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Long-term Outcomes of Minimally Invasive Rendezvous Procedures to Treat Complex Ureteric Strictures and Injuries

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Abstract

Background: Complex ureteric strictures and injuries occurring during major abdominal and pelvic operations may cause significant morbidity and distress to patients. A rendezvous procedure is an endoscopic technique used in case of such injuries.
Objective: To evaluate perioperative and long-term outcomes of rendezvous procedures to treat complex ureteric strictures and injuries.
Design, setting, and participants: We retrospectively reviewed patients undergoing a rendezvous procedure for ureteric discontinuity including strictures and injuries, treated between 2003 and 2017 at our Institution and completing at least 12 mo of follow-up. We divided patients into two groups: early postsurgical obstruction, leakage, or detachment (group A) and late strictures (oncological/postsurgical; group B).
Outcome measurements and statistical analysis: If appropriate, we performed a retrograde study ± rigid ureteroscopy to assess the stricture 3 mo after the rendezvous procedure, followed by a MAG3 renogram at 6 wk, 6 mo, and 12 mo, and annually thereafter for 5 yr.
Results and limitations: Forty-three patients underwent a rendezvous procedure, 17 in group A (median age 50 yr, range 30–78) and 26 in group B (median age 60 yr, range: 28–83). Ureteric strictures and ureteric discontinuities were stented successfully in 15 out of 17 patients in group A (88.2%) and 22 out of 26 patients (84.6%) in group B. For both groups, the median follow-up was 6 yr. In group A, of 17 patients, 11 (64.7%) were stent free with no further interventions, two (11.7%) had a subsequent Memokath stent insertion (38%), and two (11.7%) required reconstruction. Of 26 patients in group B, eight (30.7%) required no further interventions and were stent free, ten (38.4%) were maintained with long-term stenting, and one was managed with a Memokath stent (3.8%). Of the 26 patients, only three (11.5%) required major reconstruction, while four patients with malignancy (15%) died during follow-up.

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Conclusions: With a combined antegrade and retrograde approach, the majority of complex ureteric strictures/injuries can be bridged and stented with an overall immediate technical success rate of above 80%, avoiding major surgery in unfavourable circumstances and allowing time for stabilisation and recovery of the patient. Additionally, in case of technical success, further interventions may be unnecessary in up to 64% of patients with acute injury and about 31% of patients with late stricture.

Patient summary: The majority of complex ureteric strictures and injuries can be resolved using a rendezvous approach, avoiding major surgery in unfavourable circumstances. Moreover, this approach can help avoid further interventions in 64% of such patients.

1. Introduction

Complex ureteric strictures and injuries (USIs) represent a challenging problem for surgeons and patients alike, frequently requiring another major open operation or long-term suboptimal management such as the utilisation of percutaneous nephrostomies. Major abdominal and pelvic operations may occasionally be associated with USIs, with the incidence ranging between 0.5% and 10% [1]. This condition can also be secondary to urological surgery with a higher incidence after endoscopic procedures (0.5–11%) [2]. Increased utilisation of laparoscopic/robotic approaches has been associated with an increased risk of iatrogenic injuries [3,4] in oldest series; more recent publications report a risk of about 0.3% [5]. USIs can cause significant morbidity and distress to patients, and therefore, early recognition is important to increase treatment success and prevent further complications [1]. If recognised intraoperatively, the injury should be managed immediately with an appropriate technique such as end-to-end ureteroureteric anastomosis/bowel interposition, ureteric reimplantation, creation of a Boari flap, reconstruction with bowel interposition, or stent placement [6]. However, the majority of injuries become obvious postoperatively only (>65%) [2]. The presenting symptoms are frequently nonspecific including flank pain, fever/sepsis, fistula, urinoma, prolonged ileus, or renal obstruction [1]. Another challenging situation is the management of ureteric strictures as the renal function may be silently affected adversely [7]. It can be a consequence of nonmalignant (tuberculosis, endometriosis, stones, or idiopathic disease) and malignant conditions [8]. Although traditional open/laparoscopic surgical repair of USIs is the gold standard, it may be associated with prolonged operating and recovery times, longer hospital stay, and a higher risk of perioperative morbidity in comparison with an endoscopic approach [6]. Furthermore, in cases of an unreconstructable urinary tract (eg, a malignant stricture), an endoscopic approach may allow internalisation of a ureteric stent and avoid an external nephrostomy tube. A rendezvous procedure (RP) is an endoscopic technique carried out in case of complex USIs that are nonpassable with only a retrograde or an antegrade approach. It requires the simultaneous antegrade and retrograde access to the urinary tract with involvement of both an experienced urologist and an experienced radiologist. It includes a variety of manoeuvres and the utilisation of a wide spectrum of reusable/disposable instruments with the final aim of successfully bridging and stenting difficult ureters. An individualised strategy and approach is required to manage each patient with varied aetiologies and medical conditions. A combined antegrade/retrograde approach was first described by Bagley et al [9] in the treatment of an obliterated ureteropelvic junction, and the concept of an RP was first introduced at our Institute in 2002 [10]. Since that initial case series, publications on this approach have remained scarce, with a limited number of cases and short follow-up. This procedure has been utilised in different scenarios confirming its versatility to treat USIs of different aetiologies, ranging from acute iatrogenic ureteric injuries to neoplastic strictures [11–14]. In this article, we review the results of an RP in a large series of patients with a minimum follow-up of 12 mo.

