

The risk factors and complications of forgotten double-J stents: A single-center experience

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Abstract

Background: Postoperative urology patients may require the insertion of a ureteral stent. However, the delayed removal or change of the ureteral stent may lead to serious consequences for some patients. This study primarily aimed to examine the risk factors and complications associated with forgotten double-J stents (DJSs).

Methods: In this retrospective study, postoperative patients who underwent DJS insertion were recruited. Based on the brand of DJS, the maximal stent life (MSL) was classified into 3-month, 6-month, and 12-month groups, and a forgotten DJS was defined as the one that had yet to be removed 2 weeks past its MSL. A total of 479 patients were analyzed. The reasons for the use of DJSs use and the time and method of their insertion were recorded, and the risk factors and possible complications associated with forgotten DJSs were analyzed.

Results: The primary reason for DJS insertion was urolithiasis (69.7%), and insertions performed using ureterorenoscopy were the most common (413/479, 86.2%). Eighteen patients (3.8%) had forgotten DJSs, with an average overdue period of 63.17 days (18-189 days). Multivariate analysis revealed that patients older than 60 years (odds ratio [OR] = 3.626, 95% confidence interval [CI] = 1.070-12.289; $p = 0.039$) and DJSs exchanged using fibrocystoscopy (OR = 5.437, 95% CI = 1.060-28.256; $p = 0.042$) were significantly associated with forgotten DJSs. Out of the 18 patients with forgotten DJSs, three (16.67%) experienced symptomatic complications, with one developing acute pyelonephritis, and the remaining two experiencing stone encrustation.

Conclusion: Patients older than 60 years were 3.6 times more likely to have forgotten DJSs than patients aged 60 and below, and DJSs exchanged using fibrocystoscopy were 5.4 times more likely to be forgotten than those inserted using ureterorenoscopy. Greater attention with regards to tracking and recalling DJSs should be paid in high-risk patients to prevent forgotten DJSs and associated complications.

Keywords: Complication; Double-J ureteral stent; Forgotten ureteral stent; Risk factor

1. INTRODUCTION

Postoperative urology patients may sometimes require the insertion of a ureteral stent to facilitate the evacuation of retained urine in the renal pelvis and allow for stone removal, and also to prevent urinary obstruction. Because our hospital does not, at present, utilize fully biocompatible and biodegradable double-J stents (DJSs), eventually DJS must be surgically removed or changed. However, some patients will forget and fail to return on schedule for the removal of their DJSs. Overdue DJSs can lead to stone formation, stent fragmentation, infections, or stent migration. Severe encrustation and stone formation may cause hydronephrosis and, consequently, renal impairment.¹⁻³

Additional treatments are often required to handle ureteral stent complications, including extracorporeal shock wave lithotripsy and the application of endourological techniques, which not only increase the risk of kidney failure¹ and the cost of treatment but also lower the working ability and quality of life of patients.⁴

At our hospital, DJS instructions and precautions are currently provided to patients and their families in a paper format. The contents include the stent insertion position (left and right side), date of insertion, and the safe time window for stent removal or replacement. The patient or family member then signs an acknowledgement slip to confirm that they understand the contents. The only information indicated on the slip is the date of DJS insertion and the medical record number. Even though we have used this method for more than 20 years, cases involving forgotten DJSs still occur from time to time; thus, it is important to examine forgotten ureteral stents as a patient safety issue. This study primarily investigated the types of patients who were more likely to forget about their DJSs, and the complications associated with forgotten DJSs.

2. METHODS

2.1. Research participants

This study received IRB approval as a retrospective observational cohort study. The participants included patients aged

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above 20 years who underwent DJS insertion at our hospital between June 1, 2017 and August 31, 2018. After excluding DJS insertions performed outside the hospital or by the radiology division, 518 participants were identified. However, within this group of patients, 25 had died, 13 had undergone DJS removal outside the hospital, and one had experienced a stent displacement at home; hence, these patients were excluded from this study. The remaining 479 patients thus served as the focus of our analysis.

