One-stage tubeless antegrade ureteric stenting: a safe and cost-effective option?

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ABSTRACT

INTRODUCTION Antegrade insertion of ureteric stent has become an established mode of management of upper tract obstruction secondary to ureteric pathology. It is conventionally performed as a two-stage procedure for various reasons but, more recently, a one-stage approach has been adopted.

PATIENTS AND METHODS We discuss our experience of primary one-stage insertion of antegrade ureteric stent as a safe and cost-effective option for the management of these difficult cases in this retrospective observational case cohort study of patients referred to a radiology department for decompression of obstructed upper tracts. Data were retrieved from case notes and a radiology database for patients undergoing one-stage and two-stage antegrade stenting. It was followed by telephone survey of regional centres about the prevalent local practice for antegrade stenting. Outcome measures like hospital stay, procedural costs, requirement of analgesia/antimicrobials and complication rates were compared for the two approaches.

RESULTS a one-stage approach was found to be suitable in most cases with many advantages over the two-stage approach with comparable or better outcomes at lower costs. Some of the limitations of the study were retrospective data collection, more than one radiologist performing stenting procedures and non-availability of interventional radiologist falsely raising the incidence of two-stage procedures.

CONCLUSIONS In the absence of any clinical contra-indications and subject to availability of an interventional radiologist's support, one-stage antegrade stenting could easily be adopted as a routine approach for the management of benign or malignant ureteric obstruction.

KEYWORDS

Antegrade – Primary – Ureteric obstruction – One stage – Ureteric stent – Balloon dilatation – Tubeless

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There is a growing demand for interventional urology services in the management of upper tract obstruction secondary to unilateral or bilateral ureteric pathology when attempts at retrograde ureteric stenting fail in benign ureteric pathology (*e.g.* calculus disease) or is expected to fail (as in malignant obstruction of the distal [pelvic] ureter) or, indeed, when retrograde ureteric stenting is relatively contra-indicated when ureteric obstruction is associated with Gram-negative bacterial septicaemia or renal failure. Traditionally, this has been addressed with a percutaneous nephrostomy followed by an antegrade stent insertion as a second stage after a suitable interval. However, with increasing expertise and advances in technology, urologists are adopting a single-stage approach in many cases. The aim of the present study was to assess the outcome of

primary, one-stage antegrade ureteric stenting and to compare its safety and efficacy with the conventional two-stage approach.

Patients and Methods

Over a period of 30 months, 201 patients were referred to the Department of Radiology for insertion of percutaneous nephrostomy (PCN) with or without antegrade ureteric stenting, for a wide range of indications, from different clinical specialities. The radiology database was used to retrieve the list of patients undergoing this procedure during the period from June 2004 to December 2006.

Of the 201 patients, 98 underwent insertion of percutaneous nephrostomy followed by antegrade ureteric stenting.

In the remaining 103 patients, the nephrostomy was either removed after obstruction was relieved and the purpose was served or left permanently for varied reasons. This group of patients has not been considered for analysis in the current study.

Of the 98 patients, 71 had unilateral hydronephrosis (left, 44; right, 27) whereas 27 had bilateral hydronephrosis making a total of 125 renal units (Fig. 1). The age range was 26–92 years with the majority of patients in the over 60-year age group (Fig. 2). There were 73 men and 25 women. Forty-four patients were planned to have one-stage stenting but two were non-compliant possibly due to inadequate analgesia or low pain threshold, four failed to complete in one stage due to technical difficulties, hence a total of six cases were converted to two-stage procedure. Three patients had haemorrhage on nephrostomy insertion; this being a relative contra-indication to one-stage completion, they were converted to a two-stage approach. One had very tight lower ureteric stricture and, despite conversion to a two-stage procedure, failed to have an antegrade stent inserted. Hence, 34 patients (34 renal units) had a primary, one-stage (27%), tubeless approach for antegrade stenting while 64 patients (91 renal units) plus six conversions (73%) had a two-stage approach. Ultrasound scan and/or intravenous contrast imaging was used to visualise the dilated pelvicalyceal system. A standard, locally agreed protocol for prophylactic antibiotics and analgesia using per rectal diclofenac (100 mg) an hour before the procedure and intravenous amoxicillin (500 mg) and gentamicin (120 mg) just prior to intervention was followed for all patients undergoing one- or two-stage antegrade stenting. Indications for PCN and antegrade stenting for these patients are listed in Table 1. Case notes of all patients were studied to gather information regarding outcome measures such as requirement, type and duration of peri-procedure analgesic and antibiotic therapy, recovery of renal function, incidence of primary haemorrhage, sepsis as well as post-

