East African Medical Journal Vol. 100 No. 12 December 2023
PERCUTANEOUS ANTEGRADE DOUBLE J URETERAL STENT PLACEMENT AT KENYATTA NATIONAL HOSPITAL: INDICATIONS, TECHNICAL SUCCESS RATE, COMMONLY ENCOUNTERED PROBLEMS AND SOLUTIONS

John Mwangi, Interventional Radiology Fellow, Department of Diagnostic Imaging and Radiation Medicine, University of Nairobi, MBChB (University of Nairobi) Mmed Radiology (University of Nairobi), P. O Box 61-10100 Nyeri, Kenya, Peter Magabe, Lecturer and Interventional Radiologist, Department of Diagnostic Imaging, University of Nairobi, MBChB (UoN), Mmed. Diagnostic Imaging (AKUH, Nbi), Fellow, VIR (Israel), P.O. Box 19676-00202, Nairobi, Kenya, Lawrence Mugambi, Interventional radiologist, Kenyatta National Hospital, MBChB (UoN), Mmed. Diagnostic imaging, (UoN), Fellow VIR (Tehran), P.O. Box 20723-00200 Nairobi, Kenya

Corresponding author: John Mwangi, Interventional radiology fellow, Department of Diagnostic Imaging and Radiation Medicine, University of Nairobi, MBChB (University of Nairobi) Mmed Radiology (University of Nairobi), P. O Box 61-10100 Nyeri, Kenya. Email: johima06@gmail.com

PERCUTANEOUS ANTEGRADE DOUBLE J URETERAL STENT PLACEMENT AT KENYATTA NATIONAL HOSPITAL: INDICATIONS, TECHNICAL SUCCESS RATE, COMMONLY ENCOUNTERED PROBLEMS AND SOLUTIONS

J. Mwangi, P. Magabe and L. Mugambi

ABSTRACT

Background: **Percutaneous ureteric stenting using image guidance is a safe method in treating obstructive ureteral pathology. Due to the development of nephrostomy services in many hospitals, antegrade stenting has become a common procedure in the radiology department.**

Objective: **This study sought to identify the indications, determine the technical success rate and identify the commonly encountered problems and their solutions during percutaneous antegrade double J ureteral stenting at our institution.**

Materials and Methods: **Data of 53 patients who underwent 55 antegrade stenting procedures was retrieved and retrospectively analyzed. Data on study variables and technique modifications to overcome the problems encountered during the procedure was collected.**

Results: **Among the malignant causes of ureteral obstruction, carcinoma of the cervix was the most common, accounting for 79.17% of the procedures. Other malignant causes included prostate cancer (9%), bladder cancer (6%), retroperitoneal carcinoma (2%), endometrial cancer (2%) and colon cancer (2%). Benign causes of ureteral strictures included post-surgical fibrosis (42.85%, idiopathic (42.5%) and urolithiasis (14.29%). There was high overall technical success rate of 90.91%. Common problems encountered during antegrade stenting included dilated and tortuous ureters, (47.42%), suboptimal calyceal access (20.62%), tight ureteral obstruction (18.56%) and difficulties in positioning the proximal pigtail loop of the ureteric stent (13.40%).**

Conclusion: **The most common indication for antegrade ureteral stenting was malignant obstruction. Antegrade stenting has a high technical success rate. The most commonly encountered problem was dilated and tortuous ureters.**

INTRODUCTION

The ureter is a paired fibromuscular tube which courses through the abdomen and pelvis to enter into the urinary bladder. Its long course and intimate relationship to the adjacent organs makes it prone to obstruction by both malignant and benign conditions thus interfering with urinary flow.

Malignant disease is by far the most common cause of ureteral obstruction. Treatment of this condition has a higher likelihood of failure when subjected to retrograde ureteral stenting [(1)].

Iatrogenic ureteral injuries may occur with gynecological surgery contributing to more than half of these injuries[(2)]. Often times, draining of the system to facilitate ureteral healing through stenting is recommended.

Urinary decompression in malignant ureteral obstruction is key to maintain renal function, provide symptomatic relief and reduce the length of hospital stay[(3,4)].

There are no proper guidelines documented to show the most suitable method of decompressing the urinary tract in the setting of ureteral obstruction[(5)]. Percutaneous nephrostomy is the method that is most frequently used to treat acute ureteral obstruction with the goal of preserving the renal function as well as draining of the infected urine[(6)]. However, this method is complicated by the risk of infection,[(7)] tube dislocation,[(8)] and patient discomfort which can be at times severe.

