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Percutaneous Antegrade Ureteric Stenting in Patients with Failed Retrograde Approach: A Prospective Study

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Abstract

Aim: To evaluate procedural success rate and complications in percutaneous antegrade ureteric stenting. ***Materials and Methods:*** A total of 21 patients (12 males, 9 females, mean age 48 years) with obstructive hydronephrosis, of benign or malignant origin with failure of retrograde stent placement were enrolled in our study. Primary stenting was attempted in 10(48%) patients and rest of the patients was subjected to conventional two stage procedure. End point assessments were technical and clinical success rate, procedural complications. ***Results:*** A total of 26 procedures in 21 patients were done in the study: 16 procedures in 11 patients were in the secondary group and 10 procedures in 10 patients were in the primary group. Our technical success rates were 87% and 80% in secondary and primary groups, respectively. Overall technical and clinical success rate in our study was 84.6% and 85% respectively. Five out of 21 patients developed (23.8%) minor complications; however there were no major complications in our study. ***Conclusion:*** Percutaneous antegrade ureteral stent placement is a safe and effective method for manage-ment of ureteric obstructions due to both malignant and benign causes when the retrograde approach has failed and when the retrograde approach is difficult.

Keywords: ***Antegrade ureteric stenting, Nephrostomy, ureteric obstruction, Terumo Guide wire, Amplatz wire.***

Introduction

Ureters are easily affected by number of benign or malignant conditions because of their anatomical relationship to the adjacent organs and their long and narrow structure, resulting in the interruption of urinary drainage. The most common causes of ureteric obstruction are Urolithiasis, Malignant pathologies of the urinary tract (bladder and prostate), Pelvic neoplasia especially in the female genital apparatus and colon/ rectum. Less frequent causes are fibrous strictures caused by retroperitoneal fibrosis, ureteral anastomotic surgery of urinary origin, and iatrogenic lesions which are urologic, surgical, radiation induced, or medical [1-4]. The management of ureteric obstruction depends upon the underlying pathology, type/cause of obstruction/stricture and also the patient's preference and whether or not the patient is fit to under-go anaesthesia [5]. The management of ureteral obstructions caused by extrinsic compression or infiltration of the ureteral walls may become a difficult problem, especially in patients highly compromised by oncological complications [1]. Interventional radiology techniques for the treatment of obstructive urologic pathologies are proposed as a less invasive alternative to the surgical approach, which is often difficult and aggravated by high failure and complication rates [6]. Ureteral stents have been widely used for the management of these patients since their first description by Zimskind *et al*.[7] in 1967.

The various indications for ureteral stent placement are: relief of benign or malignant obstruction, adjunct to stone therapy, for ESWL, intraluminal lithotripsy, ureteral instrumentation, stone visualization, perioperative placement, alignment of drainage elements, maintenance of luminal calibre, after ureteral intervention, identification of ureter(s), management of urine leak, leak from trauma or surgery and leak due to ureteral fistula [8-11].

The characteristics of the ideal ureteral stent include: easily inserted from any access, resistant to migration, optimal flow characteristics, well tolerated by patient, biocompatible, bio durable, resistant to encrustation, non-refluxing. Radiopaque or visible at USG, easily exchanged and removed, versatile and affordable [10-14].

Traditionally, percutaneous antegrade ureteral stent placement was performed as two-stage procedure. After a period of percutaneous nephrostomy, ranging from 2 to 7 days, an antegrade ureteral stent was inserted as a second procedure. This is believed to reduce ureteral tortuosity and mucosal edema and establishes a

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granulated percutaneous tract, making insertion of the stent easier and possibly safer, [1-4,15] however recent studies have demonstrated the safety and feasibility of primary antegrade stent placement (primary renal access and stent insertion is performed as a single procedure) [16,17].

The various complications of the percutaneous ureteric stent insertion are: urinary tract infection, malposition, migration, inadequate relief of obstruction, encrustation, stent fracture, ureteral erosion or fistulisation and forgotten stent.

Materials and Methods

This study was a prospective observational study conducted in the Department of Radiodiagnosis & Imaging in collaboration with the Department of Urology of Sheri-Kashmir Institute of Medical Sciences for duration of 2 years.

