Artificial Ureter in Patients with Extensive Ureteral Damage

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Purpose: loss of significant lengths of ureter when substitution with bowel or bladder fails is a disaster in urology. This study is conducted to evaluate the results of subcutaneous nephron-vesical bypass (SNVB) in ureteral damage of different etiologies.

Materials and Methods: Seventeen SNVB were employed in patients with ureteral injuries. We employed a device consisted of an internal silicone tube covered by a coiled PTFE tube to replace the ureter. This is called artificial ureter (AU). Proximal end of the AU was introduced in the kidney percutaneously, the tube was passed through a subcutaneous tunnel, while the distal end was inserted in the bladder through a small suprapubic incision.

Results: Follow-up ranged from six months to ten years. We removed the prosthetic ureter in one patient due to gross hematuria two months after insertion. One of the patients was reoperated two days after the procedure because of urinary leakage. In all other patients, the procedure was safe and effective.

Conclusion: Subcutaneous nephron-vesical bypass is a safe and appealing alternative to a nephrostomy tube. This is a permanent device with no need for exchange. The technique can be applied in ureteral injuries due to various causes.

Keywords: flap; malignancy; trauma; transplantation ureter.

INTRODUCTION

Ureter may be damaged in a variety of contexts, i.e., trauma, cancer, iatrogenic, allograft, radiation, etc. There are several methods to remedy ureteral loss in these cases. For decades, when end-to-end anastomosis has not been technically feasible, replacement of a long segment of the ureter has been a real challenge to urologists. Different techniques were suggested to overcome this problem, including Boari flap and psoas bladder hitch alone or in combination, downward mobilization of the involved kidney, complete or partial ileal replacement of the ureter, and renal autotransplantation.[1-4] Nowadays, minimally invasive techniques are the initial procedures to repair the ureteral loss.[5] Sometimes, particularly in metastatic cancers with ureteral involvement and/or after radiation therapy, none of these procedures is feasible.[6] These patients have to bear the burden of permanent nephrostomy tubes and countless exchanges.

MATERIALS AND METHODS

Our first case of SNVB was in a transplanted kidney ten years ago. The patient had distal ureteral stenosis after transplantation and reconstructive surgery was unsuccessful. The SNVB procedure was uneventful in this patient and renal function has been preserved ever since.

Of the 17 cases who received the AU, nine were secondary to cancer and radiation therapy, five had allograft anastomotic stricture, and three cases were post-

Figure 1. Insertion of artificial ureter into the kidney.

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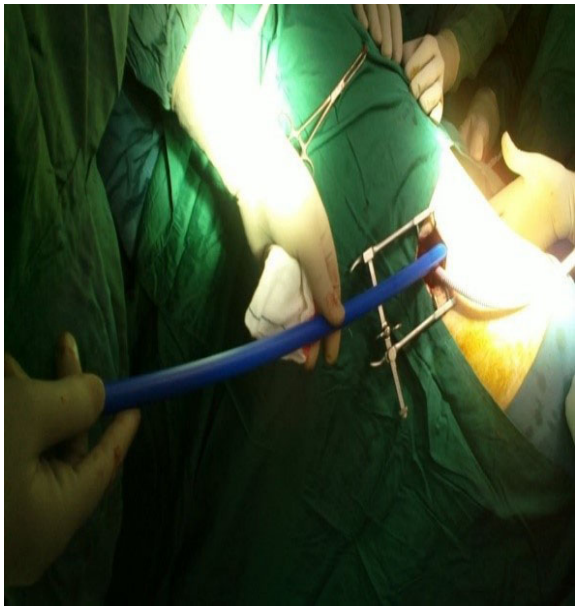

Figure 2. Subcutaneous bypass of the artificial ureter.

traumatic.

All patients had previously undergone reconstructive ureteral surgery with recurrence of obstruction. At the time of surgery, all patients had suffered from nephrostomy tube for at least 3 months.

Operative technique

A Detour double tube system was used for nephron-vesical bypass. It consists of two coaxial tubes: a porous 27 F polytetrafluoroethylene outer tube and an inner 17 F silicone tube. The procedure was performed under general anesthesia. The existing nephrostomy tract was serially dilated with metal dilatators to 30F and was used for placing the proximal end of the AU. (**Figure 1**)

Under general anesthesia and in modified flank position, a 2-cm incision was made in the suprapubic region to access the bladder. A tunneling device was used to create a subcutaneous tract between the nephrostomy site and the suprapubic incision. (**Figure 2**) The proximal end of the silicone tube was placed in a calyx so that the radiopaque ring marker was positioned at the junction of the calyx and the renal parenchyma. The distal end of the AU was then brought to the suprapubic incision using the tunneling device and the tunneling device was removed. The length of the AU tube was adjusted for each patient, and any excess length was removed, and the outer tube was peeled away for 2 cm at the distal end to expose the inner silicone tube. The bladder was distended via a Foley catheter and a small region of bladder dome was exposed. The distal end of the inner silicone tube was fenestrated and introduced into the dome of the bladder through a small incision. The outer PTFE layer was fixed to bladder serosa using absorbable sutures.

