Irish Journal of Medical Science (1971 -) (2019) 188:283–288
https://doi.org/10.1007/s11845-018-1826-x

ORIGINAL ARTICLE

To tube or not to tube? Utilising a tubeless antegrade ureteric stenting system in a tertiary referral hospital

Aisling T. Looney[1] · Padraig J. A. Daly[1] · Ivor M. Cullen[1] · Peter MacMahon[2] · Ian M. G. Kelly[3]

Received: 19 March 2018 / Accepted: 19 April 2018 / Published online: 26 April 2018

Abstract

Introduction To assess the benefits and complications of developing a practice of single-stage primary ureteral stenting in a university hospital.

Methods A practice change developed from the traditional practice of multi-stage stenting to single-episode stent placement. To evaluate this change of practice, we retrospectively analysed data of 70 patients who underwent primary tubeless antegrade ureteric stenting and compared this group to the previous 54 patients who had a covering nephrostomy.

Results There was an overall success rate of 91.3% (85/93 stents having had tubeless antegrade stenting). There were no major and 33 minor complications. The comparative group of 54 patients whose stents had a covering nephrostomy had a median length of stay of 13.2 days compared to 7.4 days for the tubeless group.

Conclusion Single-stage primary ureteric stenting is a safe practice to employ and has universal benefits for both the patient and the health service.

Keywords Hydronephrosis · Interventional radiology · Pyonephrosis · Ureteric obstruction · Ureteric stenting

Abbreviations

I.R.	Interventional radiology
mg	Milligrams
g/dL	Grams per decilitre
g/L	Grams per litre
PUJ	Pelvi-ureteric junction

✉ Aisling T. Looney
Aisling.looney@gmail.com

Padraig J. A. Daly
padraigj.daly@hse.ie

Ivor M. Cullen
ivor.cullen@hse.ie

Peter MacMahon
pmacmahon@mater.ie

Ian M. G. Kelly
ian.kelly@maila.hse.ie

[1] Department of Urology, Department of Surgery, University Hospital Waterford, Ardkeen, Waterford, Ireland

[2] Department of Radiology, Mater Misericordiae University Hospital, Eccles Street, Dublin 7, Ireland

[3] Department of Interventional Radiology, University Hospital Waterford, Ardkeen, Waterford, Ireland

Introduction

Upper urinary tract obstruction is a relatively common cause of acute and chronic renal failure. A number of pathological conditions, intrinsic or extrinsic to the urinary system, may cause obstruction. As the degree and duration of obstruction are the chief determinants of renal dysfunction, early recognition and treatment are the keys to preventing renal loss [1, 2].

In the acute setting, placing a percutaneous nephrostomy tube can decompress the obstructed urinary system. This procedure is a temporary measure that treats the symptoms and preserves the patient's renal function. It is usually undertaken by either the urology department or the interventional radiology department.

To manage the obstructing lesion in a more long-term manner, a ureteric stent ("double J") may be placed across the stricture—either via a retrograde (via urethra) or antegrade approach. In our centre, antegrade stenting is attempted when retrograde stenting fails, is unsafe or is unavailable.

Antegrade ureteric stenting is traditionally a two-stage procedure (multi-stage). The first stage involves placing a percutaneous nephrostomy tube which allows antegrade access. The usual practice was to leave the nephrostomy tube in situ for several days to decompress the system. As a second procedure, the stricture was crossed and an antegrade ureteric stent was then inserted. The covering nephrostomy was often left in situ until the patient experiences a successful 'trial of nephrostomy clamping'. The patient then returns to the radiology department for removal of the nephrostomy tube under radiological guidance. Thus, an individual patient episode lasted a number of days.

This contrasts with single-stage placement, in which renal access, stricture crossing and stent insertion are performed at a single session. As originally described by Watson and Patel, even this required a covering nephrostomy for 12 to 24 h to guard against poor stent function [3]. Therefore, the patient still experienced a procedure that required in hospital overnight stay with an often uncomfortable nephrostomy tube in place and required multiple visits to the interventional room.

