Feasibility and clinical outcomes of ureteral stenting in the office procedural suite

Karen M. Doersch, MD,[1] G. Luke Machen, MD,[2] Kim H. Thai, MD,[2] John Sung, BS,[2] Marawan M. El Tayeb, MD[2]

[1]MD/PhD Program, Texas A & M Health Science Center College of Medicine, Temple, Texas, USA
[2]Division of Urology, Department of Surgery, Baylor Scott and White Health, Temple, Texas, USA

DOERSCH KM, MACHEN GL, THAI KH, SUNG J, EL TAYEB MM. Feasibility and clinical outcomes of ureteral stenting in the office procedural suite. *Can J Urol* 2018;25(6):9596-9600.

Introduction: *Stent placement is a common procedure for addressing obstructive uropathy. However, lack of operating room (OR) availability can substantially delay this procedure. In this study, we sought to assess the feasibility, safety, and efficacy of this procedure in a clinical setting using nitrous oxide (N_2O) and local anesthesia.*
Materials and methods: *Patients included in this study included those who were determined to need management of urinary obstruction with a JJ ("double J") stent and had their procedure performed in the clinic procedure suite with N_2O anesthesia.*
Results: *We present a case series of 565 patients undergoing ureteral stent placements in a clinic operative suite with N_2O. In this cohort, complications occurred after 4.1% of procedures and unplanned admissions to the hospital occurred after 2.5% of procedures. Stent placements failed in 1.0% of procedures. Failures occurred due to pain in 2/565 patients. No anesthetic complications were encountered.*
Conclusion: *We report the feasibility and clinical outcomes of ureteral stent placements for ureteral obstruction in a clinic setting with the use of local anesthetic or N_2O anesthesia, with excellent results. A majority of patients tolerated the procedure well and only 2 of 565 had their procedures stopped due to discomfort. To our knowledge, this is the first report of the use of N_2O anesthetic for conscious sedation for the placement of ureteral stents.*

Key Words: ureteral obstruction, nephrolithiasis, ureteral stents, clinic procedures, pain, nitrous oxide anesthetic

Introduction

Placement of a ureteral stent is a common procedure performed to temporarily manage ureteral obstruction in the cases of urinary tract stones, ureteral stricture, extrinsic compression by masses, and a variety of other conditions that cause urinary tract obstruction.[1-3] In the case of urinary tract stones, urgent intervention, which may involve stent placement, is indicated in cases of obstruction, urinary tract infections (UTI), deterioration of renal function, intractable pain or vomiting, oliguria, and anuria, among others.[1,4] On the initial evaluation of an acute stone, it is important to decompress the obstruction to control pain and relieve the evolving pressure in the urinary system if the stone will not be managed immediately with ureteroscopy (URS) or percutaneous interventions.[1] Furthermore, it is important to defer surgical treatment of stone in the presence of infection because impaired glomerular filtration inhibits the entry of antibiotics into the collecting system.[5] Methods to relieve obstruction, whether due to stones or other causes, include percutaneous nephrostomy (PCN) or JJ stent.[6,7] JJ stents are frequently utilized to manage obstruction due to stones, especially in cases when URS is planned but not available immediately, when dilation of the urinary tract is needed to permit passage of URS instruments, or when stones are larger.[1,5] Furthermore, management with a JJ stent is an option for other forms of urinary tract obstruction and is more tolerable for patients with a lower risk of percutaneous infection than PCN tubes.[2,7,8] Thus, JJ stent placement remains a common and important procedure in managing stones.

Ureteral stent placement is usually performed under general anesthesia (GA).[9] However, stent placement using local anesthesia (LA) is also an option. Risks of GA include tracheal intubation complications, cardiovascular and cerebrovascular complications, and rare adverse reactions such as malignant hyperthermia. However, it is unclear how best to reduce pain and increase tolerability of stent placements in the absence of GA.

Accepted for publication October 2018

Address correspondence to Dr. Kim Thai, Division of Urology, Department of Surgery, Baylor Scott and White Health, 2401 S. 31st Street, MS-29-C269, Temple, TX 76502 USA

A substantial benefit of stent placement without the use of GA is the ability to perform the procedure in settings other than the OR. Studies have demonstrated the safety of stent placement in both the clinic and at the bedside.[5,10,11] These approaches have the advantage of avoiding the operating room, which can result in significant delays in care. A study of trauma patients showed that roughly 23% of add-on cases had documented delays in getting the patient to the OR.[12] Delays in patients needing a ureteral stent can lead to prolonged discomfort for patients. Therefore, exploring strategies to avoid the OR, and thereby avoid the associated delays is desirable.

