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The Efficacy of a Manual Database System for Tracking Ureteric Stent Placement and Removal

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ABSTRACT

INTRODUCTION: Manual paper database systems are commonly used to monitor JJ ureteric stent placement and removal. System failure can lead to patient morbidity and medicolegal implications. The objective of this study was to audit a stent database system at a large urology center in Western Sydney to determine the adequacy of the tracking procedure.

METHODS: From our single tertiary academic center, 316 patients underwent ureteric stent insertions in 2007. We conducted a retrospective analysis of the dates of stent insertion and removal (indwelling time). We noted if documentation of stent removal was clear (ie, in a surgical unit stent logbook, our urology office, or a consultant's records). If the stent removal date was unclear, clarification was sought from surgery records, inpatient manager software, patient files, records from other hospitals, or contact with the patient. Patients were divided into 5 stent follow-up categories and statistical analysis (using one way ANOVA and logistic regression) was used to make comparisons between groups. We used a stent indwelling time of 6 months as the maximum acceptable duration in situ.

RESULTS: A total of 379 stent procedures were conducted. The majority of patients had single, unilateral, denovo procedures due to stone disease. The majority of the removed stents had adequate documentation (n = 214; 56.5%). A total of 23 patients (6.1%) were deceased prior to stent removal. The remaining 142 (37.5%) of patients had no record of their stent removal in our database. Overall, 22.4% of all ureteric stents exceeded the 6-month maximum indwell time. These results were largely due to poor record keeping, loss or misplacement of endourological operation reports, or failure to notify the consultant who placed the sent if the patient was **referred to other hospitals or consultants.**

CONCLUSION: Based on the present and previous studies, the manual paper database system of ureteric stent follow-up is ineffective. We propose an electronic database recall system that alerts the attending urologist of an overdue stent and is readily accessible from within and outside the hospital.

KEYWORDS: Audit; Ureteric stents; Paper logbook database

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Abbreviations and Acronyms
ANOVA, analysis of variance

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original study

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INTRODUCTION

Stent insertion is now commonplace as part of endourological management of acute ureteric obstruction, whether this obstruction is caused by stones, benign strictures, anatomical malformations, or malignancies within or external to the ureter. However, ureteric stents inserted in such clinical scenarios can only be hailed a success if they are removed in a timely manner. Delayed stent removal or forgotten stents are associated with increased patient morbidity and complications that are difficult to manage [1]. Especially problematic is stent encrustation and fracture, which can result in obstruction and infection. Complex endourologic procedures are then required to remove the stent [2].

Each hospital must employ reliable methods for ureteric stent tracking so that each patient's stent placement is carefully documented, recorded [3], and easily retrieved. Unfortunately, there is little consensus as to the indwelling time of ureteric stents because it depends on the indication for which the stent is inserted. Stent manufacturers vary in their recommendations, but typically suggest replacement of stents after 3 to 6 months [4].

We work in a large urological unit and our institution, which is a 950-bed hospital, serves approximately one-million people in Western Sydney. Our stent follow-up is based on a manual paper database or register system. We conducted a retrospective audit of our ureteric stent insertions in the 2007 calendar year, to determine whether appropriate tracking and removal of ureteric stents was taking place. We suspect that our tracking procedures are common, so that our results will generalize to other settings.

METHODS

Stent Tracking Procedure

In our unit, ureteric stent insertions are documented in a stent logbook that is kept in the surgical unit. Unfortunately, it is incompletely utilized. Thus, we also rely on an endourological operation report that is completed by the surgeon or registrar at the time of stent insertion. This report serves as a back-up if there is a failure to record a stent insertion or removal in the logbook.

At the time of stent insertion, a *request for readmission* is completed for the patient to return to our institution at a later date to have the stent removed. Alternatively, it is clearly stated on the endourological report where the patient will be reviewed. Other places of follow-up may include the private rooms of consultants operating at our institution, private rooms of urologists outside of Sydney, or another public hospital if extracorporeal shockwave lithotripsy (ESWL) is needed (this procedure is not available at our institution). The urology office secretary files the operation reports and makes appropriate bookings for removal of the stent, whether it is at our institution or elsewhere. Therefore, our system relies on the treating surgeon, who creates a plan for follow-up of the stent at the time of stent insertion.

Data Collection Procedure

We retrospectively analyzed all ureteric stent insertions that took place in our unit from 01/01/2007 to 12/31/2007. Included patients were retrieved from the surgical unit stent logbook, endourological operation reports and discharge summaries filed in our urology office, the transplant database, and operating room booking lists.

