Am J Transl Res 2021;13(5):5685-5690
www.ajtr.org /ISSN:1943-8141/AJTR0130099

*Original Article*

# Effect of indwelling time of double J tube on infected ureteral calculi and the distribution of pathogenic characteristics in diabetics

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Received January 13, 2021; Accepted February 20, 2021; Epub May 15, 2021; Published May 30, 2021

**Abstract:** Objective: To investigate the effect of double J tube indwelling time on infected ureteral calculi (UC) and distribution of pathogenic characteristics in diabetics. Methods: 132 diabetics with infected UC admitted to our hospital from April 2017 to April 2020 were selected. All patients were implanted with a double J tube, followed by percutaneous nephrolithotomy or ureteroscopic holmium laser lithotripsy. According to the indwelling time, they were divided into a research group (≤ 7 d, 60 cases) and a control group (> 7 d, 72 cases). We compared the baseline data, and surgical data of the two groups, and analyzed pathogenic bacteria. Results: None of the differences in the operation time, hospital stay, and stone diameter were statistically significant (P > 0.05). Before placement of the double J tube, no striking differences in urinary white blood cells and blood white blood cells were observed between the two groups (P > 0.05). 7 days after the placement of the double J tube, a significant decrease of the urinary white blood cells and blood white blood cells was recorded (P < 0.05), with no significant differences between the two groups (P > 0.05). Before and after placement of double J tube, no striking differences in body temperature > 38.5°C or positive blood culture were observed between the two groups (P > 0.05). Surgical methods, stone removal rate one month after the operation, or incidence of postoperative complications were not significantly different (P > 0.05). 49 pathogenic strains were detected, among which Gram-negative bacteria accounted for 63.27%. The main pathogens were Escherichia coli and Pseudomonas aeruginosa. Conclusion: The indwelling time of the double J tube has no significant effect on the effectiveness and safety in diabetic patients with infected UC. It is necessary to reduce the indwelling time and implement targeted stone surgery.

**Keywords:** Dabetes, double J tube, ureteral calculi, infection, pathogenic characteristics of infection

## Introduction

Ureteral calculus (UC) is a common urinary system disease that is mainly induced by kidney stones or renal lesions, leading to obstruction, fluid accumulation, and dilatation of the upper urinary tract, followed by the occurrence of acute upper urinary tract infection [1]. It affects 1% to 5% of the population and directly affects their normal life [2]. Diabetic patients mainly present with hyperglycemia, emaciation, and polyuria. Urinary system infection is one of the more common complications, the incidence of which is increasing year by year [3]. In contrast, diabetic patients are prone to urinary tract obstruction, lower abdominal pain, and urinary tract infection after being affected by urinary tract infection factors, coupled with the damage to their ureteral smooth muscle, which can affect stone removal [4]. Diabetic patients easily get pyonephrosis, sepsis, and other conditions after the occurrence of UC symptoms, and certain patients even have septic shock, which poses a serious threat to their life. Indwelling double-J tube in the ureter, the first-line treatment for diabetic patients with UC complicated by upper urinary tract infection [5], is effective to achieve decompression and drainage, with high safety. It has been found [6] that it can induce urinary urgency, lumbar pain, urinary reflux, and hematuria in patients. So the double J tube should be removed in time once the

infection is controlled, and stone removal therapy should be performed for UC as soon as possible. At present, there is no uniform conclusion on the indwelling time of the double J tube. In most studies, the double J tubes were removed after 7 days of placement and the calculi were treated surgically. There are few studies on the effect of indwelling time of double J tube on the efficacy of diabetic patients with UC and infection in China. In this study, 132 diabetic patients with UC and infection admitted to our hospital from April 2017 to April 2020 were selected to investigate the effect of indwelling time of ≤ 7 days and indwelling time of > 7 days on the therapeutic effect, providing a basis for clinical treatment.

## Materials and methods

### *General data*

132 diabetic patients with infected UC admitted to our hospital from April 2017 to April 2020 were selected. Inclusion criteria: (1) Those who conformed to the international diagnostic criteria for diabetes [7], as confirmed by urinary tract CT diagnosis, and met the diagnostic criteria for UC [8]; (2) The clinical data were complete with different degrees of infection; (3) Those who underwent double J tube inserted under ureteroscope; (4) Those who received lithotripsy; (5) Those aged 35-76 years. Exclusion criteria: (1) Those who had severe heart, liver, kidney, and other organ lesions; (2) Those who were complicated with ureteral calculi or kidney stones; (3) Those who recently took a large number of glucocorticoids or immunosuppressive agents. This study was approved by the Ethics Committee of our hospital, and patients and their families provided informed consent.