procedure hospital stay; this was compared between the two approaches. Cost analysis of the consumables, radiologist's operator time and interventional radiology suite time as well as comparison of the X-ray exposure for each group was done, data for which was prospectively recorded on the radiology database as standard and as such was readily available.

Procedural details of the one-stage antegrade stenting

The patient lies prone in the IR suite and initial access to the kidney is performed using ultrasound guidance. Under fluoroscopic guidance, a Neff percutaneous access set (William Cook Europe Ltd, Bjaeverskov, Denmark) is deployed via a lower pole calyx, followed by a 5-Fr SlipCath Cobra catheter (William Cook Europe Ltd) over a 150-cm long hydrophilic 0.035-inch wire (Terumo UK Ltd). The bladder lumen is accessed and opacified with iodinated contrast medium. Then the wire is exchanged for an Amplatz superstiff wire (William Cook Europe Ltd). We have found that forcible attempts to cross a tight stricture

Table 1 Indications for PCN + antegrade stenting

Carcinoma prostate	31
Carcinoma bladder	23
Carcinoma cervix	5
Recurrent/metastatic pelvic tumour	12
Lymphoma	2
Uretero-ileal anastomotic stricture	5
Ureteric stone	16
Ureteric stricture (post RT)	3
PUJO	1
Total	98

Patients (n = 98), renal units (125).

Figure 3A One-stage percutaneous nephrostomy and antegrade stent insertion.

with a JJ stent with integral stiffener (Boston Scientific Ltd, Natick, MA, USA) may result in the inner stiffener being 'locked' into the tapered end of the stent, degrading it and preventing its easy removal. Accordingly, if there is perceived resistance in crossing the stenosis with the catheter, balloon dilation with a 4 cm × 5 mm angioplasty balloon (Cordis UK) via a 9-Fr peel-away sheath (Boston Scientific Ltd) is performed as standard practice in order to minimise the risk of the JJ stent failing to cross the stenosis or being degraded in the process. The JJ stent (Flexima JJ stent; Boston Scientific Ltd, Galway, Ireland) is subsequently measured to size by kinking a standard guide wire when its tip is at the vesico-ureteric junction (VUJ) and following partial withdrawal when its tip is in the renal pelvis; the distance between the two kinks is then measured and a stent of matching length deployed. Care is taken to ensure that there is a sufficiently large loop of wire in the bladder (crossing the midline), to avoid inadvertent migration of the distal JJ stent into the lower ureter during deployment of the renal end. If there has been bleeding during the procedure, an 8-Fr nephrostomy tube is left in the renal pelvis; otherwise, the 8-Fr pusher of the JJ stent is left with its tip in upper ureter to tamponade the track for 24 h prior to its removal. We have not encountered clinically obvious complications from the practice of 'tamponading' the track of a 9-Fr sheath with an 8-Fr pusher.

Figure 3B One-stage percutaneous nephrostomy and antegrade stent insertion.

Figure 3C One-stage percutaneous nephrostomy and antegrade stent insertion.

Results

Outcome measures of the two groups of patients consisting of one-stage stenting (34) against two-stage stenting (26) performed purely due to lack of interventionist services (20); non-compliant patients (2) and technical failures (4) due to resistant VUJ ureteric strictures were compared. In those 44 (40 + 3 + 1) cases in which a two-stage approach was adopted in the presence of absolute or relative contra-indications were not included in the comparison. Patients undergoing one-stage, primary, tubeless stenting (Fig. 3A–C) were managed with oral or per rectal analgesia in the peri-procedure period and a 5-day prescription of oral antibiotic therapy. The requirement for these medications was not significantly different to those having a two-stage procedure (Fig. 4A,B). Both groups of patients were prescribed the same post-procedure antibiotic regimen using ciprofloxacin 250 mg bid. Out of 34 patients (94.1%) undergoing one-stage antegrade stenting, 32 required oral analgesics for 48 h post-procedure compared to 56 out of 64 patients having a two-stage procedure (87.5%). All 98 patients were treated with oral antibiotics for 5 days post-procedure but two (2.04%) needed intravenous antibiotics to treat low-grade sepsis.

