CASE REPORTS

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Laparoscopic ureteroplasty using onlay appendix flap: a case series



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Abstract

Background Currently, strictures of the ureters often develop after endourology of the upper urinary tract, gynecological, and surgical interventions. For long proximal ureteral strictures, ureteroplasty with an on-lay appendix flap may be an option for treatment.

Case presentation Five patients had laparoscopic onlay appendicoureteroplastic for long right ureter strictures. The average age of the patients was 42.5 years old. Four patients developed a stricture after transurethral contact ureterolithotripsy; one patient had it after laparoscopic ureterolysis. The average stricture length was 3.5 (2.8–5.2) cm. The length of the stricture was controlled, including using near-infrared fluorescence imaging. With an average observation time of 14.6 (6.2–28.4) months, the operation was effective in all patients. The urodynamics of the upper urinary tract recovered completely in three patients and comparatively improved in two patients. All of the patients stopped feeling any pain. The observed patients were saved from external and internal drainage.

Conclusions Laparoscopic onlay ureteroplasty with an appendix in a selected group of patients may be the method of choice for long strictures of the middle and upper parts of the right ureter.

Keywords Ureteral stricture, Appendix flap, Laparoscopic ureteroplasty, Case report

1 Background

At the moment, strictures of the ureters often happen after endourology treatments for the upper urinary tract (UUT), gynecology, or surgery [1]. For long pelvic strictures, the Boari or Psoas-hitch operation is performed. Technical difficulties arise with long strictures of the proximal ureter when end-to-end anastomosis is not possible. In these cases, it is possible to perform an intestinal ureteroplasty, or the Yang–Monti principle can be applied. However, surgical and metabolic complications are observed after intestinal plastic surgery. In rare cases, in the presence of a long and wide appendix, it can be used to replace a long stricture of the ureter [2]. Over the past decade, onlay ureteroplastic surgery using grafts from the buccal mucosa or tongue has been actively introduced [3, 4]. Publications also appear in the literature on ureteroplasty using an onlay appendix flap. The first report of such an operation was from Reggio et al. [5]. Later, Duty et al. used this technique on six patients [6]. Wang et al. and Cheng et al. who published the results of one urological clinic, report on ureteroplasty using an onlay appendix flap in nine patients [7, 8]. We have successfully performed this operation on five patients.

2 Case presentation

In this study, we retrospectively collected and analyzed data from a cohort of five patients who underwent laparoscopic onlay appendicoureteroplastic (AUP) for a long stricture of the right ureter. The data collection took place between 2019 and 2022 at a single institution, following approval from the local ethical committee. The



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study conformed to the provisions of the Declaration of Helsinki (as revised in 2013). There were two men and three women. The average age of the patients was 42.5 (24–56) years old. Four patients developed a stricture after transurethral contact ureterolithotripsy; one patient had it after laparoscopic ureterolysis. Three patients were hospitalized with nephrostomy drainage, and two patients were hospitalized with a stent.

During the preoperative phase, all patients received a series of diagnostic procedures, including ultrasound evaluation of the kidneys, computed tomography of the abdomen, excretory urography, antegrade pyelography in the presence of a nephrostomy, and retrograde ureterography (Fig. 1). The average stricture length was 3.5 (2.8-5.2) cm. Information about patients is presented in Table 1. There was no preoperative renal failure in operated patients. Three of them were diagnosed with long strictures of the proximal ureter; two patients had them in the middle third. There was an unsuccessful retrograde endoureterotomy for three patients and laparoscopic resection of the ureter with ureteroureteroanastomosis for one patient. All patients reported ipsilateral flank pain, and one of them had a recurrent urinary tract infection. According to computed tomography, an expansion of the UUT was observed above the zone of narrowing. On dynamic scintigraphy, all patients had differential kidney function>30% and an increased half-life of the radiopharmaceutical > 10 min.

A successful postoperative result was thought to be free of any symptoms; the lack of hydronephrosis or grade 1; the lack of nephrostomy drainage or stent; the contrast



Fig. 1 A long stricture in the middle part of the right ureter

Table 1 Patients demographics

		n (%)
Total patient number		5 (100)
Gender	Female	3 (60)
	Male	2 (40)
Age (years), mean (min–max)		42.5 (24–56)
BMI (kg/m ²), mean (min–max)		28.5 (24.0–35.6)
Length (cm), mean (min–max)		3.5 (2.8–5.2)
Etiology	Ureterolithotripsy	4 (80)
	Ureterolysis	1 (20)
Stricture location	Upper	3 (60)
	Middle	2 (40)
Preoperative presence of drainage	Nephrostomy	3 (60)
	Stent	2 (40)

agent could easily flow into the bladder through the ureter and the surgical site.