All patients were divided into a research group and control group according to the indwelling time. The control group had an indwelling time of ≤ 7 d (n=60), the research group had an indwelling time of > 7 d (n=72). The control group aged 35-76 years, and disease duration ranged from 1 to 12 months. The research group aged 35-78 years, and disease duration ranged from 1 to 11 months.

### *Methodology*

All patients underwent hematology, urinalysis, and midstream urine culture before the indwelling double J tube. Blood culture and drug sensitivity tests were performed for patients with body temperature of more than 38.5°C. Vital signs (heart rate, respiratory rate, and blood pressure, etc.) were recorded. After indwelling double J tube, hematology, urinalysis, and midstream urine culture were performed again, and broad-spectrum antibiotics were given for anti-infection treatment. Midstream urine was collected into a sterile cup and it was transferred to the drying tube bacterial culture. Then we observed the bacterial morphology, counted and identified the bacteria. VITEK-AMS (France Bio-Merieux), a bacterial identification, was adopted for bacterial identification. Indwelling double J tube: after conventional local anesthesia, and using the posterior lithotomy position, we took a cystoscope or urotoroscope to find the ureteral orifice into the bladder, implemented a F6 double J tube. In the research group, the double J tube was removed after 7 d, followed by lithotripsy. In the control group, the double J tube was removed after 7 d, followed by lithotripsy. Under general anesthesia, we removed the original indwelling double J tube, and then performed ureteroscopic holmium laser lithotripsy. Holmium laser surgery system (Lumenis, American) was used to break the stones. We crushed the stone to a fragment smaller than 3 mm and rinsed with flushing fluid. Then the stone was excreted. Patients whose stones returned to the renal pelvis or were difficult to reach by ureteroscopy were treated with percutaneous nephrolithotomy.

### *Observation indicators*

A comparison of the operative time, hospital stay, and stone diameter as well as white blood cell count, body temperature > 38.5°C, positive blood culture, surgical methods, stone removal rate one month after operation, and incidence of postoperative complications before and after indwelling double J tube was carried out between the two groups. The distribution of pathogens was analyzed.

### *Statistical methodology*

Statistical analysis was conducted with SPSS 18.0 software and Graphics drawing was carried out with GraphPad Prism 8.0 in this study. Measurement data were represented as ($\overline{x} \pm s$) and analyzed by t-test. Enumeration data were represented as (n, %) and analyzed by $\chi^2$ test. $P < 0.05$ indicated a significant difference.

**Table 1.** Baseline information

| Index | research group (n=72) | control group (n=60) | $t/X^2$ | P |
|---|---|---|---|---|
| Gender | | | 1.536 | 0.965 |
| male | 39 | 34 | | |
| female | 33 | 26 | | |
| years | 56.42±9.50 | 56.40±9.48 | 2.365 | 0.365 |
| disease duration | 6.35±0.78 | 6.34±0.82 | 1.256 | 0.854 |

**Table 2.** Comparison of surgical conditions between the two groups

| Group | Operation time (min) | Hospital stay (d) | Stone diameter (mm) |
|---|---|---|---|
| Research group (n=72) | 37.89±13.24 | 3.78±0.42 | 15.28±1.68 |
| Control group (n=60) | 36.13±14.85 | 3.70±0.89 | 15.20±2.55 |
| *t* | 0.719 | 0.678 | 0.256 |
| *P* | 0.473 | 0.499 | 0.799 |

## Results

*Comparison of general data*

There was no marked difference in the general data between the two groups (P > 0.05) (**Table 1**).

*Comparison of surgical conditions between the two groups*

No significant differences in operation time, hospital stay, and stone diameter were seen between the two groups (P > 0.05) (**Table 2**).

*Comparison of white blood cell count before and after indwelling double J tube between the two groups*

No striking differences in urine white blood cells and blood white blood cells before indwelling the double J tube were observed between the two groups (P > 0.05). The urine white blood cells and blood white blood cells in the two groups were markedly reduced after indwelling 7-days than before indwelling, showing a significant difference (P < 0.05), but there were no significant differences between the groups (P > 0.05) (**Table 3**).

*Comparison of relevant enumeration data before and after indwelling double J tube between the two groups*

There were no striking differences concerning temperature > 38.5°C and positive blood culture before indwelling the double J tube between the two groups (P > 0.05). There were no striking differences concerning body temperature > 38.5°C and positive blood culture after indwelling the double J tube between the two groups (P > 0.05) (**Table 4**).