The present study includes procedures in which N_2O was used during the placement of stents in the clinic. Use of a mixture of N_2O and oxygen results in good pain relief properties in different areas of medicine such as labor, dentistry, colonoscopy, transrectal biopsy of the prostate, skin laceration repairs, venous ablations, and dentistry, among others.[13] N_2O stimulates the neuronal release of endogenous opioid peptides with subsequent activation of opioid receptors, gamma aminobutyric acid type A (GABA) and noradrenergic pathways. N_2O administration has a low rate of side effects, and consciousness and protection reflexes are preserved in the patient. N_2O administration is ideal for short interventions with intermediate pain level and is a safe and effective method to reduce pain.[13] Stent placement, which is typically a short procedure with a moderate level of pain is, therefore, an ideal application for N_2O anesthesia.

In this study, we present a case series of ureteral stent placements in a clinic operative suite with LA, with or without N_2O. This study aimed to assess the feasibility, safety, and efficacy of this procedure in a clinical setting.

Materials and methods

Institutional review board approval

Institutional review board (IRB) approval was granted prior to any chart review or data analysis for this project.

Design

This study was a retrospective case series.

Patients

Patients included in this study were those who were determined by the treating urology team to need management of urinary obstruction with a JJ stent and had their procedure performed in the clinic procedure suite with N_2O anesthesia from February 2014 to February 2016. Procedures evaluated were those in which a ureteral stent was placed in the clinic procedure suite for any indication. Inclusion criteria consisted of patients who were mentally capable of consenting to a stent placement in the clinic, patients who expressed interest in having their stents placed in a clinic, and patients at least 18 years of age. Exclusion criteria included stent placement in any setting other than the clinic procedure suite, patients less than 18 years of age, mentally incapable patients, patients with unstable vital signs, respiratory failure, and patients with signs of sepsis.

Required personnel

In addition to the surgeon performing the procedure, this procedure required a nurse to administer N_2O and another scrub technician, assistant, or resident. The surgeon was certified in Advanced Cardiac Life Support (ACLS), but no other certifications were required. Thus, a total of three staff members were required to perform this procedure. No special nursing training was required for the nurse administering the N_2O.

Procedure

Patients were brought to the clinic procedure suite and prepared and draped for the procedure. Patients were monitored with a pulse oximeter and intermittent blood pressure determination with a blood pressure cuff throughout the procedure. Patients receiving N_2O anesthesia were then allowed to breathe a 50%/50% mixture of N_2O and oxygen via a face mask, which was administered by a certified nurse with the patient holding the mask himself. For LA, lidocaine jelly was then applied to the urethra. Some patients received both approaches, while others had only LA. Patients were permitted to choose whether they would like to receive N_2O anesthesia. For male patients, 16 Fr flexible cystoscope was introduced all the way to the bladder, for female patients a 22 Fr rigid cystoscope was used. The ureteral orifice was identified. A glide wire was deployed into the ureter under fluoroscopy, a retrograde pyelogram was done, and a JJ stent was passed over the guide wire. Except in the cases of pregnant patients, fluoroscopy was used to determine that the JJ stent was placed through the ureter and into the kidney and the guide wire was removed. Fluoroscopy was again used to demonstrate good curl in the kidney and ureter. The cystoscopy setup was then removed, and the patient was allowed to recover from N_2O on the clinic procedure suite table, which typically took less than a minute. Any patients in whom a stent was unable to be placed in the clinic were transferred to the OR for stent placement under general anesthesia. Clinic facilities are adjacent to the hospital, allowing for a rapid response to be called

in the event of immediate complications. Crash cart, defibrillator, and other necessary safety devices were available in the clinic.

Data analysis

A retrospective chart review was then performed on the charts of patients undergoing procedures meeting the inclusion criteria. Analyses included means, standard deviations, and other descriptive statistics and were performed using Excel (Microsoft).