2. Patients and methods

We retrospectively reviewed patients who have undergone an RP for USIs, treated between 2003 and 2017, and completing at least a 12-mo follow-up. All patients have been treated at the Institute of Urology at University College London Hospital (UK) by experienced urological surgeons and interventional radiologists. An RP was offered and carried out in the event of a failed retrograde or a failed antegrade approach.

We divided patients into two groups on the basis of their aetiology and chronicity: patients with early postsurgical obstruction, leakage, or detachment were included in group A, whereas patients with chronic USIs of longer than 3 mo (oncological stricture, iatrogenic injury, or other causes) were included in group B. Outcomes were evaluated separately. To be included in group B, the iatrogenic injury had to occur at least 3 mo before the diagnosis of a USI.

If believed appropriate, multiple RP attempts were contemplated.

The RP was declared a failure in the event of failing to insert a ureteric stent by a combined antegrade and retrograde endoluminal approach.

Urine cultures were undertaken for all patients, and active infections were fully treated. Gentamicin 160 mg and co-amoxiclav 1.2 g were administered as antibiotic prophylaxis. Every case was individualised, and microbiological input was sought when prolonged courses of antibiotics were deemed necessary.

In early obstruction, laser incision (0.8 J and 5 Hz) was used to release a tied suture prior to stenting. Otherwise, it is not common to carry out laser incision during primary RP and stenting. Occasionally, laser incision is necessary when a short stricture is encountered at the secondary 3-mo retrograde ureteroscopy. It is not suitable to laser incise a long and ischaemic stricture.

An 8 Fr stent is used routinely and a percutaneous nephrostomy is always left in place. We prefer not to use a soft silicone stent as it may not resist the compression. A bladder catheter is left for at least 5 d. If an abdominal drainage is present, we remove it after 1–2 d from catheter removal, to identify eventual persisting urine leaks. A computed tomography (CT) urogram is carried out at 8 wk, and if there is no ureteric extravasation of contrast, the stent is removed at 3 mo during a retrograde ureteroscopy.

After a successful procedure of inserting a ureteric stent across a complex USI, we performed a retrograde ureteroscopy 3 mo postoperatively to assess the ureter and confirm patency. In case of successful stenting, we also evaluated whether patients were stent free permanently or whether they were dependent on some form of renal drainage (nephrostomy, ureteric stent, or urinary reconstruction). Patients with oncological diseases continued to be treated by oncologists.

Once a ureteric stent was removed, we performed a MAG3 renogram at 6 wk, 6 mo, and 12 mo to confirm patency of the ureter. A yearly follow-up with a MAG3 renogram was performed for at least the next 5 yr.

Statistical analyses were performed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA). Results for continuous variables are reported as means and ranges. Results for categorical variables are expressed as the numbers of patients (percentage).