Ureteral stenting by use of double J stents is usually recommended where long-term relief is indicated. These catheters are normally inserted via retrograde approach by endourologist using cystoscopic guidance[(6)]. However, in patients with distorted anatomy of the urinary bladder wall and those with long segment malignant ureteral obstruction, this method can be challenging or even impossible[(9,10)]. The only option in such cases is percutaneous nephrostomy with antegrade stenting.

Retrograde stenting technique in patients of renal transplant and ileal conduit urinary diversion is also challenging given their altered anatomy[(6)].

In addition, retrograde stenting especially in men is often done under spinal or general anaesthesia with attendant complications. Besides, general anaesthesia may be contraindicated for very sick patients.

In the light of the above shortcomings of the retrograde technique, percutaneous antegrade double J ureteric stenting (PAUS) using ultrasound, fluoroscopy and local anaesthesia has been shown to be a viable and safe alternative.

This study aimed to identify the common indications, determine the technical success rate and identify challenges commonly encountered and their solutions during antegrade ureteric stenting at our institution.

MATERIALS AND METHODS

Patients

This research was conducted within the radiology department of Kenyatta National Hospital.

Data of 53 patients who underwent 55 antegrade stenting procedures between 1st June 2020 to 30th June 2022 was retrospectively analyzed. The study was approved by the ethical committee of Kenyatta National hospital (P696/08/2022 and NACOSTI/P/23/23515).

Technical success of the stenting procedure was defined by proper placement of the stent within the ureter through the point of

obstruction. Statistical analysis was done using IBM Statistics.

Technique for PAUS procedure

Informed consent was obtained from either the patient or relatives. All procedures were done in the radiology department using ultrasound and fluoroscopic guidance. Prior images were first reviewed to confirm the indication. Coagulations parameters were routinely checked with a cut off INR of >1.5 and platelet of <50000/mm^3. Prophylactic antibiotics were administered before the procedure. Single stage or double stage procedure was then done. 18 or 21-gauge needle was used to access the calyceal system guided by ultrasound. 0.018 for micropuncture or 0.035 guide wire was inserted into the pelvicalyceal system. After serial appropriate dilatation, a nephrostomy tube was first deployed into the renal pelvis for a few days in a two-stage technique and stenting done later. For stenting either in one stage or two stage technique, 0.035 hydrophilic wire and an angiographic catheter were used to pass the ureteral obstruction. Once the angiographic catheter was safely in the urinary bladder, the hydrophilic wire was exchanged for a standard 0.035 guide wire. Over this stiff wire, ureteral stent was then passed through the obstruction into the urinary bladder with the aid of a pusher. The wire was then withdrawn slightly to allow for the formation of the distal loop of the stent. Once this loop was successfully formed, the wire was then withdrawn further beyond the proximal loop to allow for the formation of the proximal stent loop within the renal pelvis. Adjustment of proximal loop was done using the safety string. The wire was completely withdrawn and finally the pusher was removed last to prevent backward retraction of the proximal loop.

RESULTS

A total of 53 patients were included in the study. There were more females 44 (83.01%) than males 9(16.98%), with male to female ratio of 1:4.8. The mean age was 51.17% with an age range of 17 to 93yrs.

Indications of antegrade ureteric stenting

A total of 55 procedures were done. The most common indication was malignant strictures accounting for 87% while benign strictures accounted for 13%.

Among the malignant causes of ureteral obstruction, carcinoma of the cervix was the most common accounting for 79.17% of the procedures (figures 1, 2). Other causes included prostate, bladder, retroperitoneal, endometrial and colon cancers.

