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Percutaneous Dilatation of Non-malignant Ureteroenteric Anastomotic Strictures in Patients with Urinary Diversion After Cystectomy for Bladder Cancer: 7 Patients

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ABSTRACT

Background: The management of ureterointestinal stricture in patients who have undergone urinary diversion can be challenging. Endourological techniques have been increasingly used in recent years for such strictures.
Objectives: We report our experience and evaluate our results on balloon antegrade dilatations for benign ureteroenteric anastomotic strictures after total cystectomy and urinary diversion by ileal conduit.
Patients and Methods: Between December 1990 and May 2009, 8 balloon dilatations were performed on 7 patients with a mean age of 56.6 years (range: 50 to 72) to treat ureterointestinal strictures. Strictures were dilated percutaneously via the antegrade approach under fluoroscopic control. A ureteral multi-hole catheter was left for 6 to 8 weeks. Success was defined as radiological resolution of obstruction and the ability to recover normal activity in the absence of flank pain, infection, or the need for ureteral stents or nephrostomy tubes.
Results: The development of strictures occurred a mean of 4.5 months after urinary diversion. Eight renal units were treated (5 left, 3 right), including 1 bilateral procedure. There were 6 complete and 2 partial strictures. The operative time did not exceed 45 minutes. No major complications were encountered during or after these procedures. The overall success rate was 43%. Three patients required open reimplantation. Six of 7 patients showed satisfactory outcomes and 1 patient was lost to follow-up.
Conclusions: Percutaneous balloon dilatation of benign ureteroenteric anastomotic strictures, after radical cystectomy and urinal diversion by ileal conduit, is a minimally invasive and effective treatment option providing durable results. Based on these results, we believe that the procedure should be considered as a first-line treatment, as surgical reimplantation is reserved for failure. The selection of patients with the most favorable prognostic factors leads to excellent results.

INTRODUCTION

The incidence of secondary ureterointestinal anastomosis stricture (UAS) after urinary diversion ranges from 1 to 14% [1-3]. The highest rate of this stenosis was reported with ureterosigmoidostomy (22%) [4]. These strictures are predisposed to numerous complications, including recurrent urinary infection, sepsis, stone formation, and renal failure that is often clinically silent [5,6]. The management of these UAS presents a particular challenge for urologists.

The reference standard and most effective treatment of these strictures is open surgical repair (open ureteral reimplantation), with a success rate greater than 80% [7,8]. However, it is an invasive, difficult procedure with considerable morbidity and prolonged hospitalization [7-10]. In recent decades, endoscopic methods have been established as alternative treatments.

Advances in endourological techniques and instrumentation as well as in interventional radiology have led to a minimally

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invasive approach to UAS, resulting in decreased morbidity, operative time, hospitalization, and cost compared with open reconstruction [5,11]. The long-term success rate after conservative treatment varies markedly, ranging from 30 to 100% with different modalities [10,12-16]. In this paper we evaluate our experience with balloon dilatations by interventional radiology access of 8 benign UAS in 7 patients, with total cystectomy and urinary diversion by ileal conduit.

PATIENTS AND METHODS

This retrospective study was conducted at the Department of Urology and the Department of Radiology at La Rabta Hospital-University, Tunis, Tunisia between December 1990 and May 2009. We reviewed the clinical and radiological records of all patients who underwent percutaneous antegrade balloon dilatation of UAS. All patients had undergone total cystectomy and urinary diversion by ileal conduit for muscle-invasive bladder transitional cell carcinoma. The ureter was diverted to an isolated segment of terminal ileum. Patients with strictures due to progressive neoplasia and those who underwent pelvic or abdominal radiotherapy were excluded.

The preprocedural evaluation of patients was initiated with a clinical examination, an abdominal ultrasonography, and laboratory analyses (urea, creatinine, electrolytes, and urine cultures). The evaluation of coagulation parameters was also performed. Coagulation tests included prothrombin time, International Normalized Ratio, activated partial thromboplastin time, and platelet count. Abnormal results were corrected when necessary with platelet or fresh frozen plasma transfusion or an IV of vitamin K. We performed a computed tomography (CT) scan and often "Bricker-oscopy" in order to rule out malignancy of the ureteroileal anastomosis.