2.2. Research design

The following demographic characteristics of the patients (recorded as of October 31, 2018) were examined: age, sex, marital status, education level, reason for DJS placement, method of placement, time of placement, maximal stent life (MSL), current DJS status (due for change or removal), period of time overdue, and reason for forgetting the DJS. The presence or absence of complications in the patients with forgotten DJSs was noted, and the patients were then notified to schedule a return visit. Subsequently, the average indwelling time and the proportion of patients who delayed handling the forgotten DJSs were analyzed. On the basis of the hospital's needs with respect to clinical practices and patient diagnosis, the MSLs of the DJSs were defined according to material type and manufacturer. The MSL of Cook Universa™ soft ureteral stents, Bard Inlay™ ureteral stents, and Boston Contour™ ureteral stents were considered to be 3 months; the MSL of Bioteq double pigtail ureteral stents and Bard Urosoft tumor stents were considered to be 6 months; and the MSL of Cook Medical's black silicone filiform double pigtail stents was considered to be 12 months. To exclude overdue DJSs that resulted from factors related to medical treatment or scheduled surgery, a forgotten DJS was defined as the one that had yet to be removed or replaced within 14 days beyond its MSL.

2.3. Statistical analysis

SPSS for Windows (version 21.0; IBM SPSS Statistics, IBM Corporation, Chicago, IL, USA) was used to perform logistic regression analysis of the risk factors for forgotten DJSs. An independent sample *t*-test was used to explore correlations between the period of time overdue and complications from forgotten DJSs. All tests were two-sided, and *p* values <0.05 were considered to be statistically significant.

3. RESULTS

The demographic data of the 479 patients are shown in Table 1. Their mean age was 57.69 years, 51.1% (245/479) were male, 87.5% (419/479) underwent unilateral DJS insertion, and 12.5% (60/479) underwent bilateral DJS insertion. The primary reason for DJS insertion was urolithiasis (69.7%), followed by stricture/polyposis/angulation (18%), external compression (5.6%), and genitourinary cancer (2.5%). The reasons for undergoing DJS insertion in the remaining patients included prophylactic DJS, trauma during open surgery, and blood clots related to ureteral obstruction. The most common form of DJS insertion was through ureterorenoscopy (413/479, 86.2%), followed by fibrocystoscopy (55/479, 11.5%). Overall, 87.5% of the patients were classified into the 3-month MSL group.

The DJSs had been removed in 80.8% (387/479) of the patients. Of the remaining 19.2% of the patients, 16 had newly inserted DJSs and 76 had replaced their DJSs. The average DJS indwelling time was 42.5 days. Forty-two (8.8%) patients had overdue DJSs (Table 2), of whom 11 (2.3%) had already handled the issue after being notified via phone. These 11 patients all indicated that they had forgotten about their overdue DJSs.

Table 1
Patient demographics

| | n = 479 (%) |
|---------------------------------|-------------|
| Mean age, years | 57.69 |
| Sex | |
| Male | 245 (51.1%) |
| Female | 234 (48.9%) |
| Marital status | |
| Married | 357 (74.5%) |
| Single/divorce | 122 (25.5%) |
| Education status | |
| Illiterate | 34 (7.1%) |
| Educated | 445 (92.9%) |
| Employment status | |
| No work | 239 (49.9%) |
| Working | 240 (50.1%) |
| Site | |
| Right | 196 (40.9%) |
| Left | 223 (46.6%) |
| Bilateral | 60 (12.5%) |
| Stent indication | |
| Urolithiasis | 334 (69.7%) |
| Stricture/polyposis/ angulation | 86 (18.0%) |
| External compression | 27 (5.6%) |
| GU tumor | 12 (2.5%) |
| Other ^a | 20 (4.2%) |
| DJ insert method | |
| Ureterorenoscopy | 413 (86.2%) |
| Fibrocystoscopy | 55 (11.5%) |
| PCN (antegrade) | 10 (2.1%) |
| During open surgery | 1 (0.2%) |
| MSL | |
| 3 months | 419 (87.5%) |
| 6 months | 51 (10.6%) |
| 12 months | 9 (1.9%) |
| Over MSL | 42 (8.8%) |
| Forgotten DJ ^b | 18 (3.8) |

^aProphylactic DJS, trauma during open surgery, blood clot obstruction.

^bForgotten DJ definition: 2 weeks past the MSL.

DJS = double-J stent; MSL = maximal stent life; PCN = percutaneous nephrostomy.

Furthermore, except for three patients who were lost to follow-up, the remaining patients with overdue DJSs had already removed or replaced their DJSs prior to the notification.