All patients included in the study were referred from the department of urology. A total of 21 patients were part of this study. Primary stenting was attempted in 10 patients and rests of the patients were subjected to conventional two stage procedure. Patients with benign or malignant ureteric obstruction whether unilateral or bilateral in whom retrograde stenting was unsuccessful were included in our study. Patients with coagulopathy, lower urinary tract dysfunction, suspected pyonephrosis and patients known to be severely allergic to contrast material were excluded from the study.

Patients with Uncontrolled or symptomatic renal failure, urosepsis, intraprocedural haemorrhage and failure of primary stenting underwent conventional two stage procedure (secondary stenting).

After informed consent was taken, intravenous antibiotics and analgesics were given to all patients. All vital signs were monitored during the procedure. All patients were given local anaesthesia. Access to PCS was obtained usually through middle or superior calyx using 21G/18G needle (depending upon dilation of PCS) under USG and or fluor guidance. Passage of guide wire (.035/.018) and serial dilation of track using 6 to 8F Dilators was done. In case of primary stenting a hydrophilic guidewire was manipulated into the ureter and negotiated into the bladder/neobladder. This was followed by exchange of the hydrophilic wire with a stiff wire. A ureteric stent of suitable size and length was advanced over the guidewire using fluoroscopic guidance. Anexternal PCN catheter was placed as a safety measure and capped; patients were reassessed for resolution of hydronephrosis after 3 days. In case of resolution of hydronephrosis, the external catheter was removed. In case of persistent hydronephrosis, the patients were reassessed after 1 week, during which time they were left to external drainage. A persistently malfunctioning stent was exchanged with a new one after 1-2 weeks. In case of secondary stenting, the patients were left to external drainage for 1 week and subsequently stented using a hydrophilic wire and a MPA/Kumpe catheter followed by exchange with stiff Amplatz wire. A safety PCN catheter was left for 2-3 days and removed if USG demonstrates a satisfactory decompression.

Post procedure all the patients were followed on 1st, 7th, 15th Day and at 3 months with blood investigations, urine examination, USG and check nephrostogram whenever deemed necessary. Patients were bought to Intervention radiology suite for USG examination and check nephrostogram for assessment of satisfactory decompression and stent patency. Minor and major complications for PCN were defined according to the guidelines of the Society of Interventional Radiology [18]. Placement of the ureteral stent and completion of the interventional procedure was considered as technical success. Clinical success was defined as < 2mg/dl serum creatinine levels and complete resolution or reduction of hydronephrosis [19].

Statistical Analysis

The recorded data was compiled and entered in a spread sheet (Microsoft Excel). Continuous variable summarised as mean and categorical variables were expressed as frequencies and percentages. Graphically the data was presented by bar diagrams and pie charts. The study was done after getting clearance from institutional ethics committee.

Results

In our study, out of total 21 patients, 12 (57%) were males and 9 (43%) were females, with male to female ratio of 1.3: 1. The mean age of the patients in our study was 48years with maximum number of patients falling in the age group of 41-60 years.As of etiology, out of 21 patients, 12 had Neoplastic disease, 3 had calcular disease, 4 had postoperative stricture (uretero ileal) and 2 patients had ureteric stricture secondary to tubercular disease.

The mean pre-procedural serum creatinine level of patients in our study was 2.3mg/dl. The majority of patients had pre-procedural serum creatinine levels between 2-2.99 mg/dl. Of the 21 patients included, 19 had unilateral hydronephrosis whereas 2 had bilateral hydronephrosis making a total of 23 renal units. Out of 21 patients, stent insertion was unsuccessful in one patient having unilateral obstruction, rest of the 20 patients were successfully stented. These 20 patients were followed for improvement in serum creatinine levels and resolution of hydronephrosis.