A percutaneous nephrostomy was performed in all patients under local anesthesia and sonographic/CT scan guidance to relieve severe obstruction, evaluate obstructed kidney function, and allow subsequent endourological procedures. The preoperative assessment was comprised of antegrade opacification via the nephrostomy tube, and helical CT to assess the length and severity of the stricture and to assess the spatial relationship of the stricture to adjacent organs and vascular structures. Once the diagnosis of UAS was confirmed, the nephrostomy tract was maintained. The treatment of ureteroenteric anastomotic strictures consists of dilatation with placement of a temporary catheter through the UAS.

TECHNICAL ASPECTS OF INTERVENTIONAL PROCEDURES

All operations were performed on patients with sterile urine. They received antibiotic prophylaxis—usually a third generation cephalosporin with gentamycin—1 hour prior to the procedure and for 48 hours after the procedure. Under sedation with intravenous analgesics and minor tranquilizers, the patient was placed in an oblique supine position to expose percutaneous nephrostomy. The technique included the following steps, which were all fluoroscopically monitored in ambulance conditions:

- After removing some urine, contrast media was injected in order to perform antegrade urography and localize the stricture.
- A hydrophilic guide wire was then introduced as a guide wire, passed through the stenosis, and it was looped in the ileal conduit (Figure 1).
- A multipurpose catheter was advanced over the guide wire up to the stoma of the ileal conduit and was extended outside.
- The hydrophilic guide wire was then replaced with a stiff guide wire, which was extended from the site of

Figure 1. Guide wire extended from the site of the kidney incision outside of the ileal stoma.

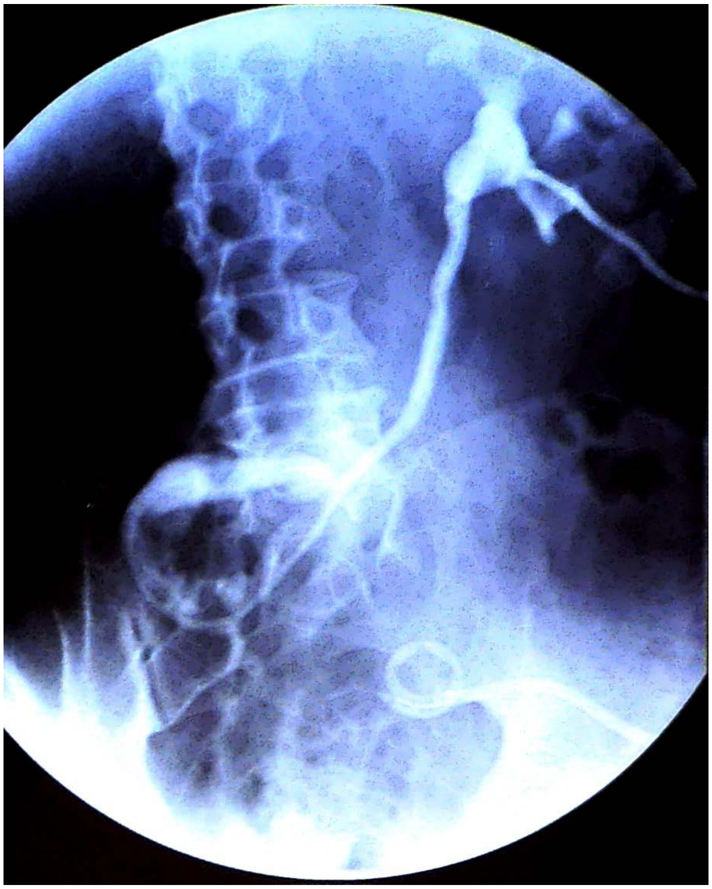


Figure 2. Post-percutaneous dilatation nephrotomography.

