0.128	1.351	1.051
P	0.418	0.899	0.180	0.305

2.2. Inclusion criteria and exclusion criteria

Inclusion criteria: (1) Medical imaging showed upper urinary tract stones; (2) The surgical method was percutaneous nephroscopic surgery; (3) The stone diameter was less than 3.0cm; (4) The informed consent form had been signed by the patient and his family.

Exclusion criteria: (1) Severe organic dysfunction; (2) Congenital renal malformation, solitary kidney or ureteral stenosis; (3) Possible urinary tract infection; (4) Multiple stones (> 3) with stone diameter > 3 cm; (5) Refusal to sign the consent form.

2.3. Surgical methods

Patients in the tubeless group were placed in the lithotomy position after general anesthesia, and the lower abdomen and perineum were disinfected and draped with 0.5% iodophor. A Leesonscope was inserted through the urethra to observe that the urethral mucosa was normal throughout, the bladder mucosa was smooth and free of new organisms, and the bilateral ureteral openings were clear. The guidewire was retrogradely inserted into the ureteral opening on the affected side. An F6 ureteral catheter was placed under the guidance of the guidewire and connected with normal saline to prepare artificial hydronephrosis. At the same time, a ureteral catheter was left in place. The patient was changed to the prone position, the draping was re-sterilized, B-ultrasound was used to locate the location of the renal pelvis on the affected side, and the 18G puncture needle was successfully inserted into the target renal calyx to elicit clarified urine. Then a super-hard guidewire

was inserted, and the sheath was expanded along the guidewire to 18F to establish a stone channel. The target stone was seen under Leeson's microscope, and the holmium laser was used for lithotripsy and flushing. Another B-ultrasound examination showed no remaining stones, and an F7 stent was placed through the puncture channel. The guidewire is left in place, and the sheath is withdrawn under direct vision. If there is no active bleeding from the puncture channel, the incision is sutured. Observe that the urine drained by the urinary catheter is light-bloody in color. In the tube group, a 16F pyelostomy tube was left in place after the sheath was withdrawn, and it was routinely removed 48 to 72 hours after surgery. The other conditions were the same as those in the tubeless group. Postoperative anti-infective treatment was routine.

2.4. Observation indicators

All patients will be re-examined 1 month after discharge. If the imaging shows that the stones disappear, the operation is considered successful, and the ureteral stent on the affected side can be removed.

(1) Compare a series of indicators, including perioperative operation duration, intraoperative blood loss, length of hospitalization, postoperative VAS score, postoperative urinary catheter indwelling time, one-time stone clearance rate, frequency of analgesic medication, and hemoglobin drop value.
(VAS refers to the visual analogue score of pain - visual analogue score, 0 to 10 points. The higher the score, the more obvious the pain.)

(2) Compare the levels of renal function factors, namely blood creatinine (Scr) and blood urea nitrogen (BUN), between the two groups of patients before surgery and 1 month after surgery.

(3) Compare the complications that occurred during hospitalization and postoperative review between the two groups of patients, including fever, hematuria, urinary extravasation, perinephric effusion, urinary tract infection, ureteral stricture, etc.

2.5. Statistical methods

This study used GraphPad Prism9.5 as the statistical software for analysis. The results were presented as mean ± standard deviation (SD). The measurement data were tested by t test; the count data were tested by χ^2. $P < 0.05$ was considered statistically significant.

3. Result

3.1. Comparison of perioperative indicators

Comparing the two groups of patients, there was no significant statistical difference in operation time, intraoperative blood loss, one-time stone clearance rate, and hemoglobin drop value ($P > 0.05$), but the differences in length of hospitalization, VAS score, postoperative urinary catheter retention time, and analgesic drug use frequency were statistically significant ($P < 0.05$). The VAS score of the control group was significantly higher than that of the observation group, and the frequency of analgesic drugs was lower than that of the observation group (**Table 2**).