Results

Patient demographics

Patient characteristics are shown in Table 1. Beginning in February 2014, 565 stent placements were performed in the clinic on 463 patients. Procedures were performed on a population that was 41% male with a mean age of 56.4 ± 17.9 years. Mean Charlson Comorbidity Index score for these patients was 3.6 ± 3.3. In 76.0% of cases, the patient was receiving a primary stent, while in the remaining 24.0%, the stent was being exchanged. A single renal unit was addressed in 90.4% of procedures. Reasons for receiving stents included kidney or ureteral stones causing obstruction or infectious complications, extrinsic or intrinsic malignant condition, ureteral strictures, ureteropelvic junction obstruction (UPJO), retroperitoneal fibrosis, or other indications, which included pregnancy, hematuria, flank pain without identified origin, endometriosis, UTI, Rosai-Dorfman disease, surgical ureteral injuries, recurrent retroperitoneal abscess, renal trauma, pyelitis, and unknown obstructive etiology. When a stone was addressed, which was the reason for the stent in 380 cases (67.2%), the mean stone size was 7.5 mm ± 4.2 mm. The stones were located in the kidney in 12.9%, the proximal ureter in 54.7% and the distal ureter in 37.6% of cases. Hydronephrosis was present in a majority of the cases, with 66.6% of cases addressing unilateral hydronephrosis and 6.8% of cases addressing bilateral hydronephrosis. Preoperative UTI was present in 19.6% of cases as determined by preoperative urinalysis (UA) or urine culture.

TABLE 1. **Patient characteristics**

Characteristic	**Number included**	**Value**
Total number of procedures		565
Number of patients		463
Age (years, mean ± standard deviation)	565	56.4 ± 17.9
Sex (% male)	565	41
Charlston score (mean ± standard deviation)	565	3.6 ± 3.3
Primary or exchange (% primary)	565	76.0
Renal units addressed (% single)	565	90.4
Indications (% of total procedures)	565	
Stone		67.2
Malignancy		14.9
Stricture		6.5
UPJO		4.4
Retroperitoneal fibrosis		2.5
Other		5.3
Mean size of largest stone (mm, mean ± standard deviation)	380	7.5 ± 4.2
Stone location (% of procedures for stones)	380	
Kidney		12.9
Proximal ureter		54.7
Distal ureter		37.6
Preoperative UTI (% of procedures)	565	19.6
Hydronephrosis (% of total procedures)	545	
Unilateral		66.6
Bilateral		6.8

TABLE 2. **Procedure descriptions**

Characteristic	Number included	Value
Procedure time (minutes, mean ± standard deviation)	467	12.7 ± 8.0
Fluroscopy time (seconds, mean ± standard deviation)	359	1.7 ± 1.4
Nitrous anesthesia (% used)	560	77.9

TABLE 3. **Procedure outcomes**

Characteristic	Number included	Value
Complications (%)	565	4.1
Unplanned admission to hospital post-test (%)	565	2.5
Stent placement failed	565	1.0

Procedures

Procedures were performed as discussed in the methods section, Table 2. Procedures averaged 12.7 ± 8.0 minutes with a mean fluoroscopy time of 1.7 ± 1.4 minutes. In 77.9% of patients, N_2O inhalation was used, and all patients received urethral lidocaine jelly to improve analgesia.

Patient outcomes

Few patients experienced complications related to their procedures, Table 3. Of our cohort of 565 procedures, complications occurred after 4.1% of procedures and unplanned admissions to the hospital occurred after 2.5% of procedures. Complications included UTI within 30 days that was not present on preoperative urine analysis in 14, stent migration in 4, stent dislodgement in 1, severe pain leading to stent removal followed by re-stenting in 1, failure of stents to resolve obstruction leading to requirement for PCN tubes in 1, and post-procedure nausea and vomiting requiring medication in 1. Reasons for new admissions included UTI or urosepsis in 4, pyonephrosis or purulent drainage from the stent in 5, intractable stent pain in 2, acute kidney injury (AKI) in, syncopal episode in 2, and hematemesis in 1. Stent placements failed in 1.1% of procedures. Reasons for failure to place a stent in the clinic setting included lost access in 1, ureteral stricture in 1, urethral stricture in 1, pain in 2, and unknown reason in 1. No procedures were aborted due to N_2O anesthetic complications or respiratory problems related to anesthesia.