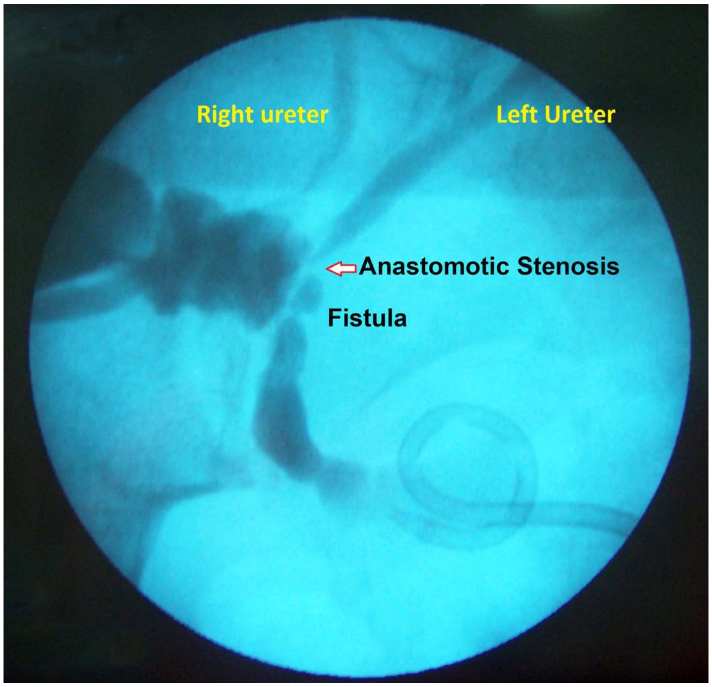
Figure 3. Placement of a double-J catheter in antegrade fashion, through the UAS.

nephrostomy to the ileal stoma. Afterwards, the balloon catheter was advanced over the guide wire in a retrograde fashion—through the stoma of the ileal conduit—up to the site of the stenosis.

- After adequate positioning, the distending balloon was inflated with diluted contrast solution, pending complete expansion, using a manometer syringe. A plane contour distended balloon, less than 10 to 20 atm, was deposed in situ for 3 to 5 minutes.
- If the stricture had remained as a notch on the inflated balloon, dilatation would be repeated several times until the notch had disappeared.
- We applied the contrast through the catheter immediately after recanalization to inspect the anastomoses' permeability (nephrotomography) (Figure 2).
- The balloon was then removed and a 20 Fr or 22 Fr multihole double-J catheter is inserted in a retrograde fashion through the stricture and left in the ureter as a stent (Figure 3).
- The double-J catheter was maintained in place for a 6- to 8-week period.
- Nephrostomy tubes were left in the kidney 7 days after the procedure for eventual repeated recanalization.
- If a smooth urine flow had been confirmed, the nephrostomy catheter would be clamped and removed if the patient passed a further 48 hours without fever or pain.

Total operative time was less than 45 minutes in all cases and patients were generally discharged on the third to fourth day. Six to eight weeks after this procedure, the stent is removed. In the following course, patients were controlled monthly in the first 3 months and twice yearly thereafter. The examination included a standard history and physical examination, kidney ultrasonography (US) or IVU and/or computed tomography, and biochemistry parameters for serum urea and creatinine. The treatment was considered successful if there was no further evidence of obstruction on radiological studies; kidney function parameters remained in/returned to normal levels; and the ability to return to full activity in the absence of flank pain, infection, or the need for ureteral stents or nephrostomy tubes. Possible prognostic factors predicting outcomes were evaluated using the chi-square test for categorical variables and the

Figure 4. Percutaneous opacification: Left UAS with anastomotic fistula (arrow).



Student *t* test for continuous data. A $P \leq 0.05$ was considered statistically significant.

RESULTS

During the period of study, 155 ileal conduit (Bricker) urinary diversions were performed in our department; thus, the incidence of this complication is 4.5%. All of these patients were men, ranging in age from 50 to 72, with a median age of 56.6 years. The mean interval between surgery and the treatment of stenosis was 4.5 months (range: 3 to 10 months). The circumstances of discovery varied. The most frequent presenting complaint was low back pain (N = 2), followed by urinary tract infections (N = 1). Renal failure was detected in 2 patients (1 patient had a solitary functioning kidney and the other had bilateral anastomotic strictures). Three patients had no complaints and were diagnosed at routine radiographic follow-up. In all patients, some degree of hydronephrosis was present. There were 6 complete and 2 partial strictures. Patient characteristics and their outcome are summarized in Table I. Strictures involved the left ureter in 4 cases, the right ureter in 2 cases, and both in 1 case. One patient presented an anastomotic fistula (Figure 4). Mean stricture length was 1.2 cm (range: 0.5 to 2).

Table 1. Patients with ureteroileal (UI) strictures.