In total, 18 (3.8%) cases involved forgotten DJSs (exceeding the MSL by 2 weeks), with an average overdue period of 63.17 days (18-189 days). Univariate analysis was performed to investigate the relation between the various factors and forgotten DJSs (Table 3), and the results revealed that the following factors were associated with forgotten DJS: age above 60 years (odds ratio [OR] = 4.448, 95% confidence interval [CI] = 1.442-13.720; *p* = 0.014), illiterate (OR = 5.517, 95% CI = 1.840-16.541; *p* = 0.002), and exchange via fibrocystoscopy

Table 2
Patients with overdue double-J stent and overdue times

| | Patient number (%) | Mean overdue times |
|---|--------------------|--------------------|
| Overdue DJS (exceeding MSL) | 42 (8.8%) | 31.17 (1-189) |
| Forgotten DJSs (exceeding the MSL by 2 weeks) | 18 (3.8%) | 63.17 (18-189) |
| Overdue DJS between 1 and 13 days | 24 (5%) | 7.17 (1-13) |

DJS = Double-J stent; MSL = Maximal stent life.

Table 3**Univariate and multivariate analysis of patient with forgotten ureteral stents for more than 14 days**

| Variable | Univariate | | | | Multivariate | | | |
|----------------------|--------------|--------------|--------------|--------|--------------|--------------|--------------|--------|
| | <i>p</i> | OR | 95% CI of OR | | <i>p</i> | OR | 95% CI of OR | |
| Age >60 years | 0.009 | 4.448 | 1.442 | 13.720 | 0.039 | 3.626 | 1.070 | 12.289 |
| Gender (female/male) | 0.132 | 0.464 | 0.171 | 1.259 | 0.660 | 0.660 | 0.772 | 0.244 |
| Married | 0.480 | 0.697 | 0.256 | 1.900 | 0.323 | 0.323 | 0.565 | 0.182 |
| Illiteracy | 0.002 | 5.517 | 1.840 | 16.541 | 0.198 | 0.198 | 2.314 | 0.646 |
| Stent indication | | | | | | | | |
| Urolithiasis | 0a | | | | 0a | | | |
| Angulation/stricture | 0.217 | 2.000 | 0.665 | 6.013 | 0.521 | 0.521 | 0.569 | 0.102 |
| External compression | 0.837 | 1.246 | 0.154 | 10.116 | 0.369 | 0.369 | 0.307 | 0.023 |
| GU tumor | 0.323 | 2.945 | 0.346 | 25.076 | 0.634 | 0.634 | 1.734 | 0.179 |
| Other ^a | 0.620 | 1.705 | 0.207 | 14.024 | 0.589 | 0.589 | 0.509 | 0.044 |
| OP method | | | | | | | | |
| URS | 0a | | | | 0a | | | |
| FCS | 0.005 | 4.475 | 1.585 | 12.635 | 0.042 | 5.473 | 1.060 | 28.256 |
| Antegrade | 0.202 | 4.061 | 0.472 | 34.897 | 0.252 | 3.931 | 0.378 | 40.908 |
| During open surgery | 1.000 | 0.000 | 0.000 | | 1.000 | 0.000 | 0.000 | |
| Single/bilateral | 0.214 | 2.066 | 0.657 | 6.498 | | | | |
| MSL | | | | | | | | |
| 3 months | 0a | | | | | | | |
| 6 months | 0.902 | 1.099 | 0.244 | 4.951 | | | | |
| 12 months | 0.267 | 3.367 | 0.395 | 28.666 | | | | |

^aProphylactic DJS, trauma during open surgery, blood clot obstruction.

0a = as reference; CI = confidence interval; FCS = fibercystoscopy; OP method = operating method; OR = odds ratio; URS = ureterorenoscopy.

(OR = 4.475, 95% CI = 1.585-12.635; $p = 0.005$). Multivariate analysis (Table 3) revealed that patients older than 60 years were 3.6 times more likely to have forgotten DJSs (OR = 3.626, 95% CI = 1.070-12.289; $p = 0.039$), and that DJSs exchanged via fibercystoscopy were more likely to be forgotten than those performed via ureterorenoscopy (OR = 5.437, 95% CI = 1.060-28.256; $p = 0.042$). These six forgotten DJSs via fibercystoscopy were all scheduled for regular exchange (at least two times).