Table 2. Comparison of perioperative indicators between the two groups

Group	Operation time (min)	Intraoperative bleeding (mL)	Length of hospitalization (d)	VAS score (points)	Postoperative urinary catheter indwelling time (d)	One-time stone clearance rate [n(%)]	Frequency of analgesic drugs (times)
Observation Group (50)	97.54 ± 10.61	95.04 ± 11.66	6.04 ± 1.24	4.18 ± 0.90	2.92 ± 0.92	48 (96%)	15
Control group (50)	98.50 ± 8.92	94.8 ± 11.57	6.54 ± 1.13	5.18 ± 0.92	3.36 ± 0.88	47 (94%)	35
χ^2/t	0.490	0.585	2.104	5.508	2.447	0.211	16
P	0.626	0.56	0.038	< 0.001	0.016	0.646	< 0.001

3.2. Comparison of renal function factor levels

There was no statistical difference in the Scr and BUN levels between the two groups of patients before surgery ($P > 0.05$). However, one month after surgery, the Scr and BUN levels of the two groups of patients showed an upward trend, and there was a statistical difference between the two groups ($P < 0.05$). The control group was higher than the observation group (**Table 3**).

Table 3. Comparison of renal function test index levels between the two groups

Group	Scr (μmol/L)		BUN (mmol/L)	
	Before surgery	After surgery	Before surgery	After surgery
Observation group (50)	87.02 ± 10.39	91.54 ± 8.31	5.22 ± 0.98	5.54 ± 0.83
Control group (50)	86.92 ± 9.38	96.60 ± 9.77	5.24 ± 0.89	6.03 ± 0.79
t	0.960	2.789	0.096	3.025
P	0.051	0.006	0.923	0.003

3.3. Comparison of complications

Statistical analysis of postoperative complications between the two groups showed that there was no statistical difference between the two groups ($P > 0.05$) (**Table 4**).

Table 4. Statistics of complications in the two groups of patients

Group	Fever (n)	Hematuria (n)	Urinary extravasation (n)	Perinephric effusion/blood (n)	Urinary tract infection (n)	Ureteral stricture (n)	Incidence rate [n(%)]
Observation group (50)	2	1	0	0	1	1	10%
Control group (50)	2	2	1	1	3	0	18%
χ^2							3.474
P							0.627

4. Discussion

PCNL is currently the preferred surgical method to replace open upper urinary tract stones and is the most widely used and most effective treatment option in most hospitals in China. In the past, a fistula tube was left in place after PCNL, which could compress and stop bleeding and promote drainage. However, problems such as delayed recovery, increased pain, and increased chance of postoperative complications were inevitable [4]. Therefore, tubeless PCNI, as a newer minimally invasive method of PCNI, has important clinical significance.

Wickhamt et al. first proposed the concept of partially tubeless PCNI in 1984, but then Winfield questioned and reported that failure to leave an indwelling fistula tube could lead to serious complications such as hematuria and urinary extravasation. Finally, Bellman and Moosanejad confirmed the feasibility of tubeless PCNI through a large number of clinical studies, and this technology was eventually promoted [6–9]. At present, a large number of studies can support the advantages of tubeless PCNI. Scholars such as Liu Jun compared 87 PCNI patients and found that there were statistical differences between the two groups in postoperative hospitalization time, postoperative first time out of bed, postoperative complications, and postoperative VAS scores [10]. Another scholar, Huang Huihu, conducted PCNI analysis on 96 patients and also found that the hospitalization time, VDS score, hospitalization expenses, and postoperative recovery time of the

control group were higher than those of the observation group, and the control group had a higher probability of fever and infection [11]. In this study, our research results are similar to those of previous studies. Among the included patients, there was no statistical difference between the two groups in the baseline data after eliminating interference ($P > 0.05$). Among the perioperative indicators, length of stay, VAS score, postoperative urinary catheter time and analgesic drug use There was a big difference in frequency ($P < 0.05$), especially in the VAS and analgesic drug evaluation, the observation group was significantly lower than the control group ($P < 0.001$), which shows that tubeless PCNI can indeed greatly reduce the pain of PCNI patients while improving the quality of life. There was no difference between the two groups in terms of operation time and intraoperative bleeding, ruling out interference from the surgeon's operating level. Although there was no difference in the one-time stone clearance rates between the two groups, the success rates were extremely high, 96% and 94%, respectively, indicating that urinary tract stones can be effectively removed with or without a fistula tube, and there is no obvious treatment advantage or disadvantage. Regarding common indicators for clinical evaluation of renal function, Scr and BUN showed relatively obvious changes. One month after surgery, the levels of Scr and BUN in both groups showed an upward trend, and the levels in the observation group were lower than those in the control group ($P < 0.05$), indicating that PCNL may cause renal function damage to a certain extent, and not placing a fistula tube can accelerate the recovery of patients' renal function damage. Finally, the incidence rates of fever, hematuria, urinary extravasation, perirenal effusion, infection, and ureteral stricture (10%) in the observation group were lower than those in the control group. Although there was no statistical significance between the two groups, the results showed that tubelessization has the potential to reduce the probability of postoperative complications.

