Learning objectives

The purpose of our educational exhibit is to:

1. Review the causes of ureteral obstruction in renal transplant recipients;
2. Consider the diagnostic process;
3. Discuss the indications, techniques, complications and outcomes related to percutaneous nephrostomy in transplanted kidneys;
4. Outline extensions of nephrostomy procedures including ureteral dilation and stent placement;
5. Summarise our experience of percutaneous nephrostomy insertion.

Background

Renal transplantation, first performed successfully in the 1950s, is the treatment of choice for most patients with end-stage renal failure. It confers longer-term survival and a better quality of life than both haemodialysis and peritoneal dialysis [1]. The success of renal transplantation is dependent on the preservation of renal graft function and despite the many advances in surgical techniques, immunosuppressive regimens and supportive therapy, many challenges remain including ureteral obstruction, which can arise post-operatively.

Causes

Ureteral obstruction is reported to occur in 2-10% of all transplant patients [2] and the main causes and risk factors are summarised in Table 1. Ureteric ischaemia is the most common cause, accounting for approximately 90% of cases [3,4]. The distal ureter close to the ureterovesical junction is usually involved. This area is particularly vulnerable to ischaemia due to its anatomical location, being furthest from the renal artery [3]. Additional recognised causes include extrinsic obstruction and errors in surgical technique. Also, a long ureter may kink and present with intermittent obstruction.

Diagnosis

The early diagnosis of a ureteral obstruction is often challenging. The clinical presentation of poor graft function and oliguria is non-specific and may be mistaken for renal allograft rejection [5]. Furthermore, hydronephrosis may or may not be present and is usually minimal in early obstruction [3]. Additionally, mild calyceal distension is a frequent occurrence without obstruction, reflecting the dependency of some calyces in the supine position.
position and free ureteric reflux if the bladder is full. Nevertheless, a rising serum creatinine level and/or oliguria indicate possible obstruction.

Investigation of the patency of the renal collecting system begins with ultrasonography, which can help to confirm the presence of hydronephrosis [3]. It is important to repeat the ultrasound examination with an empty bladder and with the patient erect. Any degree of confirmed renal dilatation in the presence of unexplained renal dysfunction should be treated as suspicious. Nuclear medicine imaging (either a DTPA or MAG3 study) and intravenous urography help to confirm obstruction, but may fail to provide definitive information, especially if renal function is compromised. Furthermore, CT and/or MRI can be beneficial for characterising the degree of hydronephrosis and the source of obstruction, but cannot exclude mild obstruction [3,4]. Antegrade pyelography with a Whitaker test may be performed but the latter is now only of historical interest.

Management

The definitive management is external drainage. Retrograde ureteral stent placement is often technically challenging [4]. For this reason, percutaneous nephrostomy tube insertion is considered by many to be the first-line intervention for suspected ureteral obstruction. Goodwin et al (1955) first described the use of nephrostomy for temporary relief of hydronephrosis of native kidneys. In recent times, the scope for percutaneous renal access has expanded. Indications can be broadly classified into four categories: relief of urinary obstruction, urinary diversion, access for endourologic procedure and diagnostic testing (Table 2).

Images for this section:
Table 1: Causes of obstruction in renal transplant patients.

<table>
<thead>
<tr>
<th>Relief of obstruction</th>
<th>Urinary diversion</th>
<th>Access for procedures</th>
<th>Diagnostic testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urosepsis</td>
<td>Haemorrhagic cystitis</td>
<td>Nephrolithotomy</td>
<td>Antegrade pyelography</td>
</tr>
<tr>
<td>Suspected infection</td>
<td>Injury</td>
<td>Stricture dilation/stenting</td>
<td>Ureteral perfusion</td>
</tr>
<tr>
<td>Acute kidney injury</td>
<td>Fistula</td>
<td>Occlusion for urinary fistula</td>
<td>- Whitaker test</td>
</tr>
</tbody>
</table>

Table 2: Indications for percutaneous nephrostomy.
Findings and procedure details

Prior to percutaneous nephrostomy insertion, acceptable INR, platelets and coagulation must be achieved and risk stratification undertaken [6]. Urine-analysis to screen for active infection and use of prophylactic antibiotics is necessary. Imaging should be reviewed for anatomical consideration, thereby reducing the risk of injury to organs and vessels [7]. With the transplant kidney, the pelvic bowel loops are especially vulnerable.