The mean post procedural serum creatinine level in our study group was 1.48mg/dl. The majority of patients had post-procedural serum creatinine levels between 1-1.99 mg/dl.In post procedure follow up there was complete resolution of HDN in 19 renal units with residual grade I in 3 renal units. In our study total 26 procedures were performed in 21 patients. Two of our patients had bilateral obstruction needing bilateral stenting. In 3 patients having unilateral obstruction initial attempts to stent failed, so 3 more procedures (secondary procedures) were attempted. Primary stenting was done in 10 patients while as secondary stenting was done in 11 patients which required repeat intervention in 3 cases. The technical success obtained in our study is described in table 1.

Table 1: Technical results in primary and secondary antegrade ureteric stenting.

Type of Stenting	Number of Procedures	Technical Success	Technical Failure
Primary	10	8	2
Secondary	16	14	2
Total	26	22	4

The overall technical success in our study was seen in 22 renal units with failure in 4 patients. The overall clinical success rate in our study is shown in table 2:

Table 2: Overall clinical outcome in our study group

Clinical outcome	Number of Patients	Percentage
Success	17	85%
Failure	3	15%
Total	20	100%

The complication profile in our study is as shown in table 3:

Table 3: Distribution of post procedural complications in patients of our study.

Complications	No. of Patients	Percentage
Haematuria	2	9.5%
UTI	1	4.7%
Stent malposition	0	0%
Stent migration	0	0%
Stent occlusion	1	4.7%
Ureteric injury	1	4.7%
No complications	16	76.2%
Total	21	100

Discussion

Percutaneous nephrostomy insertion was first described in 1955 by Goodwin and associates and it is an important technique for the provision of temporary or permanent/long-term drainage of an obstructed upper urinary tract or for establishing diversion of urine flow [20,21]. Ureteral stent placement is a routine safe procedure for the maintenance of ureteral patency. A stent can be inserted through either the antegrade or retrograde route through a cystoscope. Antegrade insertion is successful in 88%–96% of cases [22-24] but the two routes have not been critically compared in an unselected randomized fashion. However, in some patients, antegrade stent insertion is more likely to succeed, particularly if the ureteral orifices are poorly visualized-for example, in patients with pelvic, bladder, or prostate malignancy. To further make a conclusive statement, we conducted a prospective observational study at our institution in the Department of Radiodiagnosis and Imaging to evaluate the effectiveness, complications and procedural costs of percutaneous antegrade ureteric stenting and the study was done in collaboration with the department of Urology.

The study was conducted for a period of two years. During the course of the project we enrolled a total of 21 patients with ureteric obstruction with both malignant as well as benign causes. In our study there were 12 males and 9 females. There was no pattern of complications pertaining to either the male or female patients. All the patients tolerated the procedure well. Theage of the patients ranged from minimum age of 9 years to a maximum age of 66 years (mean age 48). Age did not affect the outcome of the ante-grade stenting procedures. Patients in the various age groups tolerated the stenting procedures equally well and there was no evidence to suggest particular complications were related to any specific age group. As for Etiology is concerned 12 patients had neoplastic disease, 3 had calcular disease, 4 had stricture at uretero-ileal site and 2 patients were documented cases of genitourinary tuberculosis. Post procedure the patients were followed on 1st, 7th, 15th Day and after 3 months for assessment of overall technical and clinical outcome and for any complications. Subsequently the final impressions of success and failure of PAUS procedure were made.

In total 21 patients underwent ante-grade ureteric stent insertions. In these 21 patients a total of 26 PAUS procedures were attempted. Of the 21 patients, 19 had unilateral hydronephrosis (right 11, left 8) whereas 2 had bilateral hydronephrosis making a total of 23 renal units, plus there were 3 patients in whom there was failure of stent insertion at the first attempt (two in the primary group and one in secondary group), so three more procedures were done in these three patients making a total of 26 procedures in 21 patients. 20 out of 21 patients (95.2%) had successful insertion of antegrade ureteric stent with technical success rate of 80% in primary group and 87.5% in secondary group. Overall technical success rate of PAUS in our study group was 84.6%. In 20 successfully stented patient's satisfactory improvement in serum creatinine was seen in 16 patients who had elevated pre-procedure serum creatinine levels. The mean pre-procedural creatinine levels in these 16 patients was 2.24mg/dl and the mean post procedural creatinine levels were 1.4mg/dl (average 37% improvement). Three patients showed no improvement in serum creatinine (<5% change after stenting), hence were considered as clinical failure.