The four cases in whom primary single-stage stenting was not performed had tight impassable VUJ ureteric strictures, which were negotiated at a second attempt following a period of decompression with nephrostomy. Overall hospital stay for the one-stage group was significantly reduced compared to the two-stage group primarily because of the prolonged interval between the two procedural steps in the two-stage group (Fig. 5). As the total hospital stay was purely governed by the interval between two stages in the latter group, we looked at the inter-stage interval as the deciding factor for the in-patient stay. It varied from 1–35 days (mean, 10.3 days; median, 10 days). Following insertion of antegrade stent, patients were fit for discharge from the hospital within 24–48 h irrespective of one-stage or two-stage procedural approaches.

Table 2 Reasons for a staged PCN and antegrade stent

Uncontrolled/symptomatic renal failure	27
Urosepsis	13
Haemorrhage	3
Poor patient compliance	2
Failed first attempt	4
Tight ureteric stricture	1
N/A interventional radiologist	20
Total	70

Patients ($n = 70$; 64 + 6 conversions).

Conversion rate from one stage to two stages was 6 out of 44 (13.6%). There were no major complications following one-stage antegrade stenting, except post-procedure haemorrhage in one case (2.9%), which was managed conservatively and required no transfusion. Renal function improved in all cases of one-stage stenting as expected despite an initial impairment noted for the first 24–48 h in a significant minority (15%). In those undergoing two-stage antegrade stenting, there was no significant change in the renal function following the second stage except four out of 64 patients (6.25%) showing mild transient impairment. Mean interval in days between the PCN and antegrade stenting for the two stage group was 10.3 days (range, 1–35 days; Fig. 5). Mean cost of in-patient hospital stay was higher in the two-stage group by at least £2,500 (£250/day $\times$ 10).

Table 2 shows the various reasons behind performing the procedure in two stages.

Balloon dilatation of the obstructing ureteric lesion/stricture was necessary for eight of the 125 renal units (6.4%) prior to antegrade stent insertion. A total of three renal units out of 125 (2.4%) in the current series were left with permanent nephrostomy as the ureter could not be stented after failed attempts at balloon dilatation of the ureteric stenosis. One of them was a failure of the one-

Table 3 Summary data for the different procedures

Procedure type	Average procedure time (min)	Average screening time (min)	Average radiation dose (cGycm ²)	Average procedural Cost
Unilateral PCN (1st stage)	51.5	5.28	449.03	£281
Unilateral antegrade stent (2nd stage)	79	11.5	1345.9	£384
Bilateral PCN (1st stage)	58	6.1	196.4	£407
Bilateral antegrade stent (2nd stage)	61	13.3	827.6	£415
Unilateral antegrade stent (one stage)	65	10.4	737	£376
Bilateral antegrade stent (one stage)	90	14.5	1360.2	£483

stage approach despite balloon dilatation (2.8%) and the other (bilateral, two units) from the two stage group.

Procedural cost for the one-stage approach was found to be significantly lower (£376) than the two stage approach (£665) and so was the cumulative procedural time (65 min vs 130.5 min) and consequent X-ray exposure (737 cGycm² vs 1794.93 cGycm²; Table 3).

With 2.8% failed insertions due to unyielding strictures, 2.9% peri-procedure complications in the form of haemorrhage and conversion rate of 13.6%, our overall technical and clinical success rate of primary one-stage antegrade stenting approaches 87% and 95%, respectively, comparable to other series in the literature.^{1,2} All patients undergoing antegrade stenting subsequently had their stents changed endoscopically at 6 month by the urologists. Only two patients (2.04%; one each from the one- and two-stage groups) required a stent change earlier than the scheduled 6 monthly change due to worsening renal function noted on routine check, secondary to intraluminal calcification but not on account of external compression. Following balloon dilatation of the lower ureteric stricture/stenosis of the vesico-ureteric junction and insertion of an 8-Fr stent, it is less likely for the antegrade stents to be blocked due to external compression by malignant peri-ureteric infiltration, at least over a short-to-medium term. In our series, we had no cases where JJ stent insertion failed to relieve the ureteric obstruction.

