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Original Article

Ureteral stenting in the clinic: a safe and cost-effective alternative to the operating room

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Abstract: Purpose: Ureteral stent placement is one of the most common procedures performed by urologists, and is typically done in the operating room. At Ochsner-LSU Health Shreveport, urologists have a unique setting allowing them to place ureteral stents for patients present in the outpatient ambulatory clinic without the need for nitrous oxide. This allows patients to avoid being admitted to the hospital and receiving subsequent general anesthesia in the operating room. Therefore, our novel study evaluates the feasibility, safety, and cost-effectiveness of ureteral stents insertion in the clinic. Material and Methods: In this study, we analyzed 240 patients with a total of 279 different ureteral stent insertion encounters to evaluate the safety and costs of stenting in the clinic compared to the operating room. Stents were placed in the outpatient clinic for 126 patients, which required either a new ureteral stent insertion or a scheduled stent exchange. Results: Overall, there was an increased age and length of stent duration among those who were stented in the clinic. We did not observe any increase in narcotics use, pain, adverse injuries, or differences in stent length. The total cost of a stent insertion operating room was $16,349.91 whereas the clinic procedure cost $7,865.69, however: medicare reimbursement remained the same. Conclusion: Our findings demonstrate a novel use of stenting in the clinic is feasible as an outpatient alternative. It is a safe alternative to the operating room, and more cost-effective.

Keywords: Stents, cost, cost analysis

Introduction

Ureteral obstruction is one of the most common conditions evaluated and treated by urologists. Whether the etiology is urolithiasis, ureteral stricture disease, intrinsic neoplasm, extrinsic compression from a neoplasm, or fibrosis, the double J ureteral stent is a mainstay of intervention [1]. Ureteral stents are typically placed in the operating room (OR) with the use of cystoscopic instruments, fluoroscopy, and general anesthesia or sedation. Operating room availability, the need for multi-disciplinary medical personnel, and procedural cost can be obstacles to patient care for on-time stent placement or exchange.

Invasive urologic procedures are commonly performed in the clinic setting, including diagnostic cystoscopy, prostate biopsies, and bladder onabotulinumtoxinA injections. However, ureteral stents are not commonly placed in the clinic setting. Even though this is typically a short procedure, there are few published manuscripts describing ureteral stent insertion outside the operating room. Previous studies have shown the safety and efficacy of procedures with the use of only local anesthetic or nitrous oxide [2-4]. Anytime a procedure is conducted under general anesthesia, there are common risks for both the patient and the team such as hypotension, deep vein thrombosis, stroke, and death. While there are complications that can arise when placing a ureteral stent in the clinic, the same risks exist in the operating room. A previous study of 50,000 stent insertion procedures demonstrated the most common complications to be bladder irritative symptoms (32.7%), lumbar pain (19.3%), urinary tract infection (14.8%), and hematuria (10.4%) [5]. While awake, the patient may not tolerate the procedure, especially during the cystoscopy

insertion phase, where they may perceive urethral discomfort and pain in their flanks while advancing a stent. There is an additional risk of failure if patient moves or if a stone is impacted and wires cannot be advanced alongside the stone due to pain.

Published findings suggest that clinic-based ureteral stent insertion is feasible. A direct comparison of general anesthesia to nitrous oxide (NO) demonstrated that use of inhaled anesthetic and standard general anesthesia in the OR had no difference in complication rates after the procedure [2]. Doersch *et al*. further found that there was a cost benefit to utilizing nitrous oxide in the office setting compared to the OR. Emergency room stenting has also been shown to be a feasible option when necessary. A retrospective review of 42 patients demonstrated the capacity to place a double J stent in the emergency department with a flexible cystoscope and a post placement x-ray of the kidney, ureter, and bladder [6]. However, the authors noted that 11 of the 42 stent insertions failed and were sent back to the operating room due to difficult stent placement rather than a complication due to stent insertion at the bedside [6]. In a study by Sivalingham, 46 stent placements in the emergency department were directly compared to 73 in the OR; the study found that stent placement outside of the OR was a safe option to treat acute renal colic [3].