To explain our technique, we present the case of a 69-yr-old lady who underwent open debulking surgery for a stage IV primary peritoneal carcinoma. During the postoperative period (day 7 postoperatively), a urine leak was noticed; therefore, the patient was further investigated with a CT urogram, confirming a significant urine leak with complete detachment of the left ureter. The patient was initially treated with a left nephrostomy insertion. Owing to the advanced cancer progression and the patient's general conditions, a more conservative approach was considered; thus, an RP was offered and carried out. This procedure was performed 13 d after the initial surgery; the patient was placed in lithotomy position with the shoulders slightly rotated towards the right to give access to the left kidney. This procedure required the presence of both fluoroscopy and ultrasound in the operating room; the instrumentation had to be positioned to allow both the surgeon to work retrogradely and the radiologist to work antegradely. In this case, the procedure started with the urologist working retrogradely and the interventional radiologist approaching the kidney anterogradely. An initial attempt of accessing retrogradely to the upper urinary tract failed, and after injection of contrast anterogradely, we observed a significant leak with 5 cm of ureter missing, about 7–8 cm above the vesicoureteric junction (Fig. 1). A semirigid 6/7.5 Fr (Wolf) ureteroscope was inserted from below to reach the level of detachment; simultaneously, a curved tip 6 Fr catheter was inserted antegradely, to allow antegrade insertion of a Sensor guidewire, which was then seen from below via the ureteroscope and grabbed with grasping forceps (Fig. 1). The Sensor guidewire was then exteriorised via the urethra and replaced with a Super Stiff guidewire (Boston Scientific). We believe that the utilisation of a stiffer wire is really important in these circumstances to align the ureteric stumps and ease the insertion of a ureteric stent. The ureter was then rescoped over a second guidewire from below up to the renal pelvis to ensure that there were no further strictures or injuries. An 8 Fr ureteric stent of a suitable length was inserted retrogradely under direct vision and fluoroscopic control. At the end of the case, a nephrostogram was performed, demonstrating both the nephrostomy and the ureteric stent to be in a good position without major urine leaks. Furthermore, the patient was left with an abdominal drainage and a Foley catheter. We did not observe complications in the postoperative period. Four months later, the patient underwent a second-stage relook ureteroscopy; the ureteric stent was removed and a ureteroscopy + antegrade/retrograde pyelogram was performed (Fig. 2). The ureter had healed with no residual urine leaks. At the level of the ureteric injury, it appeared slightly stenosed; however, it had a sufficiently wide calibre to allow placement of a Memokath ureteric catheter uneventfully (Fig. 3).

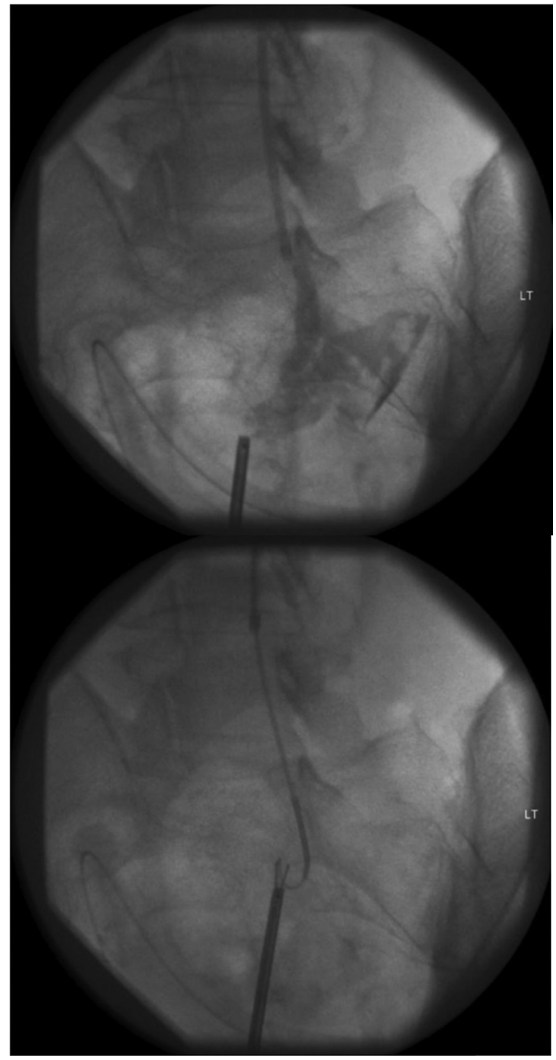

Fig. 1 – Rendezvous procedure step 1. The retrograde pyelogram shows a long defect; in a combined antegrade/retrograde way it has been possible to bridge the defect with a guidewire and place a double-J ureteric stent.

The patient died 2 yr later from malignancy with an asymptomatic Memokath stent in situ. In this case, the RP provided management of a complex complication entirely in an endoscopic way; it avoided acutely a second complex open operation in an otherwise rather unwell patient, minimising the risk of further complications and patient's distress. Furthermore, it offered better patient quality of life by avoiding having to keep an inconvenient nephrostomy or JJ stent that would have required regular changing.