As for as resolution of hydronephrosis is concerned, out of 22 successfully stented renal units there was complete resolution of hydronephrosis in 19 renal units. In rest of the 3 renal units there was residual grade I hydronephrosis. In these 3 patients stent patency was confirmed by check nephrostogram. Thus, overall clinical success rate in our study was 85% (17/20). Most of the antegrade stenting procedures were carried out as 2 staged procedures. 16 of our procedures were done as two staged procedures with a technical success rate of 87.5% and 10 procedures were performed as one staged procedure with technical success rate of 80%. As for as overall technical and clinical success rate is concerned our results are comparable to results of many internationally published research papers: Anthony Kodzo-Grey Venyo *et al* reported their experience with antegrade ureteric stenting in 89 patients they successfully stented in 105 out of 121 procedures with technical success rate of 86.7% [25]. Venyo A *et al* reported their experience with PAUS. They successfully stented 27 out of 30 patients (90%) with technical success rate of 92.5% [5]. Watson *et al* evaluated the success rate of primary antegrade ureteric stenting and they reported the overall technical success rate of 80% (40 out of 50 ureters) [16]. Patel U *et al* evaluated ureteral stent placement in 41 patients without postprocedural nephrostomy. They achieved technical success rate of 88% and clinical success rate of 83%, with no major hemorrhage [22]. Sharma *et al*. reported 41 patients, who underwent insertion of percutaneous antegrade ureteric stenting, Sharma *et al*. reported that: The over-all success rate for ante-grade ureteric stent insertion was 83% [26]. Borrell AP *et al*. reported twenty-four patients with urinary obstruction, in which 27 antegrade ureteric stent insertions were attempted. They achieved a technical success rate of 90% [27]. Kahriman G *et al*. in their study of PAUS which included 461 patients (727 procedures) achieved an overall technical success rate of 97.7% and 100% in neoplastic and non-neoplastic groups respectively, overall technical and clinical success rates were 97.9% and 86.5%, respectively [19]. Chitale *et al* reported their experience of primary one-stage antegrade stenting. They achieved overall technical and clinical success rate of 87% and 95%, respectively [17]. Jenkins *et al* reported eleven kidneys in 10 patients in which nephrostomy insertion with subsequent immediate or delayed ante-grade ureteric stenting were undertaken. Ante-grade placement of the ureteric stent was achieved in 10 of the 11 kidneys (90% success)[26].

Our results are also comparable with the results of Harding [4] who reported 34 successful per-cutaneous ante-grade ureteric stent placements from 37 attempts performed on 25 patients with a history of malignant diseases, in whom retrograde ureteric stenting was impossible or difficult. this represented a technical success rate of 92%. Reported associated complications of ante-grade ureteric stenting include complications that are associated with nephrostomy insertion as well as the complications emanating from manipulation of guide-wire and the stent in the ureter (the ante-grade stenting procedure). On the whole, percutaneous nephrostomy insertion is a relatively safe procedure when it is performed by well-trained and very-skilled interventional radiologists. Nevertheless, a number of complications associated with nephrostomy insertion have been reported by some authors [28,29] as follows: (1) Major complications were reported in 4% to 8% of cases and these included significant

bleeding requiring blood transfusion, septicaemia; and inadvertent puncturing of pleura or viscera for example the liver, colon, and spleen; (2) minor complications were reported in 3% to 15% of cases and these include retroperitoneal extravasation of urine and significant visible haematuria causing clot colic and/or catheter blockage.