For each ureteric stent insertion, we recorded the dates of insertion and removal (ie, stent indwelling time). The stents in our 2007 calendar database were followed up to 6/30/2008. For stents that were not yet removed, the future date of planned removal was recorded (where available).

We noted whether or not stent removal documentation was easily retrievable. Documentation was considered *appropriate* where surgical unit logbooks, records kept in our urology office (eg, endourological report or discharge summary), or records in the private rooms of consultants clearly demonstrated that the stent had been removed. If the date of stent removal could not be found from these avenues, documentation was considered *inappropriate*. In these cases, clarification was sought from: (1) inpatient manager software utilized by administration at our institution (ie, software used to record inpatient activities such as ward transfers, operating room bookings, and clinic appointments); (2) retrieval of patient files from the medical records department; (3) correlation with operating room booking forms; (4) request of records from other hospitals and consultants outside our network; or (5) contact with the patient.

Based on the status of stent removal and documentation, patients were divided into categories: (1) patients who were deceased prior to stent removal, (2) patients with stents removed who had appropriate documentation; (3) patients with stents removed who did not have appropriate documentation, (4) patients with stents in situ who were booked for future removal, (5) patients with stents in situ who were not booked for future removal. In addition, we recorded the indication for stent insertion, prior ureteric stents, stent placement (bilateral or unilateral), and any documented complications of stent

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insertion (eg, stent irritation, encrustation, fragmentation, migration).

Statistical Analysis

The data were analysed statistically, using SPSS version 16 (IBM Corp; Somers, NY, USA). Logarithmic conversion of data was performed to allow the use of parametric tests. The number of patients in each of the stent follow-up categories was compared (20 comparisons) with a one-way analysis of variance (ANOVA) and logistic regression. A Bonferroni adjustment was applied to the data, resulting in statistical significance at a probability level of .0025. We used stent indwelling time as the primary outcome measure, with 6 months taken as the maximum acceptable duration in situ.

RESULTS

Demographic Information

A total of 379 ureteric stent procedures were conducted in 316 patients in the calendar year of 2007 at our institution. Table 1 contains demographic information regarding the number of stent procedures, the placement (unilateral or bilateral), and the timing of insertion (denovo, previous within the study period, or previous outside the study period). The majority of patients had single, unilateral, denovo procedures.

Figure 1 contains the indications for ureteric stent insertion. By far the most common indication for stent insertion was stone disease (n = 189; 49.9%). Other indications for stent insertion (in descending order of frequency) included kidney transplants (n = 58), extrinsic compression of the ureter due to tumor, retroperitoneal fibrosis, or other cause (n = 39), benign strictures (n = 38), and a tumor located within the urinary tract (n = 34). Another 21 procedures (5.5%) were for "other" reasons, including ureteric clot (n = 3), perioperative insertion for complex surgery such as pyeloplasty (n = 5), transplant ureter narrowing (n = 3), rotated pelvis of a pelvic kidney (n = 3), chronic inflammation (n = 2), and previous ureteric injury (n = 2).

Table 1. Demographic Information Regarding the Stent Procedures (N = 379).

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Variable	n	(% n)
Number of procedures		
1	264	83.0
2	45	14.2
3	5	1.6
4	2	.6
6	2	.6
Placement		
Unilateral	338	89.2
Bilateral	41	10.8
Timing of insertion		
Previous within study period	53	52.0
Previous outside study period	49	48.0

Figure 1. Indications for ureteric stent insertion for calendar year 2007.

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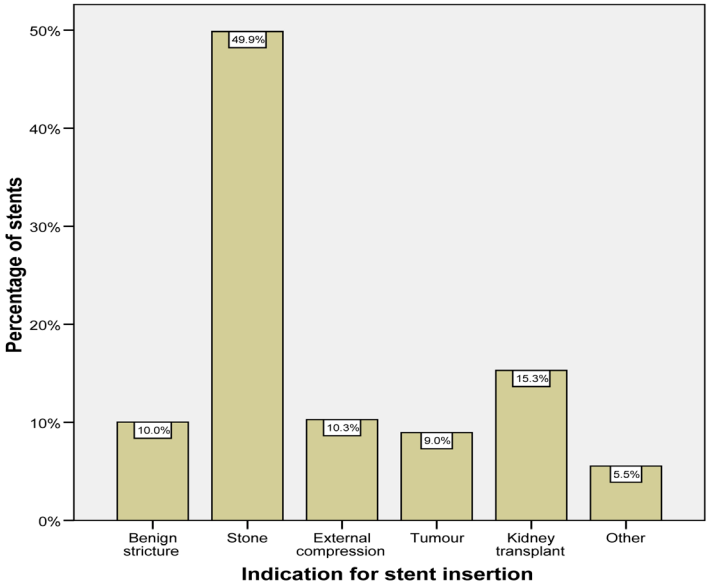