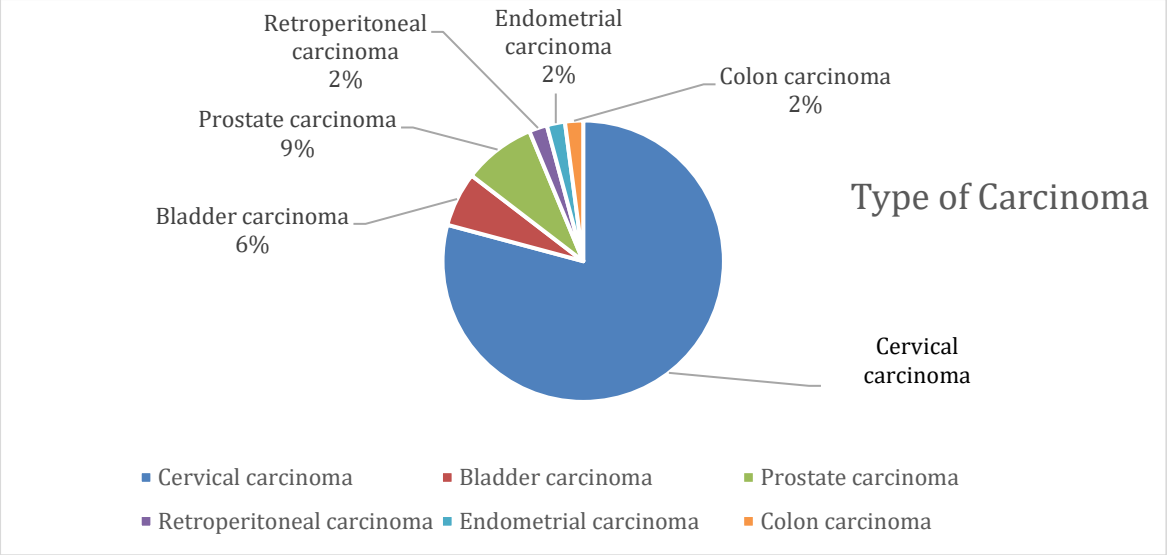

Figure 1: Pie chart showing causes of malignant ureteral obstructions. Cancer of the cervix was the leading cause (79.17%)

Benign causes of ureteral obstruction included urolithiasis (14.29%) and post-surgical fibrosis (42.85%). Idiopathic benign causes accounted for 42.85%.

Technical success rate

This study showed a high overall technical success rate for both benign and malignant ureteral strictures at 90.91%. Four procedures were performed after failure of retrograde stenting and the cause was cancer of cervix. The five procedures that failed showed distal ureteral obstruction. The majority of the procedures (98%) underwent two stage technique with prior placement of nephrostomy tubes. One case (2%) underwent one stage technique.

Commonly encountered problems

Dilated and tortuous ureters was the predominant problem encountered during antegrade ureteric stenting (table 1). Other problems included suboptimal calyceal access, tight obstruction and difficulties in positioning the proximal pigtail loop of the stent.

Table 1

Commonly encountered problems during antegrade stenting

Challenges	
Dilated tortuous ureters	n=46 (47.42%)
Suboptimal calyceal access	n=20 (20.62%)
Tight obstruction	n=18 (18.56%)
Difficulty positioning the proximal pigtail loop	n=13 (13.40%)
Total	N=97 (100.00%)

Dilated and tortuous ureters

This was caused by distal ureteric strictures resulting in various degrees of hydronephrosis. Type three (severe) hydronephrosis was the most common. Cases of severe hydronephrosis were more challenging to stent. Three shapes of the dilated ureters were observed. Normal ureter shape was seen in 43 cases, Z shape in 11 cases and pigtail shape in 2 cases (table 2, figure 3). It was more difficult to place a stent in those ureters that showed z and pigtail ureteric shapes (p value less 0.05).

Table 2

Shape of the dilated ureter

Shape of the dilated ureter N=55	n	Successful	Unsuccessful	P value
Normal	43	43 (100.00%)	0 (0.00%)	<0.001
z	11	7(63.64%)	4(36.36%)	
Pigtail/corkscrew	1	0 (0.00)	1(100.00)	

The challenge of dilated and tortuous ureters was mitigated by placing nephrostomy tubes for decompression and use of a hydrophilic guide wire with angiographic catheter to negotiate through the ureter.

Suboptimal calyceal access

Suboptimal calyceal access was observed in 20 (20.62%) procedures. This resulted in a poor angle of entry towards the proximal ureter with subsequent looping of the stent in the renal pelvis. This problem was overcome by use of a vascular sheath, super stiff guidewire and change of calyceal access to a midpole calyx where necessary (figure 4).

Tight obstruction

Tight obstruction was seen in 18(18.56%) cases. Hydrophilic guide wires and vascular catheters were used to cross these lesions. Super stiff guide wires were used to facilitate the passage of the stent through the tight strictures. In one case dilatation with a 4mm balloon was done to allow the stent to pass. Distal ureteral obstruction was the most common (figure 5).