A retrospective case review indicated that three (16.67%) of the 18 patients with forgotten DJSs experienced symptomatic complications. One patient who had a DJS with a 12-month MSL and delayed changing it by 97 days (the indwelling time was about 15 months) developed acute pyelonephritis that required hospitalization and IV antibiotic treatment. The other two patients experienced stone encrustation. One of these patients had a DJS with a 3-month MSL and delayed its removal by 33 days (the indwelling time was about 4 months). This patient developed stones that were removed via percutaneous nephrolithotomy (PCNL), and subsequently experienced stone encrustation on the upper and lower coil that required combined endoscopic cystolithotripsy (ESCL), ureterorenoscopic lithotripsy, or PCNL for DJS removal. The other patient, who underwent DJS insertion (6-month MSL; removal delayed by 20 days; indwelling time of about 6.7 months) due to stenosis and endoureterotomy, developed stone encrustation on the lower coil that required ESCL for DJS removal. The remaining patients did not suffer from any significant complications and had already scheduled the replacement or removal of their DJSs. An independent sample *t*-test indicated that there was no statistical difference ($p = 0.655$) between DJS indwelling time and complications.

4. DISCUSSION

Previous studies have defined forgotten DJSs differently. Tang et al and Monga et al defined forgotten DJSs as those used for 6 months,^{1,5} whereas Ziembra et al defined forgotten DJSs according to the date of anticipated extraction.⁶ In this study, they were classified into 3-month, 6-month, and 12-month groups

based on their MSL. Most DJSs were inserted after urolithiasis surgery (69.7%), and the indwelling time for these DJSs was shorter. Therefore, the MSL of some DJSs was defined as 3 months, even though this was shorter than the manufacturers' recommendations, providing a safe buffer in the event that a patient exceeded the 3-month period. Farsi et al reported that a longer DJS indwelling time was associated with a higher level of bacterial colonization, which could reach 75.1% for a DJS indwelling time longer than 3 months.⁷ Joshi et al also reported similar findings, proposing that colonization rate was correlated with time and female sex.⁸ Thus, shortening the MSL period to 3 months was reasonable and may have reduced the incidence of urinary tract infections.

Forgotten DJSs can lead to complications that are difficult to manage and also increase medical expense.⁴ Monga et al examined 12 patients with forgotten DJSs (indwelling time >6 months), of whom 68% experienced calcification and 45% experienced DJS fragmentation.¹ Park et al reported that among nine patients who had indwelling DJSs for more than a year, three experienced severe DJS encrustation, three experienced minor encrustation, and three did not develop any encrustation. Moreover, all of the patients developed pyuria.⁹ However, these two studies did not discuss the materials and MSL of the DJSs, making it hard to examine the relation between complications and the overdue period. Sighinolf et al analyzed the causes of stone encrustation on DJSs, and found that stone encrustation on the proximal coil was related to a history of urolithiasis and the frequent formation of stones, while stone encrustation on the distal coil was related to urinary tract infections and patient age. However, there was no correlation between distal coil encrustation burden and DJS indwelling time in this study.¹⁰ Kartal et al reported that 73.9% of 69 patients who had indwelling DJSs for >6 months experienced encrustation, with a longer DJS indwelling time being linked to a higher stone encrustation burden.¹¹ Jain et al also reported similar findings that a longer DJS indwelling time and a previous history of stones was associated with a greater degree of encrustation.¹² In the current study, two patients had stone encrustation, both of whom had a history

of urolithiasis and indwelling times of 200 days and 123 days, respectively. However, no correlations between the overdue period and the occurrence of complications were established.

The percentage of patients with forgotten DJSs differs substantially across various studies, ranging from 3% to 51%.^{5,6,13} This may be attributed to the different definitions of MSL used in each study. Using a paper-based notification approach, we still had a 3.8% incidence of forgotten DJSs, indicating the necessity of a good tracking and recall system. Despite the introduction of a stent card registry, Tang et al only achieved a 5.4% incidence of overdue DJSs (MSL of 6 months). Furthermore, 5.9% of the patients in their study were identified via theater logs rather than the card registry, and there was also a lack of regular patient data reviews. These factors prevented the effective utilization of the system to prevent forgotten DJSs.⁵

Ather et al were the first to propose the use of an integrated computerized program to track and send reminders to patients, and they managed to reduce the incidence of forgotten DJSs from 12.5% to 1.2%-1.5%.¹⁴ Lynch et al implemented a web-based stent registry with automatic recall application, and reported that 51% of the patients had exceeded the MSL, with an average overdue period of 20.89 days.¹³ In the current study, 8.8% of the patients exceeded the MSL, but only 3.8% of the cases involved forgotten DJSs, with an average overdue period of 63.17 days, indicating that the implementation of a recall system can reduce the incidence of forgotten DJSs. A mobile point-of-care application was utilized in a recent study by Ziemba et al, resulting in only 3% of the patients having overdue stents.⁶ Even though these systems can reduce the likelihood of forgotten DJSs, staffs still need to manually build and modify the relevant databases and notify patients via phone or e-mail, which could lead to human error. It is hoped that the implementation of a recall system in conjunction with the use of apps, QR codes, Google calendar, and other products will enable the utilization of two-way reminders with the aim of reducing the incidence of forgotten DJSs.