Symptomatic uncontrolled acute renal failure and urosepsis are an absolute, and intra-procedure haemorrhage is a relative, contra-indication, respectively, for primary, tubeless, one-stage antegrade stenting in our series; however, in most other cases, this approach can be safely adopted subject to the availability of an interventional radiologist.

Results of telephone/email survey about the availability of interventional services in the region

As a part of the study, we conducted a telephone survey to assess the extent of interventional services available in the departments of radiology at nine different hospitals in the region of East Anglia. Our survey revealed that, in seven regional hospitals (77.7%), antegrade stenting was almost always offered as a two-stage procedure. In the remaining two hospitals (22.3%; one of them being the authors' hospital), antegrade stenting was offered as a one-stage procedure. Only in the authors' hospital, has it been offered on a regular basis in most cases except when contraindicated on clinical grounds. This is possibly to be due to availability of an interventionist generally at all times in our radiology unit.

Discussion

This study is a retrospective, observational analysis of the management of ureteric obstruction with antegrade stenting using a one- or two-stage approach. It examines the changing radiological practice of management of ureteric obstruction adopted by the interventional radiologists over recent years. Insertion of percutaneous nephrostomy (PCN) has been a standard practice for relief of ureteric obstruction when retrograde ureteric stenting fails or is contra-indicated. PCN is indicated in both benign and malignant ureteric obstruction,⁵ irrespective of whether the latter may be curable or incurable.⁴ In fact, insertion of PCN in a symptomatic non-dilated obstructive uropathy⁵ has been shown to reverse renal failure even though the ultrasonography and CT scan revealed no evidence of obstruction. In the majority of cases, insertion of PCN is still considered to be safe as an in-patient procedure, although it has been reportedly offered as an out-patient procedure in one series,⁶ which nevertheless highlights the importance of antibiotic prophylaxis to address the significant risk of peri-procedure sepsis⁶ amongst many other complications of PCN reported in other series,⁷ for example, haemorrhage and pelvic injury. Insertion of PCN using a radiologically guided⁸ or ultrasonography guided 'Seldinger' technique followed by tract dilatation and insertion of a nephrostomy catheter (8–12-Fr) or the one-stab ultrasonography guided technique using the Bonanno catheter (6-Fr) have been described, compared and the latter found to be safe and quick in selected cases.⁹ Managing a PCN with an external appliance may not be very easy; hence, insertion of an antegrade ureteric stent to eliminate the external tube drainage and establish internal drainage is desirable as soon as is feasible. This approach effectively helps improve/maintain quality of life, particularly in patients with advanced pelvic malignancy despite a guarded prognosis. In our series, antegrade JJ stent insertion did not fail to relieve ureteric obstruction over a short-to-medium term despite the presence of malignant ureteric stricture/peri-ureteric compression in these patients.

Traditionally, an antegrade stent insertion has been considered as a staged elective procedure subsequent to insertion of PCN as an emergency procedure. This approach has been adopted as a consequence of time constraints on any radiological sessions as well as lack of interventional radiologists who, in turn, seem to have a major role in all percutaneous interventions compared to other specialists.¹⁰ Obstruction associated with acute sepsis and/or untreated renal failure are contraindications to single-stage PCN with antegrade stent insertion and a staged approach is the preferred option, as it provides therapeutic benefit and facilitates definitive treatment with minimal morbidity.¹¹