Difficulties in positioning the proximal pigtail loop of the stent

Difficulties during positioning of the proximal pigtail loop occurred in 13(13.40%) procedures (table 1). This was seen as proximal pigtail loop flipping into mid or lower pole calycx and prolapse of the stent into the proximal ureter (figure 6). The pusher and the stent safety string mechanism was used to adjust the position of the proximal pig tail loop of the stent. Metallic marker on the distal end of the pusher facilitated ready identification of the proximal end of the stent and prevented engagement of the pusher catheter with the proximal end of the stent.

Images

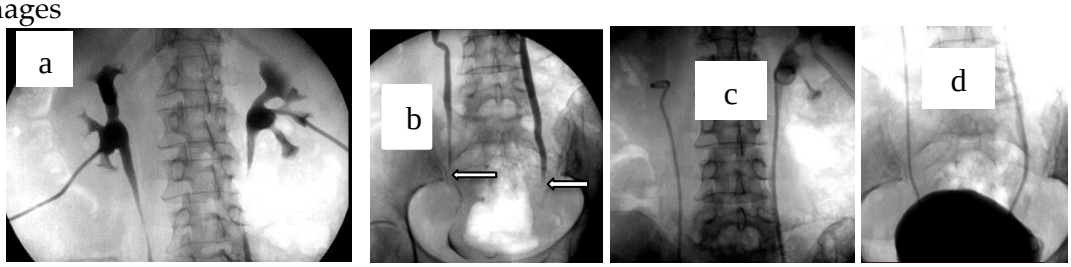

Figure 2 a-d: A 49-year-old female patient with carcinoma of the cervix, referred for bilateral antegrade ureteric stenting. Initial decompression nephrostomy tubes were placed(a). Nephrostograms show bilateral distal ureteric strictures (b, arrows). The strictures were successfully crossed and stents deployed (c, d).

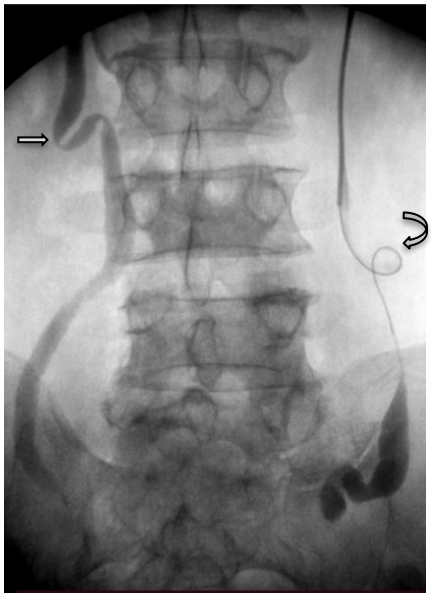

Figure 3: A 76year old male patient with prostate cancer. Antegrade stenting failed due to a large prostate tumor which obliterated the bladder lumen. Note the Z shaped ureteral tortuosity of the left ureter (straight arrow) and pigtail tortuosity of the right ureter with the guide wire forming a loop within the ureter (curved arrow).

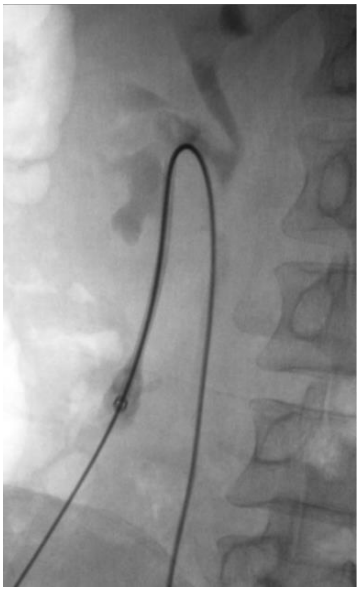

Figure 4: Suboptimal calyceal access in a 40-year-old female patient with cancer of the cervix. A vascular sheath and super stiff guide wire were used to help pass the stent down into the ureter.