Previously published studies by endourologists have demonstrated that the lack of a covering nephrostomy in percutaneous nephrolithotomy procedures does not lead to an increase in morbidity [4–6]. A study by Patel et al. [7] into tubeless percutaneous ureteral stent placement by interventional radiologists demonstrated high technical and clinical success rates.

Over the last number of years, our institution has been developing a practice of single-stage 'tubeless' antegrade stent insertions. This study aimed to evaluate our experience in changing from multi-stage to single-stage stent placements.

Materials and methods

All patients included in this retrospective study were referred to the interventional radiology (I.R.) department for management of ureteric obstruction. Patients were referred by the oncology, nephrology or urology services to relieve ureteral obstruction. The urology service referred to the I.R. department if retrograde stenting failed was felt unsuitable, or if the service was unavailable (e.g. when no on call urology service is available).

In this institution, a formal ethics committee approval is not required in retrospective studies. However, as is the usual practice, we obtained informed consent for the procedure from each patient after benefits and risks were discussed. We discussed the advantages and disadvantages of a nephrostomy tube with all patients who underwent primary tubeless ureteric stent insertions.

All patients for inclusion were selected by the principal investigator. All ureteric stent insertions occurred during the study period of May 2010 to November 2015. Patients who underwent single-stage stent placement were assessed for suitability prior to insertion, by a single consultant interventional radiologist. The inclusion criteria were as follows: the patients were older than 18 years of age and been referred for stent insertion to relieve an established unilateral or bilateral ureteric obstruction. Patients had to have preprocedural haematological studies, including a haemoglobin level of greater than 10 g/dL (100 g/L), a normal range platelet count and normal clotting function (international normalised ratio < 1.3). The underlying cause or severity of the obstruction was not an eligibility or exclusion criterion. The exclusion criteria were as follows: a coagulopathy, known or suspected urosepsis, haemodynamic instability and involvement of a transplanted kidney. Seventy patients, who had 93 stents, fulfilled criteria for review.

Retrospective analysis was then also carried out of the preceding 54 patients in the 12 months prior to the single-stage procedure, who had traditional multi-staged antegrade stents inserted with a covering nephrostomy tube.

We defined a 'primary success' as the insertion of nephrostomy, coupled with insertion of antegrade stent and removal of nephrostomy in a single setting, whereas a secondary success was a patient who had an initial nephrostomy, followed by a return to the Interventional Radiology Suite for antegrade stenting and nephrostomy removal. Hence, the process of antegrade stenting is considered 'tubeless'.

All patients undergoing nephrostomy procedures in the I.R. department are administered intravenous antibiotics according to department protocol. This is normally a single dose of gentamicin at time of procedure. If gentamicin is contraindicated, we use a third generation cephalosporin. The department follows a standard intravenous analgesic and sedative protocol for all interventional procedures. This includes the use of midazolam hydrochloride (doses titrated from 2.5 to 10 mg per patient requirements) and morphine sulphate (doses titrated from 2.5 to 10 mg per patient requirements). One patient required general anaesthesia for the procedure, aided by the anaesthetic department.

A single interventional radiologist performed all antegrade stent insertions for the study duration. We use a standard method in all patients; with a 22-gauge Chiba needle and ultrasound guidance, we gain entry to the renal pelvis. To obtain a double-contrast pyelogram, we inject small aliquots of iodinated contrast material and carbon dioxide. A posteriorly facing inferior renal calyx was then selected for a more secure renal entry point. In the situation of this calyx being unsuitable (usually anatomical reasons), a more superior calyx was chosen for access. Using an 18-gauge needle with a 5-French sheath and fluoroscopic guidance, we carefully gain an entry point for stent deployment (Fig. 1). Multiple fluoroscopic images are taken during access of the calyx to minimise vascular injury. We only manipulate the Amplatz guidewire into the renal pelvis when calyceal entry is confirmed by the aspiration of urine. We then exchange the guide wire and sheath for a hydrophilic wire and