RESULTS

The first case of AU was performed in a transplanted kidney about ten years ago and it is still functioning. One AU had to be removed due to refractory hematuria. So, SNVB was effective in preserving renal function in 16 of our 17 patients.

Urinary leakage- usually from bladder anastomosis- was one of the complications that usually responded well to conservative management with anticholinergics, antibiotics and prolonged bladder drainage with a Foley catheter. We exchanged the device in one patient because of refractory urinary leakage. Hematuria following this procedure was mostly microscopic and exertional. Most patients experienced mild frequency and urgency that responded to anticholinergics.

The youngest patient was a seven-year-old girl and the oldest was a 79-year-old man.

We used this procedure in three patients with iatrogenic ureteral trauma: ureteral avulsion (**Figure 3**), ureteral injury following total colectomy and the third case was following laparotomy for trauma. After three to five years of follow up, all three patients are well satisfied with the AU, with only one patient complaining of gross hematuria after heavy exercise.

We had five cases of prostatic adenocarcinoma which developed ureteral stenosis after radiation therapy (**Figure 4**), two cases of invasive rectal carcinoma with colostomy and two cases of adenocarcinoma of the cervix. Three of these patients died of metastatic cancer 2 to 5 years after the procedure.

Our patient population also included five patients with allograft ureteral stricture, and in all these cases we were able to save the transplanted kidney after applying this procedure.

AU is a foreign body and incrustation and stone formation is the main long term disadvantage. Although we encountered 4 cases of stone formation, all of the stones were in the bladder and they were managed with transurethral lithotripsy.

DISCUSSION

AU is basically a simple alloplastic tube connected to the urinary tract by end-to-end sutures or by intuba-

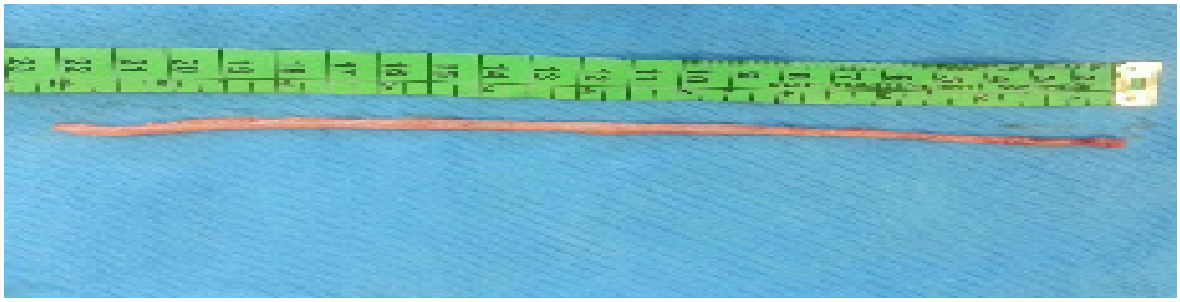

Figure 3. A case of ureteral avulsion.

Figure 4. Nephrostography in a patient after radiation therapy: ureteral obstruction is clear.

tion and closure. AU may be considered for a selected population of patients with ureteral injuries after failure of primary repair or when open surgery is likely to be hazardous because of general conditions. It should be emphasized that this procedure is not recommended as an initial attempt after ureteral injury but only when open surgery for repairing the ureter fails and there is no other way to save the ureter. Antireflux devices and peristaltic mechanisms are not necessary.[7-9]

In the 1960s and early 1970s, the first attempts were undertaken to bypass the obstructed ureteral segments with silicone prostheses. Problems with extravasation, obstruction at the anastomotic sites and incrustation were gradually overcome by changes in material, design, and surgical techniques. Subcutaneous ureteral replacement with AU, including a coaxial assembly of an inner silicone and outer expanded polytetrafluoroethylene tube, has produced good results.[10-12]

In our experience, this technique was effective and safe in ureteral injuries that ensued from different etiologies. Our results demonstrate that this technique should be considered in ureteral obstruction caused by advanced prostatic adenocarcinoma, particularly when it occurs after pelvic radiation therapy. Additionally, in patients with radical cystectomy and enterocystoplasty, placement of AU can be attempted as a last resort. A normal bladder function is obviously an essential prerequisite.

In the future, we are likely to see bioengineered neo-tissue combined with highly porous and infection-resistant alloplasts to create better and more functional neo-organs. Tissue engineering and acellular matrix grafts have produced impressive early results.[7]

CONCLUSIONS

Artificial ureteral replacement by subcutaneous nephron-vesical bypass offers a reasonable alternative to open ureteral reconstruction. This procedure has been used in ureteral obstruction caused by malignancies and radiation therapy, allograft ureteral stricture, and ureteral trauma.

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