2.1 Operation technique

All patients underwent laparoscopic onlay AUP for a long stricture of the right ureter. The operation was performed on the left side. Hasson's method placed the first of four trocars in the right iliac region. Two 6 mm trocars were placed along the subclavian line in the iliac and below the costal arch and one along the posterior axillary line after abdominal insufflation to 12 mmHg. Next, the ascending colon was mobilized and retracted medially. With the excision of scar tissues in the retroperitoneal space, the ureter was identified for the top or medium thirds. As much as possible, preserving unchanged tissues, a narrowed area was isolated, the length of which was determined in several ways. Preoperatively, antegrade and retrograde ureterography can be performed simultaneously for this. However, the true extent of the ureteral defect may be greater than indicated by the x-ray. The most effective is to use near-infrared fluorescence imaging to confirm the length of the narrowing. For this, indocyanine green was injected intravenously, and areas of normal and poor perfusion of the ureteral wall were identified (Figs. 2 and 3). Then, its lumen was dissected along the narrowed area, and the incision was continued for 1.0 cm above and below this zone. After that, the length of the stricture was determined again using a ureteral catheter wound up into the abdominal cavity (Fig. 4).

Next, the appendix was mobilized on the mesentery, cutting it off from the caecum. The narrow distal end of the appendix was then resected and detubularized along the antimesenteric border. The lateral edge of the dissected, narrowed portion of the ureter was fixed with



Fig. 2 a Intraoperative white light ureter imaging; b Intraoperative near infrared fluorescence ureter imaging: the presence of poor ureteral perfusion. The white asterisk indicates the proximal stricture



Fig. 4 a Intraoperative length of the stricture; b Intraoperative assessment of stricture length with the catheter



Fig. 3 a Intraoperative white light ureter imaging; b Intraoperative near infrared fluorescence ureter imaging: the presence of poor ureteral perfusion. The white asterisk indicates the distal stricture



Fig. 5 Stage of ureteroplasty using an onlay appendix flap. **a** Sutures between the lateral edges of the detubularized appendix (A) and ureter (U) were placed; **b** Schema for this stage of the surgery

a continuous suture to the corresponding wall of the appendix (Fig. 5). An antegrade ureteral stent was placed at 7 Ch, and the medial edges of the ureter and appendix

were closed with a continuous suture (Fig. 6). An antegrade injection of a sterile liquid tested the tightness of the sutures in the presence of nephrostomy drainage. Guliev et al. African Journal of Urology (2023) 29:56



Fig. 6 Stage of ureteroplasty using an onlay appendix flap. **a** Ureteral stent was placed, and sutures were placed between the medial edges of the appendix (A) and ureter (U); **b** Schema of this stage in the surgery

 Table 2
 Results of laparoscopic ureteroplasty using onlay appendix flap

Parameters	Results, mean (min-max)
Operation time (min)	225 (180–260)
Blood loss (ml)	160 (70–245)
Hospitalization time (days)	3.6 (3–7)
Intraoperative complications (n %)	0
Clavien-Dindo postoperative complications, (n %)	0
Observation (months)	14.6 (6.2–28.4)
Effectiveness (%)	100.0

Drainage was installed in the surgical area, trocars were removed, and wounds were sutured.

3 Results

Laparoscopic onlay AUP was successful in all patients. The average operation time was 225 (180–260) minutes, and the amount of blood loss was 160 (70–245). None of the patients required a blood transfusion. The average duration of the hospital stay was 3.6 (3–7) days. Perioperative results are shown in Table 2. During the thirty days after surgery, there were no intraoperative complications. With an average observation time of 14.6 (6.2–28.4) months, the operation was effective in all patients. The

urodynamics of the UUT recovered completely in three patients and comparatively improved in two patients. Pain disappeared from all of them. It was possible to completely save the observed patients from external and internal drainage. Dynamic scintigraphy indicated normalization of the half-life of the radiopharmaceutical.

4 Discussion

The appendix can be attributed to reserve grafts for replacing extended narrowings of various parts of the right ureter. It is usually used as a tubular insert between the proximal and distal ends of the ureter [2, 9]. In these cases, there is a risk of developing stenosis of the upper ureter-appendicoanastomosis. When replacing the lower third of the ureter, it is possible to form a wide anastomosis between the appendix and the bladder [2].