Methods

Study population

Our IRB-approved study analyzed 279 stents placed in 240 patients from a single academic medical center that offered stenting procedures in both the clinical ambulatory setting and the OR. Patient records were gathered from institutional health records from May 1st, 2019 to October 31st, 2021.

We included all patients who had a stent placed, whether unilateral and bilateral, in the clinic and operating room. Patient who are stable, no signs of infections, normal urine tests, not in severe pain, and have either: chronic indwelling ureteral stents, or came to the clinic with mild to moderate amount of pain, were offered stent in the clinic, and they had agreed on that, after explaining all risks, benefits and alternatives. Whereas patients who had previous ER precautions given, and had unstable vital signs, including and not limited to, fever/chills, signs of urinary infections, nausea and vomiting, poor oral intake, severe flank pain despite pain medication were patients who were instructed to go to the emergency room for a direct admission for an urgent cystoscopy and ureteral stent insertion performed in the operating room with criteria met for a subsequent hospital admission.

Some patients may have had a stent exchanged, where each subsequent stent was considered as a new stent encounter, but not as a new patient in our demographic data. The same principal was applied to location; the first encounter does not automatically group patients for subsequent encounters if the placements occurred in different locations. In that case, the patient demographics were included and reflected changes over time. We excluded anyone under the age of 18, adults unable to give consent, pregnant women, and incarcerated persons. When defining our outcomes, a complication included any incident that occurred following stent placement, including hematuria, flank or pelvic pain, urinary tract injury, urinary tract infection, and dysuria. When stents were removed, they were visually inspected for stone encrustation. Novel stone formation was also compared between stent insertion settings.

Statistical analysis

Statistical analysis was determined prior to the study with an alpha value of 0.05. An 80% power analysis with a 5% margin and a standard deviation of 8 from preliminary chart review projected that 96 stents placements per group should be retrospectively reviewed for non-inferiority analysis. IBM SPSS V28 software was used to analyze all data. We used a student t-test for continuous variables and demonstrated their value with a standard deviation and chi-squared for binomial data.

Outpatient office set up and protocol

Clinical stenting lags behind traditional OR stenting due to the needed clinical setup. At Ochsner LSU Health Shreveport, we have a C-arm dedicated to ureteral stent placement in our clinic. As this is a unique approach to plac-

