



The appendix as ureteral substitute: A report of 10 cases

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Abstract *Background:* Ureteric replacement in part or in total is rarely needed in children. We present our experience in using the appendix to replace the ureter.

Methods: A retrospective case note review was carried out at Sheffield Children's Hospital (UK), Ekta Institute of Child Health (Raipur, Chhattisgarh, India) and Christian Medical College Hospital (Vellore, India) of all cases of ureteric substitution using the appendix.

Results: Ten patients were identified, operated in 2002–2007: seven males and three females with a median age of 2.5 years (range 2.5 months to 12 years). The reasons for ureteric replacement were traumatic ureteric avulsion ($n = 1$), congenital ureteric stenosis ($n = 5$), non-drainage following previous pyeloplasty for pelvi-ureteric junction obstruction ($n = 3$) and ureteric stricture following reimplantation for vesico-ureteric reflux ($n = 1$). The appendix was used in an anti-peristaltic manner in all cases, and in one case a transureteroureterostomy was performed. At a median follow up of 16 months (1–72 months), all the patients were well except one whose kidney function had deteriorated.

Conclusions: Total or partial replacement of the ureter using the appendix, even in the first year of life, preserved renal function in nine cases. Ureteric continuity can be successfully restored in children using the appendix.

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Introduction

The first reported case in which the appendix was used as a ureteral substitute was documented as early as 1912 by

Melnikoff [1]. There are several options available to a surgeon faced with ureteral disruption/loss. Commonly used techniques include ileal interposition, psoas hitch, Boari flap, transureteroureterostomy, renal autotransplantation in the right iliac fossa and even nephrectomy. The use of the appendix to restore ureteral continuity has not been widely reported. We present here our experience, from three paediatric urological units, in using the appendix to replace the ureter.

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Methods

A retrospective case note review was carried out at Sheffield Children's Hospital (UK), Ekta Institute of Child Health (Raipur, Chhattisgarh, India) and Christian Medical College Hospital (Vellore, India) of all cases of ureteric substitution using the appendix. Demographic data, underlying diagnosis, type of appendicular substitution performed and follow-up data were all analysed.

A total of 10 patients were identified (Table 1). They were operated in the period 2002–2007. There were seven males and three females with a median age of 2.5 years (range 2.5 months to 12 years).

Case series

Case 1

A male infant underwent a right-sided dismembered pyeloplasty at 1 month of age for antenatally diagnosed hydronephrosis. Urine failed to drain except via the nephrostomy. Following referral, re-exploration revealed a tenuous ureter and re-do pyeloplasty failed to drain, yet there remained 30% of renal function in the operated kidney. A retrograde study revealed a ureter of less than 1 cm in length; therefore a ureteric replacement was performed using the appendix. Six years later renal function remained at 31%.

Case 2

A 12-year-old girl developed right-sided abdominal swelling following minor loin trauma. CT scan revealed rupture of her right kidney and a large perinephric haematoma, which was managed conservatively. Serial ultrasound scans revealed slow resolution of the haematoma, but with a persisting urinoma that was drained percutaneously. DMSA scan indicated non-perfusion of the lower pole. Cystoureteroscopy confirmed ureteric avulsion. At laparotomy, a lower pole partial nephrectomy was performed and ureteric continuity established with interposition of the appendix. Two years later she was well and DMSA confirmed 18% of renal function in a normal looking renal remnant as seen on ultrasound.

Case 3

A 2-year-old male child with bilateral hydronephrosis due to bilateral PUJ obstruction initially underwent a left pyeloplasty. He re-presented at 4 years of age with increasing hydronephrosis of the right side. A right pyeloplasty was performed, which failed. A nephrostogram showed no flow of dye. The nephrostomy was retained for 3 months. DTPA renogram showed a differential function of 56% on the left and 44% on the right. At re-do surgery the upper and part of the middle third of the right ureter were found to be fibrosed and strictured. The lower ureter was of normal calibre. The entire right ureter was replaced by the appendix with the caecal end anastomosed to the dilated pelvis and the appendicular tip re-implanted to the

bladder. The appendix was myotomised prior to its use by splitting the sero-muscular layer.

The postoperative nephrostogram shows good flow of dye from the pelvis past the appendicular graft into the bladder. There had been a reduction of the right hydronephrosis on US and the DTPA renogram showed improvement in drainage. At follow up of 44.6 months, the differential renal function was L = 62% and R = 38%.

Case 4

A 6-year-old male child presented with abdominal pain and was diagnosed as having right-sided congenital mid-ureteric stenosis with gross hydroureteronephrosis on the right side, and a normal left kidney. Preoperatively an intravenous pyelogram showed gross hydronephrosis of the right side with dilatation of the upper ureter that was confirmed on ultrasound (which also revealed an abrupt cut off after the middle third of the ureter). A pre-operative retrograde pyelogram revealed a mid-ureteric stenosis with function of L = 39% and R = 61%. Operatively stenosis of the ureter from the mid-ureteric level proceeding distally was found. The stenosed portion of the ureter was replaced using the myotomised appendix, anastomosing the caecal end to the dilated upper ureter and implanting the appendicular tip into the bladder. Post-operatively an IVP revealed a reduction in the right-sided hydronephrosis with flow from the pelvis past the upper ureter, through the appendix and into the bladder. A post-operative ultrasound showed no increase in the hydronephrosis while the DTPA renogram showed slow but improved drainage on the right side. The differential function was L = 41%, R = 59% at 7.6 months postoperatively. The child's pain had been relieved.

Case 5

A 3-year-old female child was admitted with a history of recurrent UTI since birth. The child had global developmental delay. A preoperative ultrasound revealed a contracted right kidney with left hydronephrosis and a gross dilatation of the left upper ureter. Micturating cystourethrogram (MCUG) showed right-sided grade 4 VUR. DTPA renogram showed a dilated left renal pelvis, upper and middle ureter with functions of L = 81% and R = 19%. An intraoperative retrograde pyelogram showed a dilated upper third of the left ureter with stenosed middle and lower thirds. The stenosed parts of the ureters were excised. The right ureter was disconnected from the right renal pelvis and anastomosed to the dilated left ureter in an end-to-end manner, thus utilizing the right dilated ureter to provide drainage for the left kidney. The gap between the disconnected right renal pelvis and the right ureter was bridged with the appendix. The caecal end of the myotomised appendix was anastomosed to the right pelvis while the distal end was anastomosed in an end-to-side fashion to the dilated right ureter. Postoperative left nephrostogram showed patency of all anastomoses and drainage into the bladder. DTPA renogram showed normal drainage on the right side and slow drainage on the left side (L = 33%, R = 67%) at 34 months after the operation.

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