3. Results

Overall, 43 patients were enrolled in the study, 17 (39.5%) in group A and 26 (60.5%) in group B. In Table 1, patients are categorised in subgroups, and aetiopathogenesis for USIs is presented. In Table 2, we reported portions of ureters

Fig. 2 – Ureteroscopy and antegrade pyelogram through nephrostomy performed at month 4 after a rendezvous procedure. The ureteric stent is in correct position, there are no contrast leaks, and the ureter looks healed with a lumen reduced in calibre at the level of the detachment.

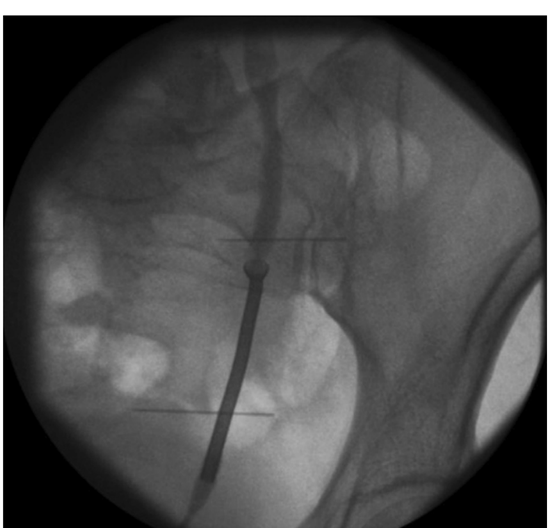

Fig. 3 – Removal of double-J stent and successful positioning of a Memokath ureteric stent.

Table 1 – Pre-RP diagnosis/reason to treat

Reason to treat	Group A, *n* (%)
Iatrogenic	
After hysterectomy	4 (15.4)
Stricture of ureteroileal anastomosis	4 (15.4)
Pelvic radiotherapy	1 (3.8)
After hemicolectomy	1 (3.8)
After pelvic lymph node dissection	1 (3.8)
After ureterolysis for endometriosis	1 (3.8)
After pyeloplasty	1 (3.8)
Malignant/other causes	
Ureteric stone	3 (11.5)
Unknown origin	3 (11.5)
Ovarian cancer	2 (7.7)
Endometrial cancer	2 (7.7)
Cervical cancer	2 (7.7)
Krukenberg tumour	1 (3.8)
	Group B
Iatrogenic	
Emergency hysterectomy	3 (17.6)
Emergency caesarean section	2 (11.8)
Ureterolysis for endometriosis	3 (17.6)
Surgery for ovarian cancer	2 (11.8)
Surgery for rectal cancer	4 (23.5)
Surgery for peritoneal carcinoma	1 (5.9)
Spinal surgery	1 (5.9)
Surgery for carcinoma of sacrum	1 (5.9)

RP = rendezvous procedure.

Table 2 – Site of ureteric stricture

Portion of involved ureter	Group A, *n* (%)
Pyeloureteric junction	1 (3.8)
Proximal ureter	4 (15.4)
Midureter	11 (42.3)
Distal ureter	6 (23.1)
Ureteroileal anastomosis	4 (15.4)
	Group B
Proximal ureter	4 (23.5)
Midureter	9 (53.0)
Distal ureter	4 (23.5)

involved by USIs for each subgroup. In Table 3, we have reported peri- and postoperative data; RP success rates were 88.3% in group A and 84.6% in group B.

Among failed cases, in group A, one case was secondary to spinal surgery, while the second had a bilateral ureteric detachment during surgery for advanced cancer of the sacrum. We also analysed the time from diagnosis to RP, and we observed that it was 23 d in the success group versus 47 d in the failure group. However, it did not reach statistical significance ($p = 0.138$).

In group B, among failed RP cases, two were secondary to cancer (cervical and Krukenberg tumour), one had a stricture of unknown cause, and one was secondary to gynaecological surgery (hysterectomy). All patients were managed with long-term nephrostomy tubes (Table 3).

We did not observe any major complication identified as Clavien-Dindo >3 in both groups. In our cohort of patients, we could not observe cases of postoperative sepsis in group A. In group B, four patients were septic postoperatively, although three of them presented with an infected state prior to RP treatment.