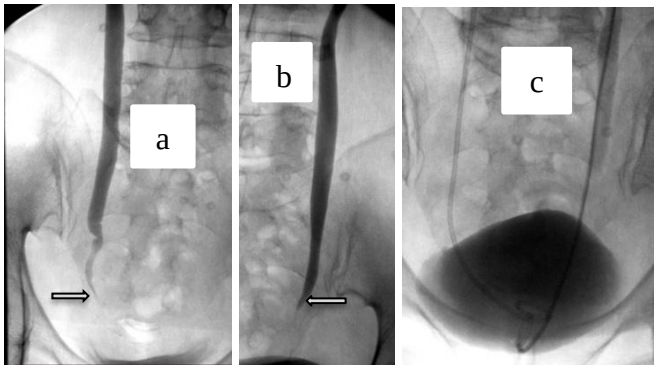

Figure 5 a-c: A 69-year-old female patient with carcinoma of the cervix. Bilateral distal ureteric strictures (straight arrows in a, b). Both strictures were crossed using an angiographic catheter and hydrophilic guide wire with successful stent placement bilaterally(c).

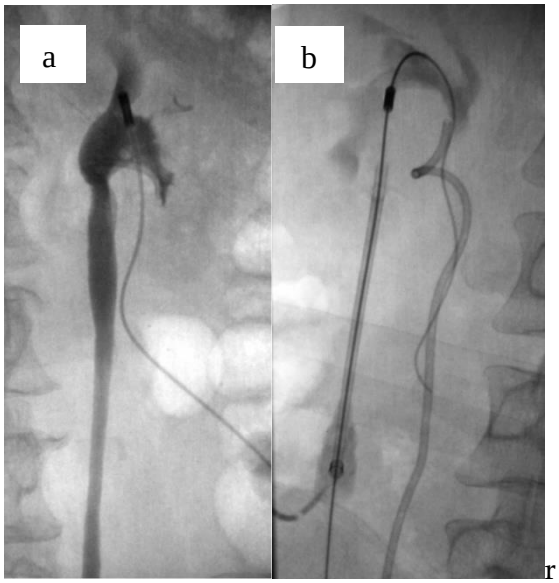

Figure 6 a, b: Difficulties in positioning the proximal pigtail loop of the double J stent. The proximal end of the stent is trapped in the lower pole calycx (a). The proximal end of the stent is seen in the upper ureter with resultant poor formation of the pigtail loop (b).

DISCUSSION

In this retrospective analysis we investigated the indications, technical success rate and identified the commonly encountered problems during antegrade double J stenting and their solutions. The study found percutaneous antegrade ureteral stenting technique to be highly effective and safe for both malignant and benign causes of ureteral obstruction. For malignant extrinsic obstructions, antegrade stenting was found to be superior to retrograde cystoscopic ureteral stenting.

Indications of Antegrade Ureteric Stenting

In this study, antegrade stenting was indicated for both malignant and benign ureteral strictures. Malignant cause was the most prevalent indication accounting for 87% of the cases while benign strictures accounted for 13%. Similar findings were reported by Nunes et al[3] in their retrospective analysis of 150 procedures done in 90 patients. This study showed carcinoma of the cervix to be

the leading cause of malignant ureteric stricture (79.17%). A study conducted by Macharia et al[11] showed cervical cancer as the most common cancer seen at Kenyatta National hospital . This reflects the high number of malignant ureteral strictures due to carcinoma of the cervix as observed in the current study. Other causes of malignant ureteric strictures in this current study included carcinoma of the prostate (9%), bladder cancer (6%) retroperitoneal cancer (2%), endometrial cancer (2%) and colon cancer (2%).

Nunes et al[3] also reported cervical carcinoma as the most prevalent cause of malignant ureteral obstruction accounting for 47% of the cases followed by prostate cancer at 32% and bladder carcinoma at 24%. Similar findings were also reported by Kahriman et al[1] in their retrospective review of 727 procedures. In their study, antegrade stenting was performed in 654 malignant strictures accounting for 90% of the cases and 73 non neoplastic strictures accounting for 10% of the cases. A study by van der Meer et al[6] also showed the most prevalent indication for double J ureteric stenting was malignant obstruction.

Technical Success Rate

Several studies have reported high technical success rate for antegrade double J stenting with low complications rates compared to retrograde ureteric stenting. Chitale et al[9] performed 60 antegrade procedures out of which 59(98%) procedures were successful. Uthappa et al[12] succeeded in 24 out of 25 antegrade procedures in malignant ureteral obstruction giving a high technical success rate of 96%. Kahriman et al[1] succeeded in 654 antegrade stenting procedures done for malignant strictures achieving a high success rate of 97% and an even higher technical success rate in benign strictures of 100%. Turgut et al[13] reported a 95% technical success rate for antegrade ureteric stenting.