Somerville J.J. and Naude J.H.'s experimental work in 1983 was the first to demonstrate the possibility of onlay ureteroplasty with a buccal mucosa graft (BMG) [10]. Fifteen years later, Naude performed similar interventions in clinical practice on five patients [11]. Currently, the BMG is actively used in urethroplasty. This technique gradually began to be used in ureteroplasty with good long-term results [3, 4, 12-14]. But in a certain group of patients with extended narrowing of the upper and middle thirds of the right ureter, it is possible to perform onlay appendix plastic surgery [6-9, 15]. With this technique, the blood supply to the posterior wall of the ureter is preserved, and due to the appendix, it's lumen expands. Reggio et al. carried out the first AUP created using onlay methodology [5]. Subsequently, they published the results of these operations on six patients [6]. Wang et al. did a minimally invasive onlay ureteroplasty with appendix on nine patients with strictures of the ureter after endoscopic treatments for stones [7]. Four of the patients had robotic surgery, and the other five had laparoscopic surgery. In seven patients, the narrowing was localized in the proximal area; in two patients, in the middle third of the ureter, the average length was 3.9 cm. The average operation time was 182 (from 135 to 220) minutes, and there were no postoperative complications of grade≥III, according to Clavien-Dindo. The objective success rate was 100%; all patients had endoscopic and radiological resolution of ureteral strictures. During the observation period, the effectiveness of the operation was 88.9%, and one patient developed a recurrence of ureteral obstruction with impaired urodynamics of the UUT and intermittent low back pain. Jun MS et al. performed the replacement of the right ureter with an appendix in 13 patients [9]. Onlay methodology was used in eight patients (62%) and tubular plastic was used

in five patients (32%). One of the patients in the postoperative period died of acute myocardial infarction. Over the observation period of 14.6 months, the effectiveness of the operation was 92%.

Existing world experience with BMG ureteroplasty suggests that BMG is well suited for benign proximal ureter strictures [12–14]. The advantages of onlay AUP compared to BMG can be attributed to a better blood supply due to the preservation of the mesoappendix. However, onlay AUP is possible only in the right ureter and, in exceptional cases, due to the length of the mesoappendix, in the pelvic section of the left ureter [2, 15]. While the BMG can be used on both sides.

Ureteral reimplantation combined with a Boari flap or Psoas hitch is preferred for lower-third strictures. If there is a strong adhesion process or a drop in the size of the bladder or bladder tissue that is not enough to fix the ureter defect, other ureter reconstruction methods, such as AUP, should be used.

Ureteroplasty with the appendix, as opposed to using the ileum, has some advantages. Firstly, there is no need for small bowel resection and anastomosis, after which surgical complications are possible. Secondly, a small area of the appendix mucosa minimizes the risk of developing metabolic acidosis by eliminating urine stasis and absorption. Thirdly, matching the size of the ureter and appendix allows you to perform an adequate anastomosis between these organs. Besides, if AUP fails, it is always possible to return to replacement with a segment of the small intestine or perform autotransplantation.

Replacement of the ureter with the appendix by the tubular or onlay method also has certain disadvantages. Firstly, in some patients, it is absent due to an appendectomy. Secondly, the appendix may not be of sufficient length or diameter to repair the ureteral defect. Thirdly, part of the ureter adjacent to a stricture should be well vascularized; therefore, in patients with postradiation strictures, the results of this operation may be unsatisfactory.

In conclusion, we would like to note that the decision to use the appendix as a "plastic material" to replace the ureter can only be definitively taken during surgery. To implement this technique, the surgeon must plan other options in advance, including ileal ureteral substitution.

5 Conclusions

Laparoscopic onlay ureteroplasty with an appendix in a selected group of patients may be the method of choice for long strictures of the middle and upper parts of the right ureter. This operation, in contrast to intestinal ureteroplasty, is technically less complicated and has a low percentage of surgical and metabolic complications.

Abbreviations

- AUP Appendicoureteroplastic
- BMG Buccal mucosa graft
- UUT Upper urinary tract

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Not applicable.

Author contributions

BG contributed to concept, design, operating the patient. BK contributed to design, manuscript editing and manuscript review. JA contributed to literature search, manuscript preparation and manuscript review. MS contributed to literature search, manuscript preparation and manuscript review. All authors have read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Institutional ethical committee approval was obtained from North-Western State Medical University named after I.I. Mechnikov on March 1, 2023, with number PG073. Because of retrospective nature of this study, the requirement for informed consent was waived.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Competing interests

The authors declare that they have no competing interests.

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