Documentation of Stent Removal

Figure 2 depicts the percentage of patients with stents, divided into the 5 follow-up categories. The majority of the removed stents had adequate documentation (n = 214; 56.5%). A total of 23 patients (6.1%) were deceased prior to their stent removal; in all cases stents were inserted for palliative purposes and the patients passed away from their underlying medical or oncological illness. Of the remaining 142 (37.5%) patients without adequate documentation (presumed "forgotten" stents), 121 (31.9%) stents were, in fact, removed. The remaining 21 stents (5.6%) had not been removed by 6/30/2008. Of these, only 9 patients had been booked for future stent removal. The remainder (n = 12) did not have their stents removed and were not booked for follow-up. Of these, 1 was traveling home overseas (to the UK) and 2 were traveling home to the New South Wales Central Coast, north of Sydney. We were unable to confirm dates of stent removal for these patients. Approximately 5 of these patients were noncompliant with follow-up appointments and the department had made several attempts to contact these patients without success once

Figure 2. The percentage of patients with stents, divided into the 5 follow-up categories.
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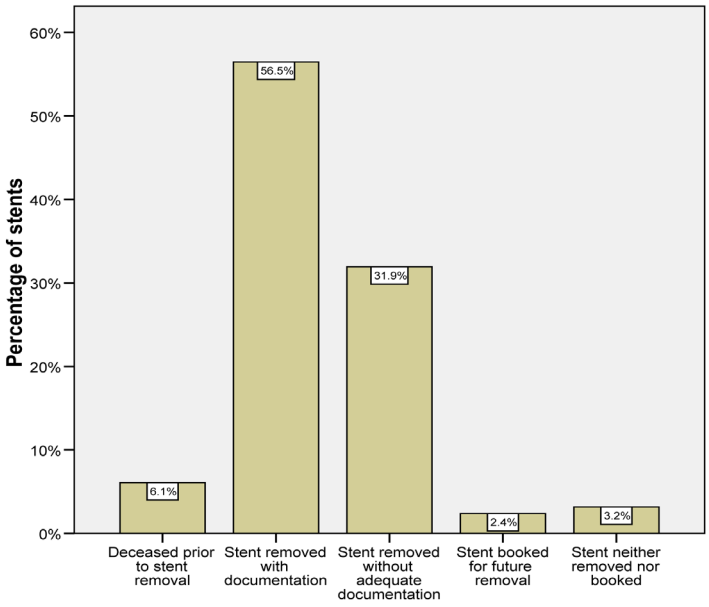

appointments were missed. The remaining 4 patients were lost to follow-up.

Of the 214 stents that were removed with adequate documentation, the source of documentation included the stent logbook or records in the urology department (n = 177) or consultant rooms (n = 37). Of the 121 stents removed without adequate documentation, sources of clarification of the stent removal date included: (1) inpatient management software (iSoft; Sydney, Australia) used at our institution (65.3%); (2) operating room booking records (12.4%); (3) patient confirmation of the date of stent removal (11.6%); (4) patient records requested from another hospital (5.8%), and (5) patient files from the medical records department (5%).

Stent Indwelling Time

For each stent follow-up category, the median indwelling time and interquartile range are recorded in Table 2. The box and whisker plots for indwelling times are illustrated in Figure 3. As expected from the box and whisker plots, the one-way ANOVA demonstrated that there were no statistically significant differences in mean stent indwelling time for: (1) patients who were deceased prior to stent removal and patients whose stents were removed with adequate documentation ($P = .438$), or (2) patients with stent removal with adequate documentation and patients with stent removal without adequate documentation ($P = .173$). However, there was a significant difference between the mean stent indwelling time for each of the first 3 categories (patients who were deceased prior to stent removal, patients whose stents were removed with adequate documentation, and patients whose stents were removed without adequate documentation) and the mean stent indwelling time for each of the last 2 categories: patients were booked for future stent removal and patients with stents in situ and no planned follow-up (all with $P \leq .001$). The median indwelling times for patients in the last 2 categories was significantly longer than the median indwelling times of the patients in the first 3 categories.