The transplant kidney is assessed using combined US and fluoroscopy, but sole US or CT guidance can be used. Patients are positioned supine [6]. Conscious sedation is achieved using titrated sedo-analgesia with monitoring of BP, pulse and oxygen saturation. The skin, soft tissue and renal capsule in the expected trajectory are anaesthetised with 1% lidocaine [6]. The ideal calyx for renal access in the transplant kidney is the most superior and lateral as this will be well away from the peritoneal reflections and bowel, as well as the renal vessels; but sometimes the interpolar or lower pole calyx may be more appropriate. In any case, a lateral entry should be ensured. Under US guidance an appropriate needle is directed into the centre of the chosen calyx (either a 21G access set or a 18G/4F sheathed needle can be used) [6]. Once entry into the calyx is established, the needle stylet is removed and urine aspirated and reserved for bacteriological culture. An equal or lesser measure of contrast can then be injected to opacify the renal collecting system. Greater amounts of contrast cause overdistension and extravasation of infected urine resulting in urosepsis [6]. After correct positioning is confirmed, a guidewire is advanced out of the calyx towards the ureteropelvic junction. Following this, fascial dilators are used to expand the track to one french size larger than the chosen drainage catheter. We use an 8F pigtail catheter. The position of the catheter is then confirmed and the catheter attached to a drainage bag and sutured to overlying skin [8].

Functional improvement will be seen in a day or two, and the nephrostomy tube is replaced with a ureteral stent. Balloon ureteroplasty can be performed at the same time to ensure long-lasting ureteral patency. We use a high-pressure 8mm diameter balloon for ureteroplasty. The ureter can then be held open with a stent, usually in place for 4-6 weeks [9].

There may be a ureteral leak, in which case this should be treated with prolonged nephrostomy drainage (with or without stenting). Recurrent strictures will require eventual surgical re-construction. If surgery is not feasible, then long term plastic stenting with regular exchange, or metal ureteral stenting should be considered.

Although measures are taken to reduce the incidence of complications, major complications occur in 1-4% of individuals [3], and can be categorised into injury to
adjacent structures, severe bleeding and severe infection [8]. Temporary haematuria occurs in most patients, but the risk of severe bleeding requiring transfusion is 1-3%. Transient low-grade fever occurs in almost many cases, and septic shock with pyonephrosis is a risk [7]. Urosepsis has a high mortality/morbidity rate and so prevention is key.

Our population

Between 1994 and 2013, 1477 kidney transplant procedures were performed at our institution. A total of 73 nephrostomies (PCN) were performed in 52 patients following renal transplantation. 39 patients had 1 nephrostomy, 8 patients had 2 PCNs, 2 patients had 3 PCNs, 1 had 4 PCNs and 8 PCNs were performed in 1 patient. The mean age was 47 years (Range, 18-72 years) and gender distribution was 50 males (68.5%) and 23 females (31.5%). The technical success rate was 100%. There were 3 significant bleeds - one was treated expectantly and one required bladder washouts and blood transfusion. The third case required embolisation. There were no cases with septicaemia or bowel injury and no graft losses secondary to renal intervention.