After successful RPs, 64.7% and 30.7% of patients in groups A and B, respectively, were permanently stent or nephrostomy free, while the others required some additional surgical treatment. Details on this regard are reported

Table 3 – Peri- and postoperative details

	Group A	Group B
Number of patients	17	26
Age (yr), mean (SD)	46 (9)	73 (13)
BMI, mean (SD)	23.3 (3.1)	22.7 (3.7)
Sex, *n* (%)		
Male	2 (12)	9 (35)
Female	15 (88)	17 (65)
Age, median (range)	50 (30–78)	60 (28–83)
Laterality, *n* (%)		
Left	6 (35)	12 (46)
Right	10 (59)	13 (50)
Bilateral	1 (6)	1 (4)
Number of attempts, *n* (%)		
1	17 (100)	21 (80.76)
2	0 (0)	4 (15.40)
3	0 (0)	1 (3.84)
Operative time (min), (range)	76 (35–150)	110 (50–205)
Outcome, *n* (%)		
Success	15 (88.3)	22 (84.6)
Failure	2 (11.7)	4 (15.4)
Long term outcomes, *n* (%)		
Technical RP success	15 (88.30)	22 (84.60)
Stent/nephrostomy free	11 (64.70)	8 (30.70)
Regular stent changing	0 (0)	10 (38.40)
Memokath	2 (11.70)	1 (3.80)
Ureteric reimplantation	2 (11.70)	3 (11.50)
Failed RP	2 (11.70)	4 (15.40)
Permanent nephrostomy	1 (5.88)	4 (15.40)
Major reconstruction	1 (5.88)	0 (0)

BMI = body mass index; RP = rendezvous procedure; SD = standard deviation.

in Table 3 and intended for patient's last available follow-up. The mean follow-up was 6 yr (standard deviation [SD] 4.5) in group A and 6 yr (SD 3.7) in group B.

4. Discussion

USIs represent uncommon but challenging complications for reconstructive surgeons [15]; if not treated on time, it can lead to serious short- and long-term complications varying from infections (sepsis, infected urinoma, and abscess formation), fistula formation, retroperitoneal fibrosis to loss of renal function, and worsening of hypertension [16]. These patients are recovering from a major operation, and are often distressed by their complication and not usually keen for an immediate major open operation to repair or reconstruct their damaged ureters. They may also be clinically unfit to go through a second major surgery. When offered, they would usually prefer a minimally invasive procedure to manage their ureteric injuries.

The RP has been shown to be versatile and can be utilised to treat USIs with different aetiologies. After initial anecdotal case reports to treat obliterated ureteropelvic junction stricture [9], stricture of the ureteroileal anastomosis [11], and iatrogenic ureteric injury after radiofrequency ablation for renal cancer [12], limited retrospective data have been published, reporting results of RP to treat a variety of different conditions. Yates et al [17] reported a small series of seven patients in whom an RP was performed for postsurgical ureteric strictures. Of these seven patients, the procedure was successful in five (71%) and they were rendered stent free with no need of additional surgeries. However, the mean follow-up was short (21 mo). Pastore et al [14] showed similar results in a group of 18 patients treated acutely with an RP for iatrogenic ureteric detachment. In all cases, the procedure was successful, with a mean follow-up of 26.5 mo; the authors observed a success rate of 88% (16 patients out of 18 had complete restoration of ureteric patency without additional surgeries and were free from a stent/nephrostomy). Furthermore, Keoghane et al [13] recently published a series with 18 RPs performed for a variety of different causes, ranging from iatrogenic acute injuries to malignant strictures. The authors reported success in 16 out of 18 (89%) cases, and eight out of 18 (45%) patients were stent free at 6 mo after initial treatment. In this series, the follow-up was variable from a minimum of 1 mo to 5 yr.

The incidence of iatrogenic injuries is relatively infrequent, with gynaecological surgeries being responsible for approximately 70–80% of cases, radical hysterectomy being the main cause, while in decreasing order, colorectal, vascular, and urological surgeries account for the remaining 20–30% [4,18,19].

Initial management usually involves drainage of the collecting system with an indwelling ureteric stent or percutaneous nephrostomy. There is a paucity of data evaluating long-term results and patients' quality of life after treatment for USIs for cases of open/laparoscopic reconstruction.

Wenske et al [20] reported results of 100 distal ureteric open repairs showing a success rate of 81%, with a median follow-up of 48.7 mo. Similar results have been reported in a study including 24 psoas hitch procedures, with a success rate of 91.6% and a mean follow-up of 53 mo [21].

Reports comparing open reconstruction versus laparoscopic/robotic are sparse. Both techniques seem to have similar success rates (92.4% vs 90.3%) [22]. However, complication rates seem to favour robotic approaches. In fact, Kozinn et al [23] analysed results of ten robotic cases versus 24 open procedures, showing reduced blood loss in the robotic group (327 vs 30 ml) and shorter hospital stay (5 vs 2 d). Similar results have been shown by Isac et al [22].