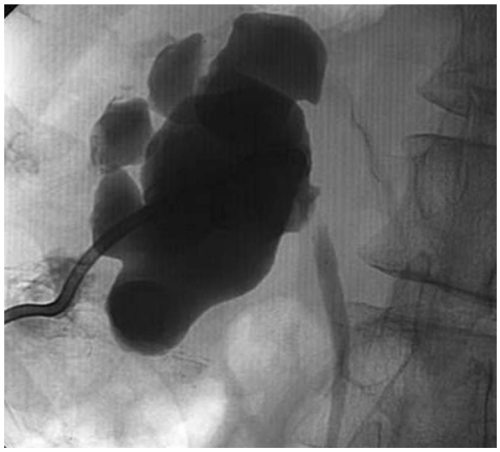

Fig. 1 Frontal image after renal access obtained and contrast injection. A pelvoureteral junction (PUJ) obstruction is demonstrated

6.5-French catheter. If we find the renal collecting system to be obviously infected, by aspirating frank pus from the renal pelvis, we abandon placing the ureteral stent and leave a draining nephrostomy tube in place. The specimen is sent for culture and sensitivity and patient treatment is initiated. Otherwise, by manipulation of the wire and catheter, the ureter is accessed and we attempt to cross the stricture (Fig. 2). If successful, we advance the hydrophilic wire and catheter into the bladder and exchange for a stiff guide wire. Then, an 8-French double J ureteric stent is inserted across the stricture (Fig. 3). Eight-French stents were used in preference to 6-French due to their increased longevity, and their insertion was often aided due to the degree of ureteric distention. We use additional devices depending on the circumstances encountered. Narrow strictures sometimes require predilation before stent insertion, with a 9-French dilation catheter

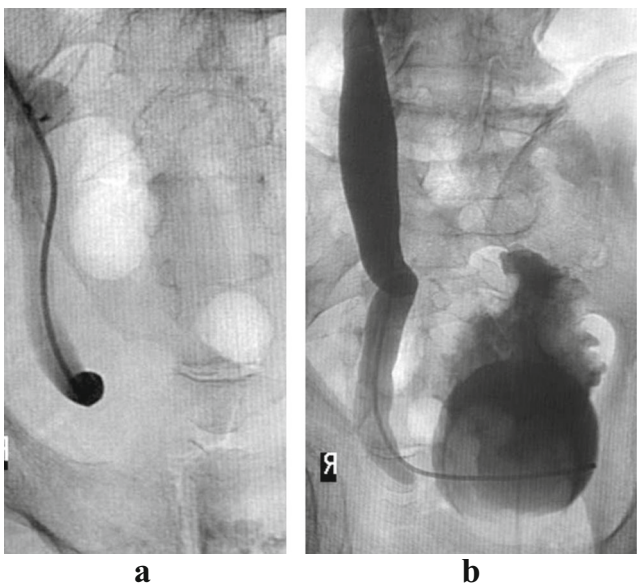

Fig. 2 **a** Demonstrates a distal ureteral obstruction with distended collecting system above and wire at obstruction. **b** Shows successful crossing of stricture with wire now in bladder