The present study compares well to these findings with a high overall technical success rate of 90.01%. Among the malignant strictures, this study recorded a technical success rate of 91.67% which compares favorably with the findings in literature varying between 85 and 98%. The study recorded a technical success rate of 85.71% among benign strictures which is in concordance with the documented rate in literature.

The three procedures done due to post-surgical fibrosis all succeeded giving a technical success rate of 100%. This compares favorably with findings of studies done by Toporoff et al[14], Liatsikos et al[15] and Kahriman et al[1].

Four strictures which were initially treated with retrograde stenting and failed were successfully treated by antegrade stenting. All the four strictures were caused by carcinoma of the cervix and affected the distal ureters. Similar findings were reported by van der Meer[6] where 21 strictures which failed during retrograde stenting were successfully stented via antegrade approach. Uthappa et al[12] succeeded in 24 (96%) out 25 procedures that had failed prior retrograde stenting attempt. It therefore appears that antegrade ureteric stenting is superior to retrograde stenting in the setting of malignant distal ureteric strictures.

Commonly encountered problems

The problems encountered during antegrade stenting procedure in this study included suboptimal calyceal access, dilated and tortuous ureters, tight obstructions and difficulties in positioning the proximal pigtail loop of the stent. Similar findings are reported in literature by Lu et al[16] and Salazar et al[17].

In this retrospective series, the challenge of suboptimal calyceal access was observed in 20(20.62%) procedures. This was overcome by use of an angled angiographic catheter to negotiate through the pelvi-ureteric junction and use of super stiff guidewire combined with a vascular sheath to reduce the looping of the stent at the renal pelvis. These

measures were also found helpful by Lu et al[16] in their prospective study of 50 consecutive cases of antegrade ureteral stenting procedures. The same study recommended the use of upper or mid pole calyx to avoid this problem of poor angulation altogether. We also found it easier to stent through the mid pole calyx compared to the lower pole.

In the present study the challenge of grossly dilated and tortuous ureters was seen in 46 (47.42%) procedures. Two stage antegrade ureteral stenting technique was employed in 54(98.18%) out of 55 procedures where a nephrostomy tube was placed prior to stenting. We found this helpful in decompressing the ureters with sharp bends and kinks and thus easier negotiation of the glide wire and catheter down the ureter into the bladder. Similar recommendation was made for grossly dilated and tortuous ureters in the study by Lu et al[16]. Shreshta et al[18] suggested the technique of twisting and turning with retraction of the assembly to straighten grossly dilated and tortuous ureters.

In the present study, very tight obstructions were recorded in 18 (18.56%) procedures. To mitigate this challenge, use of a vascular sheath and a super stiff guide wire were found to be very helpful. In addition, the mid pole calyceal access was found to provide an easier angulation to pass the stent through the obstruction. Similar suggestions were made by Lu et al[16] with addition of per urethral snaring of the wire for very tight strictures and subsequent placement of the stent either via retrograde or antegrade route. Shreshta et al[18] also proposed per urethral snaring of the guide wire combined with the use of a flexometallic sheath to help place the stent through very tight obstructions. In one procedure in our study where the stent failed to pass through a tight stricture, dilatation using a 4mm balloon was done and stent was placed successfully. Pre-stenting balloon dilatation to improve technical success is also recorded in studies by Kahriman et al[1] and Santos et al[19].

Difficulty in positioning the proximal pigtail loop of the stent was seen in 13(13.40%) procedures in this study. Where the stent was deployed too deep, the safety string was used to pull the stent upward into the renal pelvis. Flipping of the proximal end of the stent into a calyx during removal of the safety string was prevented by use of a vascular sheath or the pusher. This challenge was eliminated by Lu et al[16] by routinely using 9F peel-away sheath. Lu et al[16] further observed that use of a peel-away sheath facilitated deployment of a safety nephrostomy tube at the end of the procedure where necessary.

Limitations of this study included the retrospective design and a small sample size.

CONCLUSION

The study showed that the most common indication for antegrade ureteral stenting at KNH was malignant obstruction largely from carcinoma of the cervix. Antegrade stenting has high technical success rate for both benign and malignant ureteral obstruction. Among the commonly encountered problems, grossly dilated and tortuous ureters with Z and pigtail ureteric shapes are more challenging to stent. Though challenges are encountered during antegrade ureteric stenting, they can be overcome by various technique modifications.