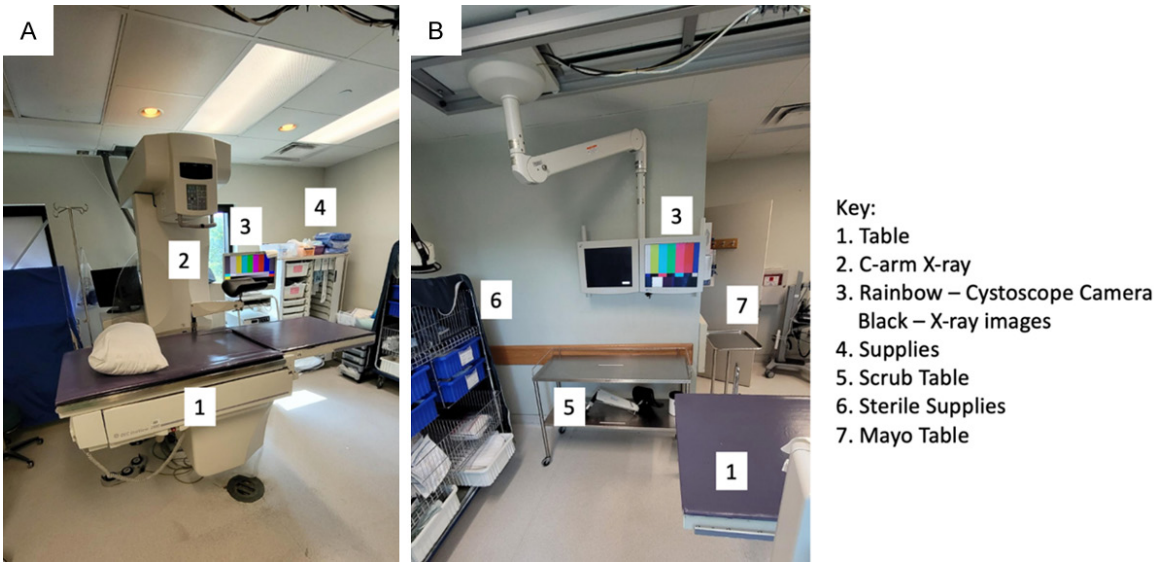

Figure 1. Cystoscopy room set up. The cystoscopy room is presented from two different views. A. The table, C-arm, one screen, and equipment can be seen with labels 1, 2, 3, 4 respectively. The surgeon is located at the foot of the bed with the scrub table located to their left. B. An alternative view of the working field. The dual screen with both cystoscopy and fluoroscopy is seen in Label 3. The scrub table in Label 5 is sterilely draped and only sterile equipment is placed there. Label 6 is where the sterile equipment is kept. Label 7 is an additional table if needed.

ing a stent, we outline our protocol from start to finish and visually depicted our office cystoscopy suite **Figure 1**. Prior to setting up in the room, the patient is given three separate intramuscular injections: meperidine and promethazine for pain and nausea, as well as prophylactic antibiotics, usually intramuscular ceftriaxone. Our suite has a cystoscopy table in the center of the room with a fixed x-ray system perpendicular to the bed, illustrated in **Figure 1**.

Informed consent is obtained for all patients. For males, a flexible cystoscope is used, whereas for females, a rigid cystoscope is used. Prior to scope insertion, lidocaine jelly is injected into the urethra.

If there is a previous stent present, the stent is gently grabbed at the distal tip, and a guide wire is introduced through the lumen of the stent, up to the kidney. The stent is backloaded, then the new stent advanced over fluoroscopic guidance and visual control. Clinical judgement is used if we elect to place a guide wire alongside the old stent, then remove the old stent and place a new one on the wire. This is most commonly done in our male patient population.

If the patient is unstented, we usually begin by performing a retrograde pyelogram by injecting 2-10 mL of radio-opaque contrast to delineate the collecting system. We then advance a guide wire into the ureteral orifice though the ureter and up to the kidney, allowing us to advance a stent under fluoroscopic control and visual cues.

After the stent is placed, the cystoscope is removed, the patient is cleaned up, and is able to leave the clinic. If a stent is removed, it is visualized for encrustation and clinical judgement is used to determine if the stent should be sent to pathology.

Results

Patient demographics

This study analyzed 240 individuals and a total of 279 stents placed in a single academic medical center, with 114 patients in the operating room compared to 126 in a clinical setting. Average age was 45 years old in the operating room compared to 50 years old in the clinic (P=0.026) (**Table 1**). Patients with stents placed in the OR were more likely to have heart disease (P=0.047). There was no difference in

Table 1. Patient demographics

Demographics	Operating Room	Clinic	*P* Value
Age (SD)	45.3 (1.9)	50.4 (1.3)	0.026
Height, m (SD)	1.63 (0.02)	1.66 (0.01)	0.285
Weight, lbs (SD)	184.5 (7.0)	185.4 (5.5)	0.919
Male	41 (53.2%)	36 (46.7%)	0.22
Female	73 (44.7%)	90 (55.3%)	
Comorbidity: Heart Disease	14 (10.8%)	6 (4.4%)	0.047
Comorbidity: Diabetes	13 (10%)	17 (12.4%)	0.533
Indication for Stent Placement			
Stone	70	78	0.565
Stricture	9	26	0.007
Other	10	4	0.180

Patient demographics were compared among our two patient populations. Age, body characteristics, gender, and comorbidities were compared. The average for each value was reported with the standard error of the mean in the parenthesis for age, height, and weight. Gender is reported in a total count with a *p*-value corresponding chi-squared test. Comorbidities are reported in total counts with the percentage of the total population in parentheses.