Only two studies have discussed the risk factors associated with forgotten DJSs. Jain et al performed univariate analysis of a forgotten DJS group and a control group, and found that there were statistical differences between the types of insurance that they were covered under, with the forgotten DJS group being mostly covered by Medicaid or nothing at all.¹² Since the participant groups examined in this study were all covered by Taiwan's National Health Insurance program, insurance-related issues were not explored. Multivariate analysis conducted by Divakaruni et al showed that uninsured patients were six times more likely to have forgotten DJSs than insured patients, and that male patients were 2.8 times more likely to have forgotten DJSs than female patients. However, no associations with other variables such as age, English ability, and marital status were established in that study.¹⁵ In the current study, the DJS instructions and precautions are written in Chinese, and the overdue date was also indicated in the same document. Patients must be able to read and come back to receive further treatment before that time. The patient's inability to read was also established, and was significantly associated with forgotten DJSs in univariate analysis, but not in multivariate analysis. This result is compatible with Divakaruni et al in that English ability is not associated with forgotten DJSs. Jin et al reviewed 102 studies and explored the relationships between variables and compliance.¹⁶ They found that the conclusions regarding elderly patients differed across studies, and that while most studies concluded that the elderly patients had better compliance, other studies concluded that the elderly patients had poorer compliance due to poorer vision, hearing, and memory. In the current study, age was associated with forgotten DJSs, with patients older than

60 years being 3.6 times more likely to have forgotten DJSs. Therefore, it appears to be even more necessary to explain the importance of the scheduled removal time to elderly patients with indwelling DJSs, or to inform family members of the importance of giving reminders.

This is the first study to examine DJS insertion methods and the risk of forgotten DJSs, and the results showed that the patients were more likely to have forgotten DJSs if their DJSs were inserted or changed solely via fibrocystoscopy. Six of the patients with forgotten DJSs had their DJSs replaced via fibrocystoscopy, all of whom were scheduled for regular DJS replacement (at least two times), and by the time they returned for follow-up, their DJSs had already exceeded the safety range with respect to MSL. The fact could be attributed to their failure to remember this matter or to their physicians' failure to assist in scheduling return visits or providing reminders. Thus, it is necessary not only for patients to pay attention to their DJS replacement schedule but also for physicians to remind their patients of scheduled return visits or schedule replacement.

There are several limitations to this study. First, the study was a retrospective study. Hence, the accuracy of the data was determined by the manner in which the cases were recorded previously, and it was not possible to conduct retrospective reviews to examine the role of private insurance and the patients' employment status. Second, this study was a single-center study that focused mostly on patients residing in northern Taiwan, which may have led to regional bias. Third, the causes of forgotten DJSs were not explored, and it was only established that the 11 patients who were notified via phone with regards to their return visits had failed to return according to schedule as they had forgotten about the visits. As for the other patients with forgotten DJSs who had either addressed the issue or were lost to follow-up, the reasons for the forgotten DJSs remain unknown. However, most previous studies have indicated that such patients retain their indwelling DJSs for >6 months or a year due to forgetting about the matter. Lastly, stone analysis was not performed to study the stone contents of the patients with stone encrustation. Lam et al reported that encrustation mostly consisted of a combination of calcium oxalate and phosphate,¹⁷ and Sighinolfi et al identified whewellite as the most common encrustant.¹⁰

In conclusion, patients older than 60 years were 3.6 times more likely to have forgotten DJSs than patients aged 60 years and below, and DJSs inserted using fibrocystoscopy were 5.4 times more likely to be forgotten than those inserted using ureterorenoscopy. Patients who are more likely to have forgotten DJSs should be given appropriate reminders, and the implementation of a reminder system or the use of biodegradable DJSs could reduce the incidence of forgotten DJSs.

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