*Comparison of surgical data and incidence of postoperative complications between the two groups*

There were no significant differences in terms of surgical methods, stone removal rate one month after the operation, and incidence of postoperative complications between the two groups (P > 0.05) (**Table 5**).

*Distribution and constituent ratio of pathogenic bacteria*

A total of 49 pathogenic strains were detected, among which Gram-negative bacteria accounted for 63.27%, and the main pathogens were Escherichia coli and Pseudomonas aeruginosa (**Table 6**).

## Discussion

Urinary calculus (UC) has a high incidence in clinical practice and is easily complicated by urinary system infections and other conditions. Patients with more severe infections can also cause a septic shock as well as uremic sepsis, thereby increasing their mortality [9]. Diabetes mellitus is an independent risk factor for UC [10]. When the urinary system is affected by infectious agents, lower abdominal pain, urinary tract obstruction, and urinary tract infection may occur in diabetics [11], which leads to damage to their ureteral smooth muscle, thus affecting stone expulsion. As far as the current clinical research status is concerned, the growth rate of urinary tract infection rate in diabetic patients remains fast, which is 10-times higher than that in healthy subjects [12]. Studies have shown that diabetes with UC is easily complicated by sepsis and pyonephrosis, with a short course of the disease and acute onset, which makes patients prone to septic shock and even seriously threatens their life. Therefore, for diabetic patients with UC and urinary tract infection, active anti-infec-

**Table 3.** Comparison of relevant measurements before and after indwelling double J tube between the two groups

| Group | Urine white blood cells (×10³/μl) | | Blood white blood cells (×10⁹/L) | |
|---|---|---|---|---|
| | Before indwelling | After indwelling 7 days | Before indwelling | After indwelling 7 days |
| Research group (n=72) | 9.73±2.43 | 3.44±0.82* | 14.81±3.26 | 8.18±1.64* |
| Control group (n=60) | 10.18±3.70 | 3.53±0.60* | 15.20±3.63 | 7.85±1.27* |
| *t* | 0.838 | 0.707 | 0.678 | 1.351 |
| *P* | 0.404 | 0.481 | 0.499 | 0.179 |

Note: *represents the comparison with that before indwelling (P < 0.05).

**Table 4.** Comparison of relevant enumerated data before and after indwelling double J tube between the two groups

| Group | Body temperature > 38.5°C | | Positive blood culture | |
|---|---|---|---|---|
| | Before indwelling | After indwelling 7 days | Before indwelling | After indwelling 7 days |
| Research group (n=72) | 55 (76.39) | 1 (1.39) | 47 (65.28) | 1 (1.39) |
| Control group (n=60) | 42 (70.00) | 2 (3.33) | 33 (55.00) | 3 (5.00) |
| $\chi^2$ | 0.686 | 0.557 | 1.448 | 1.452 |
| *P* | 0.408 | 0.455 | 0.229 | 0.228 |

**Table 5.** Comparison of surgical data between the two groups

| Surgical data | Research group (n=60) | Control group (n=72) | $\chi^2$ | *P* |
|---|---|---|---|---|
| Surgical methods | | | 0.052 | 0.819 |
| Holmium laser lithotripsy | 57 (95.00) | 69 (95.83) | | |
| Percutaneous nephrolithotomy | 3 (5.00) | 3 (4.17) | | |
| Stone removal rate one month after operation | 56 (93.33) | 70 (97.22) | 1.141 | 0.285 |
| Incidence of postoperative complications | | | 0.047 | 0.828 |
| Gross hematuria | 16 (26.67) | 19 (26.39) | | |
| Renal colic | 16 (26.67) | 17 (23.61) | | |

tion treatment with an early reduction of pressure in the renal pelvis to relieve obstruction and ensure unobstructed drainage can control the infection faster.

The main methods of decompression and drainage commonly used in clinical practice are percutaneous nephrostomy and indwelling double J tube, both of which function in relieving the obstruction, reducing the pressure in the renal pelvis, diverting urine, and controlling infection [2, 14]. One study stated [15] that percutaneous nephrostomy is more suitable for patients with more severe disease, larger stones, and higher locations, while an indwelling double J tube is suitable for patients with smaller stones. Flukes et al [16] reported that intraurethral indwelling double J tube is the first-line treatment for upper urinary tract infections, but there is no uniformity regarding the length of their indwelling time. The double J tube is a foreign body in the human body, and easily stimulates the mucosa of the ureteral wall, resulting in a series of uncomfortable symptoms such as low back pain, urinary urgency, and hematuria, and some patients even find it difficult to tolerate and need to have it removed [10]. Clinically, after infection control, the double J tube must be removed on time and targeted therapy should be performed to improve and enhance their prognosis.