Table 2. Stent characteristics

Stent characteristics	Operating Room	Clinic	*P* Value
Number of days until removal (SD)	39 (3.5)	62.9 (6.5)	0.002
Stent French (SD)	6.3 (0.7)	6.7 (0.7)	0.001
Stent Length, cm (SD)	25.1 (0.26)	25.7 (0.18)	0.063
Stent Exchanges	27 (36.5%)	47 (63.5%)	0.012

The stent characteristics were compared in the clinical and operating room settings. The number of days, stent french, and stent length were all reported with an average (standard error of the mean) and compared using a t-test. Both the number of days and stent french were found to be significant. The stent length has no difference. Stent exchanges are reported as whole numbers and a non-parametric binomial distribution was used to compare differences in location for stent exchange.

patient height (P=0.285), weight (0.919), gender (P=0.22), or diabetes (P=0.533) (**Table 1**).

Stent characteristics

Stent characteristics among the two groups were compared in the OR and the clinic. There was a significant difference in the average number of days from an OR stent insertion to removal, 39 days, compared to the clinical setting average of 63 days (P=0.002) (**Table 2**). There were also differences in the average stent diameter of an OR stent of 6.3 Fr compared to 6.7 Fr in the clinic (P=0.001) (**Table 2**). The stent length did not have any significant difference in the two settings; the OR average was 25.1 cm compared to 25.7 cm in the clinic (P=0.063) (**Table 2**). Among the total stents placed, 74 were stent exchanges, with 27 done in the OR and 47 in the clinic (P=0.012) (**Table 2**).

Stent outcomes and complications

Stents that were placed in the OR had a 10% complication rate, whereas stents places in the clinic had an 18.3% rate (P=0.054). The number of patients that left with a narcotic prescription was 36.2% in an operating room compared to 37.2% in the clinic (P=0.856). Eight stent encounters had new stone formation when placed in the operating room, while five had stone formation following clinic stenting (P=0.342). Nineteen stents were removed from a placement with stone encrustation in the OR, compared to 21 stents placed with encrustation in the clinic (P=0.851) (**Table 3**).

Procedural costs

Stent placement has a much lower cost in clinic across multiple factors, including medical supplies ($11,513.85 in OR vs $5,885.45 in clinic), rooming ($3,326.00 in OR vs $0 in clinic), and

Table 3. Outcomes following stent placement

Outcomes	Operating Room	Clinic	*P* Value
Complications	13 (10.0%)	25 (18.3%)	0.054
Narcotics prescribed	47 (36.2%)	51 (37.2%)	0.856
Stone Formation Post-Stent Placement	8 (6.2%)	5 (3.6%)	0.342
Stent Encrustation	19 (14.6%)	21 (15.4%)	0.851

The total number of patients who had a complication, received a narcotic prescription, had novel stone formation, and had stent encrustation following stent placement is shown, n (%).

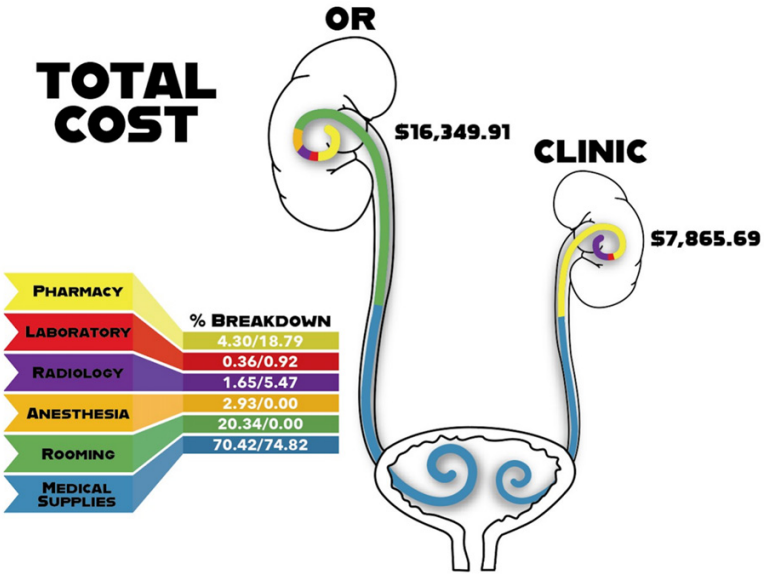

Figure 2. Stent insertion costs. Stents placed in the operating room are seen in the right kidney and the clinic in the left. Will add more here with final photo.