REFERENCES

1. Kahriman G, Özcan N, Doğan A, İmamoğlu H, Demirtaş A. Percutaneous antegrade ureteral stent placement: single center experience. Diagnostic and Interventional Radiology. 2019;25(2):127.

2. Dowling RA, Corriere Jr JN, Sandler CM. Iatrogenic ureteral injury. The Journal of urology. 1986;135(5):912–5.

3. Nunes TF, Tibana TK, Santos RFT, Carramanho J da C, Marchiori E. Percutaneous insertion of bilateral double J stent. Radiologia brasileira. 2019;52:104–5.

4. FENG MI, BELLMAN GC, SHAPIRO CE. Management of ureteral obstruction secondary to pelvic malignancies. Journal of endourology. 1999;13(7):521–4.
5. Hsu L, Li H, Pucheril D, Hansen M, Littleton R, Peabody J, et al. Use of percutaneous nephrostomy and ureteral stenting in management of ureteral obstruction. World journal of nephrology. 2016;5(2):172.
6. van der Meer RW, Weltings S, van Erkel AR, Roshani H, Elzevier HW, van Dijk LC, et al. Antegrade ureteral stenting is a good alternative for the retrograde approach. Current urology. 2017;10(2):87–91.
7. Bahu R, Chaftari AM, Hachem RY, Ahrar K, Shomali W, El Zakhem A, et al. Nephrostomy tube related pyelonephritis in patients with cancer: epidemiology, infection rate and risk factors. The Journal of urology. 2013;189(1):130–5.
8. Kaskarelis IS, Papadaki MG, Malliaraki NE, Robotis ED, Malagari KS, Piperopoulos PN. Complications of percutaneous nephrostomy, percutaneous insertion of ureteral endoprosthesis, and replacement procedures. Cardiovascular and interventional radiology. 2001;24:224–8.
9. Chitale SV, Scott-Barrett S, Ho ETS, Burgess NA. The management of ureteric obstruction secondary to malignant pelvic disease. Clinical radiology. 2002;57(12):1118–21.
10. Yossepowitch O, Lifshitz DA, Dekel Y, Gross M, Keidar DM, Neuman M, et al. Predicting the success of retrograde stenting for managing ureteral obstruction. The Journal of urology. 2001;166(5):1746–9.
11. Macharia LW, Mureithi MW, Anzala O. Cancer in Kenya: types and infection-attributable. Data from the adult population of two National referral hospitals (2008-2012). AAS Open Res. 2019 Nov 14;1:25.
12. Uthappa MC, Cowan NC. Retrograde or antegrade double-pigtail stent placement for malignant ureteric obstruction? Clinical radiology. 2005;60(5):608–12.
13. Turgut B, Bayraktar AM, Bakdık S, Hamarat MB, Öncü F, Gönen M, et al. Placement of double-J stent in patients with malignant ureteral obstruction: antegrade or retrograde approach? Clinical Radiology. 2019;74(12):976-e11.
14. Toporoff B, Sclafani S, Scalea T, Vieux E, Atweh N, Duncan A, et al. Percutaneous antegrade ureteral stenting as an adjunct for treatment of complicated ureteral injuries. Journal of Trauma and Acute Care Surgery. 1992;32(4):534–8.
15. Liatsikos EN, Karnabatidis D, Katsanos K, Kraniotis P, Kagadis GC, Constantinides C, et al. Ureteral injuries during gynecologic surgery: treatment with a minimally invasive approach. Journal of endourology. 2006;20(12):1062–7.
16. Lu DSK, Papanicolaou N, Girard M, Lee MJ, Yoder IC. Percutaneous internal ureteral stent placement: review of technical issues and solutions in 50 consecutive cases. Clinical radiology. 1994;49(4):256–61.
17. Salazar JE, Johnson JB, Scott RL. Perforation of renal pelvis by internal ureteral stents. American journal of roentgenology. 1984;143(4):816–8.
18. Shreshta MK, Narkhede A, Gupta A. Antegrade Double-J Stenting in Grossly Dilated and Tortuous Ureters. Journal of Clinical Interventional Radiology ISVIR. 2020;4(02):125–9.
19. Santos RFT, Tibana TK, Marchiori E, Nunes TF. Antegrade insertion of a double J catheter in the treatment of malignant ureteral obstruction: a retrospective analysis of the results obtained with a modified technique at a university hospital. Radiologia Brasileira. 2020;53:155–60.