The results of this study showed no significant differences in operative time, hospital stay, or stone diameter between the two groups (P > 0.05). No striking differences in urine white blood cells and blood white blood cells before indwelling the double J tube were observed between the two groups (P > 0.05). The urine white blood cells and blood white blood cells in the two groups were markedly reduced after indwelling 7-days than before indwelling, showing a significant difference (P < 0.05), but there were no significant differences between

**Table 6.** Distribution and constituent ratio of pathogenic bacteria

| Pathogenic bacteria | Number of strains (n=49) | Constituent ratio (%) |
|---|---|---|
| Gram-negative bacteria | 31 | 63.27 |
| Escherichia coli | 12 | 24.45 |
| Pseudomonas aeruginosa | 9 | 18.37 |
| Klebsiella pneumoniae | 5 | 55.56 |
| Acinetobacter baumannii | 3 | 6.12 |
| Other | 2 | 4.08 |
| Gram-positive bacteria | 14 | 28.57 |
| Staphylococcus aureus | 6 | 12.24 |
| Enterococcus faecalis | 4 | 8.16 |
| Staphylococcus epidermidis | 2 | 4.08 |
| Staphylococcus haemolyticus | 1 | 2.04 |
| Other | 1 | 2.04 |
| Fungus | 4 | 8.16 |
| Candida albicans | 2 | 4.08 |
| Candida glabrata | 1 | 2.04 |
| Candida tropicalis | 1 | 2.04 |

the groups (P > 0.05). There were no striking differences concerning body temperature > 38.5°C and positive blood culture before indwelling the double J tube between the two groups (P > 0.05). There were no striking differences concerning body temperature > 38.5°C and positive blood culture after indwelling the double J tube between the two groups (P > 0.05). This suggests that the targeted stone surgery should be performed within 7-days after the indwelling double J tube. Compared with the surgery with the indwelling double J tube for > 7-days, the efficacy remained consistent, and the indwelling double J tube in the ureter could effectively improve the inflammatory state. With the continuous development of minimally invasive endoluminal surgical techniques, ureteroscopic holmium laser lithotripsy has emerged as the primary choice for the treatment of ureteral stones due to its low trauma, high lithotripsy efficiency, low patient pain, faster postoperative recovery, and high-safety [17]. However, ureteroscopic lithotripsy is also deficient in that it can easily cause reflux of stones in the upper ureter, or there may be distortion or stenosis below the ureteral stones, which may lead to an inability to perform lithotripsy or failure of lithotripsy at the stone site. Thus, percutaneous nephrolithotripsy should be used at this time [18]. Most of the patients in this study underwent ureteroscopic holmium laser lithotripsy after a double J tube inserted under the ureteroscope, and there were no marked differences in the stone removal rate and postoperative complication rate of patients at 1-month after surgery (P > 0.05). It was also suggested that the time of the indwelling double J tube was not correlated with the treatment outcome. We should reduce the duration of preoperative indwelling to ensure the efficacy and safety of patients and perform targeted stone surgery as early as possible. The results of this study showed that a total of 49 pathogenic strains were detected, among which Gram-negative bacteria accounted for 63.27%, and the main pathogens were Escherichia coli and Pseudomonas aeruginosa. The main reasons for UC with urinary tract infection included ureteral damage by stones, decreased local immunity, and invasion of opportunistic pathogens, thereby causing infection, coupled with urine stasis caused by stone obstruction, which in turn increases the risk of infection. Especially in diabetic patients, due to their dysfunction in glucose metabolism, their immunoglobulin status is low, which affects the normal function of their white blood cells and lymphocyte levels, resulting in decreased autoimmune capacity and increased risk of urinary system infection [19]. The limitations of this study are as follows. First, this is a retrospective study that has potential selection bias, and confounding factors may affect the results. Second, no drug susceptibility test was performed after the strain was detected. The study will be performed to conduct further drug susceptibility tests on the strains.

In conclusion, the indwelling time of the double J tube has no significant effect on the effectiveness and safety of diabetic patients with infected UC. It is necessary to reduce the indwelling time and implement targeted stone surgery early.

## Disclosure of conflict of interest

None.

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