Table 4. Medicare reimbursement

	Stent Insertion	Stent Removal
Medicare Reimbursement	$2,807.32	$1,634.89

Medicare reimbursement was gathered from the CPT codes 52332 for stent insertion and 52310 for stent removal. The totals shown are the same regardless of location of stent placement or removal.

anesthesia ($479.00 in OR vs $0 in clinic). The operating room did have lower costs than a clinic procedure regarding pharmacy ($703.26 in OR vs $1,477.67 in clinic), laboratory ($58.30 in OR vs $72.60 in clinic), and radiological expenses ($269.50 in OR vs $429.97 in clinic). The total cost of a stent insertion operating room was $16,349.91 whereas the clinic procedure cost $7,865.69-a difference of $8,484.22 (**Figure 2**).

Stent removal costs were similarly higher in the operating room ($4,520.20) compared to the clinic ($2,208.63). The operating room had higher costs for expenses such as pharmacy ($194.49 vs $33.30), medical supplies ($2,153.21 vs $1,864.03), rooming ($1,880.00 vs $0), and anesthesia ($254.00 vs $0). Conversely, the operating room was cheaper in laboratory expenses ($38.50 vs $41.80) and radiology ($0 vs $269.50).

These costs are unaffected by Medicare reimbursement. Medicare reimburses $2,807.32 for stent placement (CPT 52332) and $1,634.89 for stent removal (CPT 53210) regardless of setting (**Table 4**).

Discussion

Double J ureteral stents have numerous indications and are among the most common procedures performed by urologists. Diagnostic cystoscopy, prostate biopsy, and intravesical onabotulinumtoxinA injection are only a few procedures that are normally preformed in an office setting, but ureteral stenting is seldom performed there [3, 6]. At LSU Health Shreveport, we have a unique opportunity to examine the safety, efficacy, feasibility, and costs associated with placing de novo stents as well as stent exchanges in the office setting. Our cystoscopy suite includes a C-arm, a sterile prep area, and multiple monitors for the providers and patients to view. Although not widely done nationwide, our team has been placing clinic-based stents for over ten years. Together, we have an ideal combina-

tion of experience, tools, and patient volume to compare the outcomes of OR and outpatient placed ureteral stents.

Few studies examine the feasibility of clinic-based ureteral stenting. Doersch *et al.* compared patients stented in their clinic versus the operating room [2]. While they found no significant difference in complication rates, their study used nitrous oxide for sedation. Our patients instead were given meperidine intramuscularly for pain control and local lidocaine jelly in the urethra, which may be safer because NO^2 has been reported to cause pulmonary artery hypertension and diffuse hypoxemia [7, 8]. Though long-term side effects are rare with use of NO^2, short-term dizziness, nausea, vomiting, and fatigue are common side-effects [8]. Additionally, there is a subset of patients for whom use is contraindicated: critically ill, severe cardiac disease, first trimester of pregnancy, and severe psychiatric disorders [8]. Lidocaine for local anesthesia is used in a vast majority of minor procedures, and allergic reactions are rare [9]. In our study, we saw no adverse effects, allergic reactions, or complications with lidocaine use as a local anesthetic. Doersch *et al.* also reported significantly shorter operative time in the clinic compared to the operating room [2]. While a very small percent of our patients experienced discomfort during their procedure, none reported major discomfort that would require it to be stopped or them to be taken to our adjacent hospital.

We observed an increased stent duration, with clinic-placed stents of 62 days vs 38 days in the OR. This is because many of our patients with chronic indwelling stents have their stents exchanged in the clinic and may go 6-8 months between stent exchanges. Even though a statistical difference was shown in the duration of stent placement, our data do not suggest adverse effects from this prolonged duration. We observed a significantly increased stent diameter in the clinic (6.7 Fr) vs OR (6.3 Fr), but we observed no adverse outcomes with our larger diameter stents, leading us to believe that this size discrepancy does not have clinical relevance or changes outcomes. This likely reflects larger stent diameter in patients with chronic indwelling stents, extrinsic compression, and chronic ureteropelvic obstruction. Previous work from our group found that stent diameter may lead to increased rates of encrustation; with this in mind, we have emphasized the importance of on-time stent removal to our patients [10].