Open/laparoscopic strategies for USIs are deemed to be superior to RP in long-term results [24]. However, literature is limited by the retrospective nature of all studies, with small sample sizes, short follow-up, and no direct comparison of the two strategies. For this reason, it is rather difficult to come to any generalisable conclusion [25], and we believe that the choice of treatment should be individualised and tailored to the patient's needs. In case of young fit patients, a reconstructive approach may offer advantages over an RP approach, as it seems to offer a better long-term outcome. In older comorbid patients, an RP offers high chances of success and avoids problems related to a second major operation, which can frequently be technically very difficult outside high-volume centres.

Looking at our failed cases, our data seem to suggest that the time elapsed from the ureteric injury to an RP plays an important role. In fact, the mean time from injury to treatment was 23 d in the success group versus 47 d in the failure group. In our study, this difference was not statistically significant, but we believe that this could be related to the small sample size. The reasons for this are multifactorial, but we believe that the urinoma, especially if infected, has a role in inducing fibrosis of the periureteric tissues, with the results of rendering the ureter very "unfriendly" and any instrumentation very difficult. Furthermore, the ureteric stumps may become progressively more displaced, ischaemic, and friable with higher chances of a delayed stricture.

In cases of unreconstructable urinary tracts, this technique may also offer an alternative to external nephrostomy tube drainage, which frequently adversely affects patients' quality of life and requires regular changing. Both ureteric double-J or Memokath stents and percutaneous nephrostomies have pros and cons, but in patients with no irritative symptoms, an internalised stent will improve patient's quality of life, avoiding the utilisation of an external bag to collect urine.

In a study conducted by Monsky et al [26], the authors compared the quality of life and complications in patients with a malignant ureteric stricture undergoing either double-J stent insertion or percutaneous nephrostomy to treat hydronephrosis. They observed that the overall quality of life was reported to be similar in the two groups, but patients with nephrostomy had more minor complications, leading to additional unplanned tube changes (83% in the nephrostomy group vs 16% in the double-J stent group). We believe that this factor should also be taken into consideration when discussing treatment options with patients.

There are no published guidelines regarding the optimal follow-up period and modalities. The patients without stents have to be followed very carefully because of the risk of developing a secondary stricture that may lead to loss of kidney function. The follow-up scheme that we propose has two advantages: firstly, identification of early complications can lead to a prompt intervention and therefore a more favourable outcome. Secondly, frequent follow-ups can reassure patients who are distressed by their condition and the possible loss of renal function.

Additionally, our data suggest that an endoscopic approach is a feasible option in the majority of cases believed to be "very difficult", despite final RP technical success/failure. In fact, 76.47% of patients in group A and 73.07% in group B avoided major surgery and were released from percutaneous nephrostomies. This, we believe, underlines the important role of endoluminal surgery in the treatment of USIs.

In our opinion, this technique can be performed in almost all cases of early USIs with high chances of success, and in case of a failure, open/laparoscopic repair can still be performed. In case of late USIs, our data suggest that one out of three patients can be rendered free from a nephrostomy tube with consequent significant improvements for their quality of life.

In summary, advantages of an RP include the following:

1. It offers endoscopic management of complex USI cases (up to 88% of success rate), reducing major open/laparoscopic reconstruction, especially in the acute complicated phase following a major operation.
2. It offers an alternative to permanent nephrostomy in patients with unreconstructable ureters with significant improvement of patients' quality of life.
3. After successful stenting, up to 64% of patients do not need any further treatment and remain stent free permanently.

5. Conclusions

To our best knowledge, this is the largest series published on RPs and with the longest follow-up for all types of USIs to date. Furthermore, we present cases with a very-long-term follow-up (up to 14 yr). We emphasise the minimal invasiveness nature and versatility of this technique, which can be offered to all USI patients. In countries with centralised and subspecialised health care, it can be a valuable and individualised "first-line" minimally invasive option in order to prevent patients from being transferred to another centre for further treatment and avoid further major reconstruction, with good and acceptable results.

Author contributions: Giuseppe Celentano had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Mazzon, Smith, Choong.
Acquisition of data: Mazzon, Celentano.
Analysis and interpretation of data: Mazzon, Smith, S. Allen.
Drafting of the manuscript: Mazzon, Smith, Arumuham.
Critical revision of the manuscript for important intellectual content: C. Allen, Bolgeri.
Statistical analysis: Mazzon, Celentano.
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