Discussion

Obstructive uropathy remains a common challenge for urologists and the best methods for managing these obstructions depends upon the cause of the obstruction, the patient's condition, and patient and physician preferences. Managing obstruction is important to decompress the urinary system, decrease pain, and prevent renal failure. Ureteral obstruction can be managed by JJ stents, as in this study, or by PCN tube placement.[6,7] Each of these methods has advantages and disadvantages. Joshi et al demonstrated, in a retrospective analysis, that insertion of JJ stent was successful relieving obstruction caused by stones more often than PCN.[6] In the case of extrinsic ureteral compression due to benign or malignant processes, Chang et al found that PCN tubes had lower failure rates than JJ stents.[7] Additionally, in this study, PCN placement improved creatinine and hydronephrosis more than JJ stents. However, PCN tubes are also more difficult for patients to tolerate and introduce the risk of percutaneous infection. Thus, in all urological obstructive processes, JJ stents remain an important management strategy.

Achieving adequate pain control during JJ stent placement is important. Strategies to control pain include both GA and LA, each of which has advantages and disadvantages. GA has the advantage of the patient being totally unconscious and immobile. However, the employment of GA can increase case time for these short procedures, and also exposes the patients to risks associated with GA. Some additional LA indications include severe respiratory failure, hyperkalemia, ongoing pregnancy, and patient's choice. Thus, there has been substantial interest in alternative methods for controlling pain during these procedures, such as LA. Studies have demonstrated that the placement of a JJ stent is uncomfortable for conscious patients receiving LA.[10] In the present study, we used N_2O in 77.9% of patients, which subjectively provided adequate pain control,

although pain scores were not formally calculated due to the retrospective nature of the study. Furthermore, there were no complications associated with the use of N_2O in the clinic, indicating that this method is likely both safe and effective for use during JJ stent placement. N_2O has been successfully used in other office-based procedures, such as dentistry, cutaneous surgical procedures, and others.[13] To our knowledge, our study is the first report of this anesthetic strategy in JJ stent placement.

In this study, ureteral stent placement was attempted in the clinic setting during over 500 procedures, often with N_2O used as the anesthetic, with a high rate of success. In a review of the literature, two other studies were identified using LA to perform stent placements, and no studies examined the use of N_2O as an anesthetic for stent placement procedures.[5,10] Sivaligam et al reported the feasibility of office-based stent placement under LA with rigid cystoscopy.[5] The success rate and postoperative complications were similar in the groups with GA versus LA. Carrouget et al found that ureteral stent placement under LA in women could avoid the unnecessary risks and costs associated with GA.[10] This study found that ureteral stent placement under LA in women could be performed safely and effectively without increasing complication risk. However, this study also found that the procedure is painful and should be applied only to selected cases. Thus, others have shown that it is possible to place stents in the clinic setting without GA. In our study, only 1% of stent placements in the clinic setting failed, typically due to intolerable pain in the patient or due to failure to pass the stent into the urinary tract due to the obstructive process. Additionally, complications occurred in about 4% of patients in this cohort. This complication rate is similar to the complication rates in other studies. The study by Carrouget et al, which compared JJ stent placement with LA to GA demonstrated complication rates of 22.2% and 5.5% respectively and had no instances of stent failure. In another study by Sivalingam et al, which also compared LA to GA for stent placement, neither group experienced complications, but there were stent placement failures in 8.7 and 1.3% of cases respectively. Thus, our complication and placement failure rates are in line with those reported in the literature for other types of anesthesia. Furthermore, both of these studies are much smaller than the present study. Strengths of the present study include the cohort size of over 500 patients and the inclusion of a variety of stent indications for generalizability of the results. Weaknesses of this study include the retrospective non-randomized design, lack of a control group, and the heterogeneity of anesthesia and analgesia methods used in the cohort (77.9% receiving both LA and N_2O and 22.1% receiving only LA). Further study is therefore needed to demonstrate the safety and efficacy of this technique in comparison to others, such as GA. However, in comparison with the literature, it appears that our rates of complication and placement failures appear similar to other published studies examining similar techniques.

Conclusions

We report a case series of 565 patients undergoing JJ stent placement for ureteral obstruction in the clinic setting with the use of LA with or without N_2O anesthesia instead of GA, with excellent results. □

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