Placing a stent in the OR is not without risks of complications. A study of 50,000 stent insertion procedures in the OR demonstrated an overall complication rate of 8.27% with the most common complications being bladder irritative symptoms (32.7%), lumbar pain (19.3%), urinary tract infection (14.8%), and hematuria (10.4%) [5]. Other studies have described complications associated with ureteral stent placement include ureteral injury, renal pelvic perforation, stent fragmentation, and stent placement failure [2, 11-15]. Our sample size was much smaller than this report; however, our complication rate remained on par with their large study with a 10% and 18% complication rate in the OR and clinic setting respectively. This 8% difference was not statistically significant, but warrants further investigation as to which complications may be occurring more frequently and how these could minimized. Lastly, although we did not observe this and it was only reported a single time in 50,000 reviewed charts, a stent may perforate the ureter and enter the retroperitoneum. Some patients may not tolerate this procedure without general anesthesia due to intraprocedural pain, requiring termination of the procedure and subsequent stent placement in the OR. This is consistent with other studies as ureteral stenting in clinic has also shown to be reliable and safe [2, 3, 6, 16].

Stent placement in the clinic allowed our patients to mitigate the risks of general anesthesia, which include cardiorespiratory complications, delayed discharge/unplanned admissions, sore throat, chipped teeth, and overall lethargy [17]. Additionally, our clinic patients were not given any additional narcotics and did not receive them at a higher rate than when a stent was placed in the OR. This is important as it has been identified that patients given NSAIDs instead of a narcotic after stent placement have a lower rate of ED visits, calls to clinic, and medication refill requests [18].

Perhaps the biggest advantage of clinic stent placement is the lower cost when compared to OR stent placement [2]. Gershman *et al.* noted stents in clinic cost about $600 compared to approximately $2,300 in the OR, saving $1,551

per procedure. Sivaligam *et al.* showed the cost of stents with only local anesthetic was $11,037 vs $30,741 with the use of general anesthesia [3]. Our cost analysis was in-between these two reported costs, with an OR stent placement procedure costing $16,349.91 and a clinic stent insertion costing $7,865.69, for a difference of $8,484.22.

Our study and others like it have demonstrated the safety and efficacy of ureteral stenting in the clinic. Ureteral stenting is a common procedure, and the use of general anesthesia and operating rooms is not always necessary. Shifting some of these procedures to the clinic can help free up OR availability for other procedures. Notably, Dhupar *et al.* demonstrated that even short setbacks in OR availability for urgent cases are associated with significantly increased hospital costs [19]. In centers where patient volume is extremely high for patients needing urgent and emergent surgeries, stenting in the office can help relieve the burden of room availability on the hospital.

This study has limitations, with the most prominent being that it is a retrospective review at a single academic medical center. As a retrospective review, we are unable to actively assess any pain during the procedure and can only rely on the operative note. Additionally, some patients may have requested an OR stent insertion due to previous pain thresholds, which we would have been unable to assess retrospectively. Although we included all patients with stent placement, we cannot rule out selection bias with patients who underwent a stent procedure in the outpatient setting. Lastly, our cost-analysis is generalized for the average patient with the CPT codes for stent placement or exchange and is not a direct calculation from each procedure and averaged out, so there may be small variations in costs with each procedure.

Conclusion

Double J stent placement and removal are among the most common procedures done by a urologist. In most instances, the procedure is currently performed in the operating room, placing a large burden on the hospital system. Our academic medical center has been performing ureteral stent insertion, removal, and exchanges in a clinic setting for over a decade. Analysis of our outcomes demonstrated no difference in complications, infections, and narcotic prescribing. Additionally, we found a significant reduction in cost for procedures done in clinic rather than the OR, despite Medicare reimbursement being the same independent of location. Overall, stenting in the clinic is a safe and useful procedure that has the potential to be widely adopted in urology practice.

Disclosure of conflict of interest

None.

Abbreviation

OR, Operating room.

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