Sex/Age	Side	Time to Onset	Length (cm)	Results	Follow-up (mo)	Treatment	Outcome/End of Study
M/56	left	3	2	failure	11	ORA	died with normal kidney function parameters
M/75	right	9	0.5	success	17	PAD	asymptomatic with poorly functioning renal unit
M/78	right	4	1	success	6	PAD	died with normal kidney function parameters
M/62	left	7	0.5	failure	-	ORA	-
M/76	left	3	2	failure	5	NFI	died with multiple metastasis and renal failure
M/61	left	4	0.7	success	20	PAD	still alive
M/50	bilat	10	1-2	failure	23	ORA	still alive, with bone metastasis

ORA: Open revision of anastomosis (repeat Briker)
NFI: No further interventions
PAD: Percutaneous antegrade dilatation

Under direct fluoroscopic control, the guide wire could be passed through the stricture in only 3 patients. Three balloon dilatations of ureteroenteric strictures, with the placement of a temporary catheter, were performed in 3 out of 7 patients. Improvement in the drainage of contrast medium through the ureteroileal anastomosis was recognized after performing balloon dilatation. In these 3 patients, we had success in recanalization of UAS. Primary success rates of the procedure were only 43%. All failures involved left-sided ureterointestinal strictures.

Perioperatively, minimal extravasation was documented in 1 case. However, no urinoma was diagnosed postoperatively by sonographic control. No significant complications from the ureteral balloon dilatations and/or anterograde insertion of a nephrostomy catheter were observed intraoperatively or postoperatively. No specific medication was administered except antibiotics when necessary. The average postoperative hospital stay was 3.7 days with no major complications. In one case, a ureteroenteric fistula healed with external drainage and prolonged stenting. After the removal of the ureteral stent, additional dilatation was not necessary in any patient.

Failure was managed by open surgical revision in 3 cases and abstention because of poor general health conditions in 1 patient. Follow-up data after stent removal were available for all stenoses but 1 [5-23]. No stenoses recurred. For 1 patient (1 stricture) there was lack of follow-up information after the last control and removal of the catheter. Kidney function parameters remained postoperatively within normal limits. Excretory urography (IVP) showed prompt functioning. Furosemide renography showed no evidence of obstruction. The patient, who underwent a bilateral endoureterotomy procedure, had a non-obstructed right kidney but a poorly functioning, obstructed left kidney at the last follow-up visit. However, he was asymptomatic, and he elected not to pursue further treatment. Two patients died of unrelated causes, including myocardial infarction and pneumonia at 6 and 11 months, respectively, after successful management. One patient died of metastatic disease. Only 2 patients are still alive. Patient age and gender, side and length of the stricture, and interval between urinary diversion and UAS were not analyzed as possible prognostic factors because of the little number of patients.

DISCUSSION

UAS are the most frequent causes of gradual deterioration of renal function after urinary diversion [5,6] due to complete obstruction of the interior lumen and consecutive progressive hydronephrosis [17]. The apposition of 2 different types of mucosa (intestinal and ureteral) and technical defects that cause ureteral ischemia are considered the 2 main causes of such strictures [5]. Moreover, the tissue incompatibility causes transitory epithelial metaplasia, which implicates ureteral cicatrization [17]. Other predisposing factors have been identified, such as urinary extravasation and infections [5]. Important factors for avoiding UAS include meticulous surgical technique involving mobilization of the sigmoid mesentery cephalad to the origin of the inferior mesenteric artery to avoid obstruction of the left ureter, and preservation of the ureteral adventitia to optimize blood supply and the use of soft stents postoperatively [18,19].

In most cases, strictures developed within 1 to 3 years of the urinary diversion [20]. In our series, the strictures developed early (mean: 4.5 months) after ileal conduit urinary diversion. Symptomatic ureteral dilatation requires prompt investigation [21]. Occasionally, patients remain asymptomatic, and long-term imaging demonstrates auto-nephrectomy. Therefore, careful postoperative follow-up is essential, particularly in ureteral units that demonstrate some degree of dilatation on the immediate postoperative IVP [21]. These strictures may be associated with tumor recurrence [5]; thus, repeat evaluation with CT, urinary cytology, and possibly endoscopic visualization would help to identify any recurrent malignancy [11].

The major goal of treatment of a UAS is to restore adequate urine drainage from the kidney without using indwelling devices such as ureteral stents or nephrostomy catheters [20]. Open revision of the anastomosis remains the standard in treating UAS [22-24] with a reported success rate of 89% [7]. However, open surgical revision can be difficult to perform, with significant intraoperative and postoperative morbidity, due to dense adhesions caused by previous surgery or fibrosis arising from radiotherapy [22].