Failure of relief of ureteric obstruction following JJ stent insertion (stent failure) is known to occur due to extrinsic compression/peri-ureteric infiltration by malignancy,^{12–15} with a mean time to stent failure of 4.8 months, mean of 5.5 stent exchanges at a mean interval of 3.6 months.¹² At almost one year, stent failure due to extrinsic compression has been reported in nearly half (40–46%) of the treated patients.¹⁵ Although the reasons for stent failure in the face of extrinsic obstruction are not clear, the only parameters that seemed to be predictors of stent failure were greater post-treatment creatinine¹² and luminal size.¹⁴ Stent failure has been arbitrarily defined as clinical occlusion of the stent within 30 days of placement and at times as early as within 24 h of insertion.¹⁴ In-dwelling internal ureteric stents (IUSs) are more likely to be obstructed than a percutaneous nephrostomy (PCN) placed for the management of extrinsic ureteric obstruction; hence, those with IUSs need to be carefully monitored for on-going obstruction.¹⁵ However, one of the main reasons for our series showing no incidence of failed diversion due to persistent obstruction has been the usage of balloons to widen the VUJ strictures, which would effectively keep the lumen patent until a routine stent change planned at 6 months from initial placement.

Our results support an argument for utilising a one-stage approach for insertion of PCN and antegrade stent in most circumstances. The one-stage 'tubeless' technique has been facilitated by technological improvements which include hydrophilic coating on wires and stents, low profile balloons and improvements in imaging guidance which minimises renal trauma. In turn, this has resulted in decreased procedural time and X-ray exposure time. It has been a cost-efficient approach as demonstrated in our study and arguably the way forward for patients and departments of radiology as the service provider, as well as its consumer clinical specialities. Our study has clearly shown that patients tolerate the one-stage approach very well with hardly any increase in the requirement for analgesia and antibiotics. Moreover, the procedure-related hospital stay and costs are considerably reduced, further strengthening the case for a one-stage approach. Patients not only tolerate the percutaneous tract dilatation for the insertion of PCN under local infiltration anaesthesia and sedation, but also undergo dilatation of ureteric stricture as a

prerequisite to antegrade stent insertion at the same sitting in selected cases. On the whole, these patients withstand the one-stage procedure remarkably well and have a very low incidence of complications.

Study limitations

The study has some limitations:

1. It was a retrospective, observational study with collection of data for the study period based on clinical case notes. However, the degree of error was reduced significantly by referring to the radiology procedure reports stored on PACS and correlating them with the written case note entries and ensuring that the post-procedure indices compared were haematological and clinical and recorded in every patient according to a standard protocol.
2. There were 3–4 interventional radiologists responsible for the deployment of JJ stents with slight differences in their technique used and the consequent time taken for the completion of procedure which we have not recorded.
3. Non-availability of interventional radiologists raises the incidence of two-stage procedures. In an ideal situation, our study figures suggest that nearly a third (31.25%) of the patients who had two-staged JJ stent insertion could have had a one-stage JJ stent insertion had an interventionist been available.

Before we accept the one-stage antegrade stenting as a standard, cost-effective approach for the management of upper urinary tract obstruction, particularly in patients with advanced pelvic cancer that was present in 73 out of the 98 patients (74.5%) in this series, it would be prudent to compare it with alternative techniques such as metallic endoluminal stents¹⁶ or subcutaneous nephrovesical bypass stents¹⁷ in a prospective, multi-arm, multicentre, clinical trial for this sub-group of patients.

Conclusions

Primary, one-stage, tubeless, ureteric stenting for benign or malignant ureteric obstruction is a safe and cost-effective option in the majority of cases, subject to interventionist support from uro-radiology. In the absence of any clinical contra-indications, it could be adopted as a routine approach for the management of upper tract dilatation/obstruction secondary to ureteric obstruction.

Balloon dilatation of the VUJ ureteric stricture not only facilitates placement of the antegrade ureteric stent across a tight rigid/unyielding obstruction, but also possibly delays stent failure secondary to extrinsic compression of the ureter secondary to malignant pelvic pathology.

Prospective, randomised, controlled trials to compare the outcome measures of one-stage versus two-stage antegrade

ureteric stent placement as well as effects of pre-stenting balloon dilatation of the ureter are needed to standardise treatment of extrinsic ureteric obstruction.

Acknowledgement

Our sincere thanks to Lisa Hendrick, Service Lead for Interventional Radiology at the Norfolk & Norwich University Hospital NHS Foundation Trust for her kind help with this study.

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