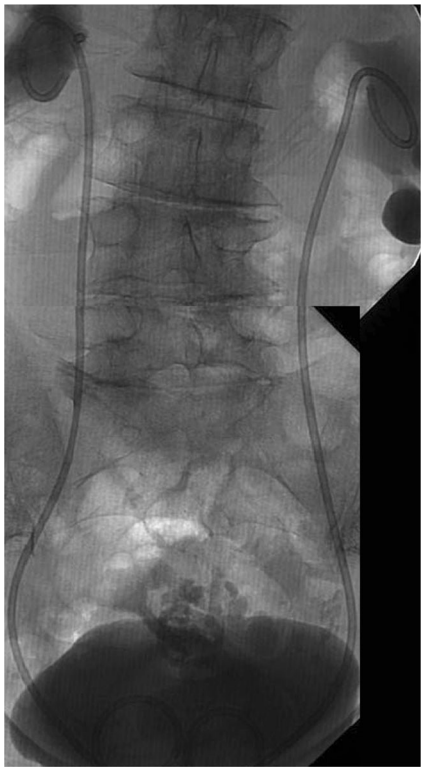

Fig. 3 Successful deployment of bilateral double J stents

and sometimes a 6-mm diameter, 4-cm long balloon dilation catheter. For tortuous ureters, we use a 9-French sheath. In ureters with strictures that cannot be crossed with the 6.5-French angled-tip catheter, we would use a 4-French hydrophilic catheter and 9-French dilation catheter in a final attempt to negotiate the obstruction. With every successful stricture bypass, we obtain an immediate nephrostogram to evaluate the double J stent's function. We also assess the amount of renal pelvic clotting present by slow injection of iodinated contrast medium into the renal pelvis via a 6.5-French catheter. We reduce any risk of extravasation and bacteraemia by taking care not to over distend the collecting system. As long as clotting does not occur in the ureter and/or over half of the renal pelvis, and the stent functions adequately, the catheter is removed over the re-inserted guide wire. Bleeding at guidewire exit site is monitored for a minimum of 5 min, and if insignificant, the wire is also removed. A suture is used for skin closure, and an adhesive sterile dressing is placed over the wound site. After the procedure is complete, we monitor haemodynamic parameters and wound site ooze for several hours in the radiology department or on the ward.

A retrospective review was made of all radiological and clinical notes to obtain data on method of stent insertion, on complication rate and success rates. Since commencement of our study, we intend to treat all patients with a single-stage primary (tubeless) procedure where possible.

Functional antegrade ureteric stenting without a covering nephrostomy was a considered a success—whether the patient

had no prior nephrostomy (primary success) or if they had had a prior nephrostomy inserted (secondary success, e.g. patients with pyonephrosis and problematic calculi)—i.e. any antegrade stenting without a covering nephrostomy after its deployment was considered a success—even if the patient had a prior nephrostomy. A successful procedure was one without major complications, where the stent was demonstrated to be patent by the passage of contrast material from renal pelvis to bladder. We used the scoring system of the Society of Cardiovascular and Interventional Radiology [8] to grade complications. Minor complications are those that are clinically non-significant and thus require minimal treatment. Major complications do require therapy and are a reason for an increase in care provided. They have the potential to result in significant morbidity or mortality. Haematuria that was self-limiting was regarded as a minor complication.

Table 1 Causes of ureteral obstruction in 70 patients without a covering nephrostomy

Obstructive cause	Single-episode primary stents*	Multi-stage stents*
Benign		
Stricture	5 (5)	3 (3)
Calculi	6 (6)	6 (6)
PUJ obstruction	1 (1)	4 (3)
Other	3 (2)	1 (1)
Malignant		
Bladder	9 (6)	4 (3)
Cervical	16 (11)	3 (2)
Colonic	13 (8)	0 (0)
Prostate	8 (5)	6 (4)
Other	1 (1)	3 (3)

*Numbers in parentheses are numbers of patients

Results

A total of 97 double J stents were successfully placed in 71 patients over the study period. One patient who had four stents placed over the study duration was excluded as their procedures involved a transplanted kidney. Figure 4 displays the patients included in the study, whether their stent was inserted in the new single-stage or the previous multi-stage procedure, and their demographics. The causes of ureteral obstruction are listed in Table 1.

The overall combined primary and secondary success rate was 91.4% (85 of 93 stents), i.e. 91.4% of all stents were successfully inserted without a covering nephrostomy. The primary success rate, i.e. stents deployed with no nephrostomy at any point, was 100% (45/45 patients). All stents were observed to drain contrast at end of procedure, and in all cases, the stent functioned well. No patients in this group required a covering nephrostomy at a later stage.

Of the other 25 patients who had a preceding nephrostomy, 17 (68%) had successful single-stage tubeless ureteric stent insertion. Eight (32%) of the 25 multi-stage patients were unsuccessful, i.e. required a covering nephrostomy after stent insertion. Reasons for cover included excessive bleeding [4], usual practice at the time [2], pyonephrosis [1] and renal pelvic trauma [1]. These nephrostomies were left on free drainage in the post-procedural period and later removed following clinical improvement and a successful trial of clamping.