Although the many advantages of tubeless PCNL have been described, it does not mean that tubeless PCNL can be applied to all patients, nor does it mean that tubeless PCNL is necessarily better than conventional PCNL. Tubeless is only one of the options for PCNL, rather than a new innovative technology. The only difference between the two is the presence or absence of an indwelling pyelostomy tube [1]. If the patient is found to have a tear in the renal pelvic system, ureteral stenosis or distal obstruction, indications for second-stage surgery, severe infection, bleeding and other signs during the operation, tubeless PCNI will no longer be suitable [12].

5. Conclusion

In summary, both conventional and tubeless PCNL are effective ways to remove upper urinary tract stones. When contraindications are eliminated, tubeless PCNL can be used as the first choice. It is safe and reliable, helps reduce pain, shortens the length of hospitalization, promotes renal function recovery, reduces postoperative complications, and improves the quality of life. It has clinical practical value.

About the author

Corresponding author: Zhao Wenchao, April 1985, male, Han nationality, Heze City, Shandong Province, deputy chief physician, Taizhou People's Hospital Affiliated to Nanjing Medical University, research direction: urinary tract stones
First author: Zhu Liang (1998-06), male, Han, Suqian, Jiangsu, master's degree, resident physician, Taizhou People's Hospital, research direction: urinary tract stones.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Chen B, Hu H, Zhang Y, et al., 2020, Research Progress on Tubeless Percutaneous Nephroscopy in the Treatment of Kidney Stones. Lingnan Modern Clinical Surgery, 20(5): 659–663.

[2] Wang X, 2022, Effect of Flexible Ureteroscopic Holmium Laser Lithotripsy Combined with Standard Channel Percutaneous Nephrolithotomy in the Treatment of Patients with Upper Urinary Tract Stones. Chinese Journal of Civil Health, 34(22): 43–46.

[3] Ichaoui H, Samet A, Ben H, et al., 2019, Percutaneous Nephrolithotomy (PCNL): Standard Technique Versus Tubeless – 125 Procedures. Cureus, 11(3): e4251.

[4] Zhang Q, 2020, Comparative Analysis of Partially Tubeless and Indwelling Nephrostomy Tube Percutaneous Nephrolithotomy for the Treatment of Upper Urinary Tract Stones. Chinese Medical Guide, 18(12): 155–156.

[5] Wang Q, Wang X, Feng C, et al., 2023, Research on the Clinical Application of Tubeless Minimally Invasive Percutaneous Nephrolithotomy in Kidney and Upper Ureteral Stones. Chinese and Foreign Medical Research, 21(20): 1–5.

[6] Wickham J, Miller R, Kellett M, et al., 1984, Percutaneous Nephrolithotomy: One Stage or Two? British Journal of Urology, 56(6): 582–585.

[7] Winfield H, Weyman P, Clayman R, 1986, Percutaneous Nephrostolithotomy: Complications of Premature Nephrostomy Tube Removal. Journal of Urology, 136(1): 77–79.

[8] Bellman G, Davidoff R, Candela J, et al., 1997, Tubeless Percutaneous Renal Surgery. Journal of Urology, 157(5): 1578–1582.

[9] Moosanejad N, Firouzian A, Hashemi S, et al., 2016, Comparison of Totally Tubeless Percutaneous Nephrolithotomy and Standard Percutaneous Nephrolithotomy for Kidney Stones: A Randomized Clinical Trial. Brazilian Journal of Medical and Biological Research, 49(4): e4878.

[10] Liu J, He W, Lou Y, et al., 2024, Discussion on the Safety and Feasibility of Partially Tubeless Percutaneous Nephrolithotomy. Chinese Journal of General Medicine, 22(10): 1679–1683.

[11] Huang H, Huang W, Guo X, et al., 2020, Treatment Experience of Percutaneous Nephrolithotomy without Nephrostomy Tube. Chinese Journal of Endoscopy, 26(8): 55–60.

[12] Zilberman D, Lipkin M, De La Rosette J, et al., 2010, Tubeless Percutaneous Nephrolithotomy—The New Standard of Care? Journal of Urology, 184(4): 1261–1266.