Recent advances in cutting devices and stent material have given the urologist less-invasive therapeutic options that have shown positive success with stricture management. Particularly, interventional radiology methods in the treatment of UAS offered minimal invasive approaches in ambulance conditions with the possibility of repeated procedures and radicalization [17]. Currently, conservative techniques are preferred as initial therapeutic options because of decreased associated morbidity, operative time, hospitalization, and cost [12]. First-line endoscopic treatment is often indicated, particularly in obese patients with a poor general state and patients who have already had several surgical procedures [25]. Subsequent open revision does not seem to be compromised by initial endourological procedures [11]. These results demonstrate that there are measurable differences between hydrophilic guide wires based on guide wire characteristics and operator preference

Various endourological techniques have been described for AUS, including implantation of a double-J catheter or self-expandable metallic stent, cold knife or electrosurgical endoureterotomy,

Table 2. The results of endourological management of ureterointestinal strictures.

References	Population	Treatment	Success (%)	Follow-up (mo)
Touiti [5]	6 strictures	Acucise	50	16
Kramolowsky [7]	7 strictures 9 strictures	endoscopic incision open revision	71 89	14
Bierkens [9]	15 strictures	cold-knife incision	53	32
Meretyk [10]	14 strictures 21 strictures	electrocautery electrocautery cold knife balloon dilatation	57 39 68 26	28.6 36 12 36
Watterson [11]	24 strictures	Holmium:YAG laser	70.8	22.5
Cornud [12]	33 strictures	electroincision	71	> 12
Lin [14]	10 strictures	Acucise endoureterotomy	30	24
Shapiro [16]	37 strictures	balloon dilatation	16	12-72
Preminger [28]	6 strictures	Acucise endoureterotomy	50	7.8
Poulakis [29]	43 strictures	cold-knife incision	60.5	> 36
Wolf [30]	30 strictures	various methods	50	23
Lovaco [31]	25 strictures	intraluminal invagination incision	80	51
Laven [32]	19 strictures	Holmium:YAG laser	57	20.5
Lovaco Castellano [33]	5 strictures	endoscopic incision	100	16.6

balloon catheter dilatation, Acucise endoureterotomy (cutting the balloon), Holmium:YAG laser endoureterotomy, and endoureterotomy with direct endoscopic vision [11,26]. The procedure adopted by our team was a combination of balloon dilatation of the stricture and anastomosis stenting in order to improve the effectiveness of dilatation for ureteral strictures [7, 9,10,12,27]. We believe that balloon dilatation could be the first line of treatment for UAS, except for some patients with a long stenosis or a previous history of intrapelvic radiation.

The success rate at various follow-up intervals is 33 to 80% for the treatment of UAS using conservative modalities [5,7,9-12,14,16,28-33] (Table 2). The results depend on the used tool. The type of hydrophilic wire is a very important factor to consider [34]. The Glidewire and ZIPwire were more likely to have technical and procedural success compared to HiWire ($P < 0.05$) [34].

The success rate of high-pressure balloon dilatation followed by double-J stenting ranged from 30 to 60% [35-37]. It was only 43% in our series. Laser endoureterotomy appears to give better results (75%) than cold knife, electrode, or Acucise endoureterotomy (40 to 60%) [2]. However, there were not significant differences in cutting performance, and there were minimal complications [10,29,30,38].

These endourological approaches to UAS provided satisfactory, long-term results; however, the patency seemed to decrease with follow-up [11,12]. The long-term overall success rates of percutaneous dilatations of ureteral strictures with a balloon catheter vary markedly in the literature, ranging from 5 to 67% [16,39,40]. The success rates of endoureterotomy are 73, 51, and 32% at 1, 2, and 3 years, respectively [12,30].

We stented for 6 to 8 weeks, allowing sufficient time for ureteral regeneration to occur, which is a widely accepted practice in published studies [15,38]. Ravery et al. [41] postulated that the increased duration of ureter stenting may have promoted healing of the ureter, and attributed the high success rate to the very long duration of stenting (4 to 30 months). In contrast, Wolf et al. [30] proved that statistically the stenting duration ($\leq$ 4 weeks versus > 4 weeks) did not influence the short- and long-term success.