In our study five out of 21 patients (23.8%) developed complications pursuant to their ante-grade stent insertions these were haematuria(n=2), urinary tract infection(n=1), stent occlusion (n=1) and ureteric injury(n=1). these were considered as minor complications according to the guideline [30]. The complications are summarized as follows:

Two patients developed haematuria following procedure which lasted longer than 24 hours but resolved without any further intervention or blood transfusion. One patient developed urinary tract infection following stent insertion on day 3rd which was managed with oral antibiotics. Stent occlusion was seen in one patient during follow up (day 29th) which was fixed by urologists. In one patient ureteric injury was encountered during manipulation of guidewire, patient was kept on external drainage via PCN and was successfully stented a week later. No Major complication like significant bleeding requiring blood transfusion, septicaemia and inadvertent puncturing of pleura or viscera for example the liver, colon, and spleen was seen in our study. On reviewing the literature our complication profile is similar to the many of the internationally published studies. Patel U *et al* evaluated ureteral stent placement in 41 patients without postprocedural nephrostomy. They reported septicaemia in 2 patients that required repeat nephrostomy and 2-8 days of extra hospitalisation and mild haematuria in 13 patients (36%) that resolved of its own. No major bleeding occurred in their study [22]

Kim and Park evaluated seven patients who underwent ante-grade ureteric stent insertion. Complications included abdominal/flank pain (n = 7), visible haematuria (n = 5), and elevated blood pressure (n = 1). All the complications were relieved within three days after the procedure and conservative management [31] Hausegger and Portugaller reported their experience with regard to insertion of percutaneous nephrostomy and placement of ante-grade ureteric stenting. The complication rate in their study was about 10% for major and minor complications together and only 4 to 5% for major complications [15]. Carrafiello G *et al* evaluated three ureteral stenting techniques in 45 patients with bilateral malignant ureteral obstructions. All of the patients were treated with ureteral stenting: 30 (mild strictures) with direct stenting (insertion of the stent without predilation), 30 (moderate/severe strictures) with primary stenting (insertion of the stent after predilation in a one-stage procedure), and 30 (mild/moderate/severe strictures with infection) with secondary stenting (insertion of the stent after predilation and 2–3 days after nephrostomy). The primary technical success rate was 98.89%. No major complications were reported in their study. The minor complication rate was 11.1%. The incidence of complications for the various techniques was not statistically significantly [32].

Kahriman G *et al* performed 727 PAUS procedures in 461 patients A total of 23 postprocedural complications (3.2%) were seen in 21 patients. There were namely stent malposition(n=10), urinary tract infection (n=3), stent occlusion (n=3), perirenal hematoma (n=5), haematuria (n=3), and perirenal abscess formation (n=1). Three of them required postprocedural hospitalization and were considered as major complications [1].

In our study average Procedural cost per patient for the one-stage approach was found to be lower (`8100) than the two-stage approach (`9900). In addition to this, there are other cost advantages to one stage approach as it is a procedure where nephrostomy and ureteric stenting is done in single sitting (single radiologic event) which translates into improved bed usage, less hospital visits and overall decrease on hospital burden, hence making primary stenting (one stage approach) a cost-effective strategy. Furthermore, as primary stenting is done in single sitting the use of sedation and analgesia is also reduced. The total procedure related fluoroscopic screening times were also recorded during the procedure the mean fluoroscopic screening time for the primarily stented patients was 13.1min and for secondarily stented patients it was 18.7min. On reviewing the literature our observations are in full agreement with many of the internationally published studies. Chitale *et al* reported their experience with One-stage tubeless antegrade ureteric stenting: a safe and cost-effective option. They concluded that one-stage approach was suitable in most cases with many advantages over the two-stage approach with comparable or better outcomes at lower costs [17]. Watson GM *et al* reviewed their experience with primary antegrade ureteric stenting and they concluded that in carefully selected patients, the majority of obstructed ureters can be primarily stented using simple equipment. The reduced hospital stay and overall success rate significantly improves the cost competitiveness of antegrade ureteric stenting [16].

Conclusion

Our experience over a period of 2 years would suggest that percutaneous antegrade ureteral stent placement is a safe and an effective method for management of ureteric obstruction due to both malignant as well as benign causes, when the retrograde approach has failed or is difficult to perform. The procedure is usually carried out without any requirement of general or spinal anaesthesia and it is well tolerated by patients of all age groups and sex. Our results also suggest that in selected patients, primary antegrade ureteric stenting (one stage approach) is a technique with a high success rate at lower costs.

Declarations

Funding

None

Conflict of Interest

None

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