We present some instructive cases from our practice:

Case 1 - A 69 year old man cadaveric renal transplant recipient. Past medical history of renal failure, secondary hypertension, glomerulonephritis and diabetes mellitus. (Figs 1-4)

Case 2 - A 45 year old male cadaveric renal transplant recipient. This example illustrates a ureteric anastomotic leak, causing hydronephrosis which was successfully stented. (Figs 5-9)

Case 3 - An 18 year old female live renal transplant recipient. Duplex transplant kidney nephrostomy complicated with renal urinary leak. (Figs 10-12)

Images for this section:
Fig. 1: (a) US scan performed 33 days after transplantation to investigate unexplained rising creatinine shows moderate hydronephrosis. (b) US scan 7 days later shows worsening hydronephrosis. The transplant ureter was dilated up to its distal anastomosis indicating a likely anastomotic stricture.
Fig. 2: Nephrostomy, ureteric stenting and balloon dilation performed due to further deterioration in renal function. (a) US guided puncture of inter-polar calyx and 7-F sheath inserted over stiff wire. Nephrostogram confirms a short, tight stricture in the distal ureter (arrow). (b) This was crossed with a BMC and hydrophilic wire. Dilation of the stricture was performed with an 8 mm x 40 mm balloon. The stricture was confirmed by waisting of the balloon. (c) Later abolished. (d) An 8.5F antegrade double-J stent was sited. A locked covering nephrostomy was placed.

![Fig. 2 Images](image)

Fig. 3: Nephrostogram 3 days after nephrostomy and stenting. (a) Control image demonstrates satisfactory position of ureteric stent. (b) Following contrast administration via the indwelling nephrostomy, contrast flows readily into the urinary bladder. The nephrostomy was consequently removed under fluoroscopy over a standard wire.

![Fig. 3 Images](image)

Fig. 4: (a) US performed 7 days following nephrostomy removal demonstrated satisfactory appearance of the transplant kidney with no residual hydronephrosis. (b) Ureteric stent in situ (arrow).
Fig. 5: US performed for rising creatinine 71 days post-transplant demonstrates hydronephrosis which does not resolve following micturition. A collection deep to the transplant kidney is observed, thought to represent a lymphocele (arrow).
**Fig. 6:** Nephrostomy performed on the same day. Ultrasound guided puncture of the posterior left upper pole calyx. (a) Nephrostogram confirms moderate hydrenephrosis. An anastomotic leak is seen at the anatamosis of the transplant ureter with the bladder (arrow). (b) 8Fr locking pigtail nephrostomy sited (arrow).

**Fig. 7:** Patient recalled the following day for ureteric stenting. Initial nephrostogram once again demonstrated brisk anastomotic leak. (b) 8.5Fr, 12cm, antegrade ureteric stent placed. Covering nephrostomy left, to assist with urinary diversion and protect anastomosis.
**Fig. 8:** Nephrostogram performed 6 days after stenting. There is prompt passage of contrast into the bladder. The anastomotic leak is no longer visualised. Nephrostomy removed.
Fig. 9: US scan performed 12 days following stenting shows resolution of hydronephrosis.
Fig. 10: IVU demonstrates duplex renal transplant with delayed excretion from the upper moiety and a standing column within the ureter (red arrow). The ureteric stent has migrated into the bladder (green arrow). Normal appearing calyces are seen in relation to the lower moiety and the ureteric stent to this section of the duplex kidney appears to be in a satisfactory position. There is contrast seen in in the bladder, which is felt to represent drainage from the lower moiety.
**Fig. 11:** 8F nephrostomy placed within dilated upper moiety.

**Fig. 12:** (a) Nephrostogram performed 2 days following nephrostomy shows extravasation from calyces in the upper moiety of the transplant duplex kidney (arrow). (b) An 8.5F 12cm ureteric stent was placed with satisfactory position. A 10F nephrostomy was left to drain the kidney.
Conclusion

Obstruction of the renal transplant should be diagnosed and treated promptly. Percutaneous nephrostomy is a safe and effective method to relieve ureteric obstruction, with a good technical and short-term success rate. Further studies are warranted to evaluate the long-term effects on both graft survival and mortality.

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References