The median length of stay for the 45 patients who underwent a primary antegrade stent successfully inserted was 7.4 days and for the 25 patients who had a preceding nephrostomy, their median length of stay was 10.1 days.

We then retrospectively analysed the 54 patients who had had 60 multi-stage antegrade stent insertions in the 12 months prior to our practice change, i.e. the group who all had a covering nephrostomy after their stent had been deployed. Their indications for ureteric obstruction are outlined in Table 2. Their median length of stay was 13.2 days.

There were no major complications in any double J stent insertion over the study duration. The most common minor complication was limited haematuria: 33/70 patients in the tubeless group and 22/54 in the tubed group. Other recorded complications included post-procedural hypotension [2] and

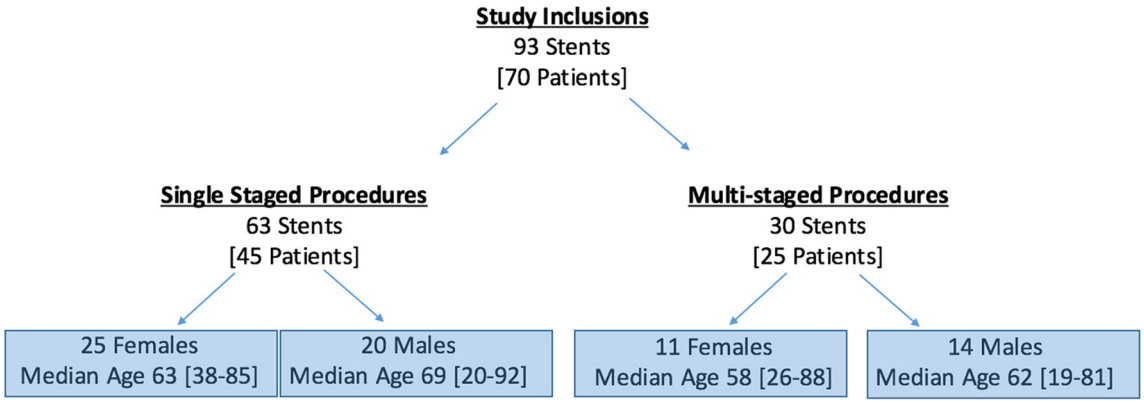

Fig. 4 Patients for study inclusion

Table 2 Causes of ureteral obstruction in 54 patients with a covering nephrostomy

Obstructive cause	Multi-stage stents*
Benign	
Stricture	10 (9)
Calculi	9 (9)
PUJ obstruction	4 (4)
Other	7 (5)
Malignant	
Bladder	5 (4)
Gynaecological	6 (5)
Colonic	3 (3)
Prostate	10 (9)
Other	6 (6)

*Numbers in parentheses are numbers of patients

peri-procedural urinary frequency [2]. These complications were primarily managed by the referring team (e.g. urology).

Discussion

Upper urinary tract obstruction from any cause is a condition readily treated by placement of a ureteral stent. The placement of internal stents by the antegrade route is usually indicated when retrograde stenting fails, is unavailable or is felt unsuitable. The most obvious disadvantage of antegrade stenting is the increased risk of complications associated with percutaneous renal access, namely bleeding. The traditional requirement for multiple visits to the interventional suite was another drawback. The nephrostomy drainage tube was felt necessary due to the risk of bleeding and thrombosis in the renal collecting system after renal puncture. With improvements in technique and materials, it has been shown that, in non-infected systems, one can safely primarily stent ureters [3]. That is, access the system and place the stent in a single session. However, this was still a multi-stage treatment as a covering nephrostomy was left in situ overnight to be removed in the department the next day. In an effort to reduce the discomfort and pain caused by the post-procedural nephrostomy tube, some urologists and radiologists attempted tubeless antegrade procedures. Several previous studies, by urologists performing percutaneous nephrolithotomies, have demonstrated that single-session stents are safe, if the procedure was uncomplicated [4–6]. A recent study by an interventional radiology department has demonstrated that single-stage primary (tubeless) stenting is feasible in selected patients [7]. The major complication rate from this study was 6% for single-stage stents compared to 2% for two stage.