Table 3 contains the number of patients with stents in situ for less than 6 months and more than 6 months, respectively, for each stent follow-up category. These data are also represented in Figure 3. Overall, 22.4% stents of the total inserted in 2007 exceeded the acceptable 6-month maximum for stent in situ duration. All stents booked for future removal and in situ stents that were not booked for future removal exceeded the 6-month maximum.

Stent Complications

Stent complications were not reliably noted in patient records. There were 30 documented episodes of complications (7.9%

Table 2. Median Duration of Stent In Situ and Interquartile Ranges According to Follow-up Categories (N = 379).
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Stent Follow-up Category	Median Indwelling Time, Months	Interquartile Range, Months
Patient deceased prior to stent removal	2.20	0.76-4.27
Stent removed with adequate documentation	3.19	1.05-5.79
Stent removed without adequate documentation	1.81	1.12-3.68
Patient booked for future stent removal	7.56	6.79-10.13
Stent not removed; not booked for future removal	10.59	8.46-15.77

Table 3. Number of Patients With Stents Under and Over Maximum Acceptable Indwelling Time of 6 Months (N = 379).
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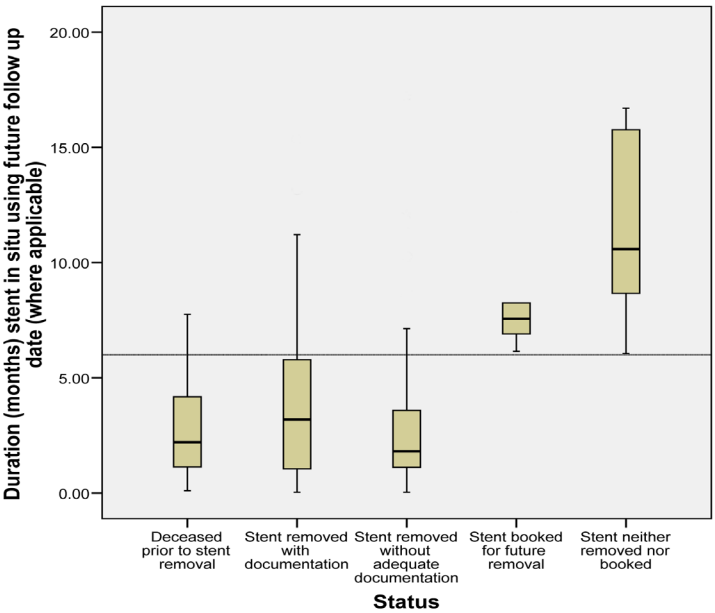
Stent Follow-up Category	Less Than 6 Months in Situ		More Than 6 Months in Situ	
	n	% n	n	% n
Patient deceased prior to stent removal	21	91.3	2	8.7
Stent removed with adequate documentation	166	77.6	48	22.4
Stent removed without adequate documentation	107	88.4	14	11.6
Patient booked for future stent removal	0	0	9	100
Stent not removed; not booked for future removal	0	0	12	100

of all procedures). These included encrustation (n = 15), blockage (n = 9), migration (n = 3), infection or sepsis (n = 2), and nephrectomy that was performed because the stent was insufficient to relieve ureteric obstruction (n = 1). Correlation of complications with indwelling time was not an objective of our study; this information would be best performed with prospective collection of data.

Figure 3. The duration of the stent in situ for each ureteric stent follow up category.
doi: 10.3834/uij.1944-5784.2011.04.05f3



The horizontal dotted line represents the 6-month maximum acceptable indwelling time.

DISCUSSION

Ureteric stent insertion has become one of the most common procedures of modern-day urological practice. Indications include treatment of ureteric or kidney stones, ureteric trauma or stricture, genitorurinary reconstructive surgery, hydronephrosis, and obstruction caused by malignancy or retroperitoneal fibrosis [5,6]. The length of time a stent is left in place (indwell time) is generally determined by the indication for stent placement and by surgeon experience, and can vary from a few days to the duration of a patient's life [4]. The maximum time a stent can safely remain in place is determined by the kind of stent, but it is not well defined [7,8]. Stent manufacturers usually recommend exchange of stents at 3- to 6-month intervals, and studies have shown that the prevalence of complications increases with longer indwelling times [7]. In our review, we used 6 months as the maximum acceptable indwell time for ureteric stents.