Reasons for variation in the results afforded by the different methods are the diversity of the etiologies, the lack of standardized protocols, the small number of cases involved, short follow-up, and the various definitions of success in each series. Moreover, no large-scale, prospective, randomized trials with controlled variables of endourological methods have been published [5,31].

The main advantages of these methods are their simplicity, safety, the short operating time with extremely low morbidity, decreased blood loss, diminished patient discomfort, and the decreased length of hospital stay [5,7]. They are especially indicated in obese patients, patients with a poor general state, or patients who have already undergone several surgical operations [5]. The main advantage of electrocautery incision is that the incision width and length can be fully controlled, and, if bleeding occurs, coagulation can be performed immediately [11,31,32]. The main limitation of the Holmium:YAG laser and Acucise are their overall cost [5,11]. With balloon dilatation, the procedure took place on an outpatient basis, so cost was low and hospitalization time is not more that a few hours.

Although endoureterotomy has been reported to be more successful than balloon dilatation in managing ureterointestinal strictures, no particular type of incisional procedure has yet proved itself superior to others [32]. Moreover, no consensus has been reached concerning postoperative time to continue stent diversion, stent size, or whether an antegrade or a retrograde approach should be used. Although shorter strictures respond more favorably to endoureterotomy, no definitive cutoff for stricture length has been reached. Numerous studies have suggested that endoureterotomy is most successful in strictures less than 2 cm and of non-ischemic origin [13, 42]. However, regardless of the type of endoscopic procedure, there is always a risk of injury to the vital surrounding structures, such as the nearby blood vessels or intestine [10]. Wolf et al. [30] described 6 major complications (including a lacerated common iliac artery requiring open repair) in a series of endoureterotomies using electrocautery and Acucise modalities for the incisions. Preminger et al. [28] described major vascular injuries to the common iliac artery in 2 patients, with potentially fatal consequences [12]. In our study, we didn't have any periprocedural or late complications, including bleeding, extensive urinoma, or urosepsis.

To prevent such complications, careful preoperative, anatomic evaluations are required to avoid injuring the surrounding structures. CT scans (3-D CT) are essential to assess the anatomical relations of the stricture with adjacent organs (gastrointestinal tract or vessels) [5]. Direct endoscopic observation of the ureter may be of value in preventing arterial injuries because it enables operators to inspect arterial pulsations, as reported by Meretyk et al. [10].

Risk factors for the failure of conservative management are complete UAS longer than 2 cm; a premature appearance of the anastomotic stricture, as in our series (due to a severe surgical/technical mistake with extensive ischemic damage of the ureteroenteric area); kidney function (less than 25% of total renal function) [14,30]; hydronephrosis grade; the presence of urinary infection at presentation; a history of radiotherapy; and the total number of endoscopic strictures involving the distal ureter [5,29,31]. Moreover, a trend toward a lower success rate was noted in procedures involving left-sided anastomotic strictures. It was reported that the additional mobilization of the left ureter as it is brought through the sigmoid mesentery compromises its vascular supply and may render it more resistant to endoureterotomy [8,43]. Ischemic strictures have been shown to have a lower success rate with all endourologic interventions [13]. Thus, ureteral strictures with a compromised vascular supply should be managed by endoureterotomy rather than balloon dilatation [44]. The selection of patients with the most favorable prognostic factors is crucial to obtain excellent results.

In all cases, long-term follow-up is crucial to detect early recurrence and to re-treat or re-stent the structured area to maintain renal function.

Some investigators recommended a second endourologic treatment with balloon dilatation, with comparable long-term results compared to those in the first treatment [39]. A combination of different methods (balloon dilatation and incision) has been suggested [40] as a possible alternative method [9,10,30]. The balloon dilatation is ineffective in patients with a long stenosis of the ureter or a previous history of radiation therapy for uterine cancer [20].

It is important to recognize that the number of strictures in this series was not large enough to allow conclusive statements regarding which factors predict which outcomes.

CONCLUSIONS

We reported our experience for non-malignant UAS after radical cystectomy. Based on our results, we believe that percutaneous antegrade balloon dilatation is a simple, effective, minimally invasive with extremely low morbidity treatment option in patients with UAS after urinary diversion. The success rate obtained is high and it persists after long-term follow-up. It should be proposed as a first-line treatment for strictures with a good prognosis before open surgical correction.

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