In this present study, we had no major complications over a 5-year period. This may be due to careful patient selection and/or the use of appropriate antimicrobial therapies. Patients who had any history or imaging suggestive or urosepsis were never single-stage stented. We carefully monitored for bleeding, particular at the chosen calyx, after the procedure. There were no episodes of major bleeding after any stent placement. This has been the main concern with single-session stenting. No tamponading tube is left in situ to prevent bleeding along the track of the renal puncture. In the large study by Limb and Bellman in 2002, 5% of the patients required postoperative transfusion and 3 patients were later readmitted with haemorrhage that required embolisation [5]. However, there were no cases of major bleeding in Patel's 2004 study [7] or in a small study from 1999 [9]. This may be due to improved technique of renal entry but probably more significantly from using smaller tracks, 8-French in this study versus 34-French in Limb and Bellman's study.

Our institution does not operate a urology service on call—urology expertise is not available after 5 pm or at weekends. This likely impacted on our length-of-stay variations.

We feel our change of practice has been successful with no significant increase in even minor complications rates, along with a decrease in median patient length of stay. Not quantified, but important, is the accepted improvement in patient comfort, by not having an external tubing device and also that the patient required less invasive treatments. The institution also saves financially, not just from the reduction in length of stay, but in the reduction of interventional procedures.

Our study was limited by the fact that it is a retrospective study and therefore relied on historical clinical notes for complication assessment. Only one radiologist performed all the procedures which may overestimate the success rates.

In conclusion, single-stage primary stent placement is a feasible change of practice with no greater risk to the patient. Patient selection should be limited to those with normal haematological studies and those without any evidence of urosepsis or haemorrhage at time of procedure. All must receive sufficient preprocedure intravenous antibiotic cover. Patient, healthcare providers and healthcare institutions can all benefit from tubeless antegrade ureteric stent insertions.

Compliance with ethical standards

Informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Neal DE, Styles RA (1989) Late renal failure due to prostatic outflow obstruction. BMJ 298(6673):602

2. Better OS, Arieff AI, Massry SG, Kleeman CR, Maxwell MH (1973) Studies on renal function after relief of complete unilateral ureteral obstruction of three months' duration in man. Am J Med 54(2):234–240
3. Watson GM, Patel U (2001) Primary antegrade ureteric stenting: prospective experience and cost-effectiveness analysis in 50 ureters. Clin Radiol 56(7):568–574
4. Bellman GC, Davidoff R, Candela J, Gerspach J, Kurtz S, Stout L (1997) Tubeless percutaneous renal surgery. J Urol 157(5):1578–1582
5. Limb J, Bellman GC (2002) Tubeless percutaneous renal surgery: review of first 112 patients. Urology 59(4):527–531
6. Shah HN, Kausik VB, Hegde SS, Shah JN, Bansal MB (2005) Tubeless percutaneous nephrolithotomy: a prospective feasibility study and review of previous reports. BJU Int 96(6):879–883
7. Patel U, Abubacker MZ (2004) Ureteral stent placement without postprocedural nephrostomy tube: experience in 41 patients. Radiology 230(2):435–442
8. Rajan DK, Patel NH, Valji K, Cardella JF, Bakal C, Brown D, Brountzos E, Clark TW, Grassi C, Meranze S, Miller D, Neithamer C, Rholl K, Roberts A, Schwartzberg M, Swan T, Thorpe P, Towbin R, Sacks D, CIRSE and SIR Standards of Practice Committees (2005) Quality improvement guidelines for percutaneous management of acute limb ischemia. J Vasc Interv Radiol 16(5):585–595
9. Goh M, Wolf JS Jr (1999) Almost totally tubeless percutaneous nephrolithotomy: further evolution of the technique. J Endourol 13(3):177–180