Effectiveness of Manual Follow-up System

Our results clearly demonstrate that the manual paper database system of ureteric stent follow-up is inadequate. Only 214 of the total 379 patients (56.5%) had obvious documentation of removal of their stent. When we added the 23 patients that were deceased prior to stent removal, there were still 142 (37.5%) patients with no record of stent removal in our manual database system. These results were largely due to poor record keeping and loss or misplacement of endourological operation reports. Furthermore, when patients are referred to other hospitals or to consultants outside our area health service, no system exists to notify the consultant who placed the stent that the appliance has been removed.

Fortunately, 121 of the 142 presumed "forgotten" stents were removed. However, this was only discovered after clarification

was sought from multiple sources. It is because of the manual review and time required for such a task that the paper database is infrequently updated [9].

Of the 21 patients with stents in situ, 9 patients were booked for future removal. In most cases these patients were noncompliant with follow-up appointments made by the department or by consultants, which resulted in delays in their stent removal. Ultimately, 12 patients did not have their stents removed. Two of these patients were traveling and 5 were noncompliant. The remaining 4 patients were lost to follow-up largely due to inadequate follow-up plans being made on discharge, and because there was no system in place to alert the department that their stents had become overdue for removal or exchange.

The shortcomings of our stent follow-up system are obvious. Over one-third of patients (37.5%) are unaccounted for in our stent database for having their stents removed, and almost one-quarter of patients (22.4%) exceeded the safe time limit of 6 months for stent removal or exchange. The current register or database system does little to prevent stent loss or overdue stents. When stents have been removed within an acceptable follow-up time frame it is usually other safeguards in place that have been effective (eg, booking or referring patients for stent removal at discharge) [9]. Furthermore, our database fails to readily capture stents inserted routinely for recipients of kidney transplants at our institution, largely because these patients are managed by the transplant team (we accessed the transplant database to ensure that such patients were included in the present review). In addition, our present manual system does not readily track antegrade stents that are placed in the radiology department.

The present results suggest that the manual paper database system is an ineffective method of stent follow-up. Our results correlate with those of Thomas et al [1], who reported that 22.4% of their ureteric stents were unaccounted for in their manual logbook system of tracking stents. McCahy and Ramsden [10] reported that removal of 6% of stents was delayed when solely using the logbook system. Likewise, Tang et al [9] noted that a manual stent card system failed to flag up to 5.4% patients with overdue stents and another 25.1% of patients had no record of stent removal. Ultimately, paper systems of tracking ureteric stents are at risk of loss, damage, and inaccurate entry. In addition, they are not accessible by other healthcare professionals who might be involved in the management of the patient, which can result in patients "slipping through the net" [11].

Potential of Electronic Follow-up Systems

We aim to implement an electronic stent management system at our facility. In addition to recording patient contact and demographic details, this system will automatically record stent information including type of stent, date of insertion when stents are scanned in the surgical unit (whether it be urology or transplant) or in radiology prior to being placed in situ. The system would need to be accessed with ease by all professionals involved in removal of the stent, either inside or outside the facility by an appropriate password protection. Most importantly, an automatic review would by conducted by the software to remind the consultant in charge via email when stents were about to become overdue (ie, exceed the maximum safe indwell time of 6 months). Our proposed system will be similar to the stent extraction reminder facility proposed and executed by Lynch et al in London [11]. As part of the completion of the audit cycle, we aim to prospectively reaudit our stent follow-up once this new electronic system is introduced and implemented.

There is evidence that an electronic stent register improves stent follow-up, even when there is manual entry of data at the point of stent insertion. Ather et al [12] implemented an electronic stent register whereby operating room personnel enter data at the time of stent insertion and the database acts to remind the patient 2 weeks prior to the stent overdue date. They found that overdue stents were reduced from 12.5% to 1.2%. Similarly, at Freemantle Hospital in Newcastle UK, an electronic stent register reduced stent removal delay from 6% to 1% [10]. The electronic database has the added advantage of being accessible to all professionals who are responsible for inserting stents, including interventional radiologists [9] and clinicians outside the immediate-area health service. However, even these systems are susceptible to lack of data capture at the time of stent insertion. For this reason, we favor the implementation of bar-code technology to scan ureteric stents at the time of insertion, which has shown to increase data capture from 61% to 87% [2,11].

CONCLUSION

Our manual paper based system for tracking ureteric stent removal is inadequate to ensure that all ureteric stents are removed in a timely manner. There is a need for the widespread use of automated systems.

Conflict of Interest: none declared.

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