Psoas hitch and Boari flap
ureteroneocystostomy

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Introduction


This technique includes three major advantages for a complex ureteroneocystostomy: i) Mobilisation of the bladder with fixation above the iliac vessels to guarantee a tension-free ureteric anastomosis; ii) Formation of an adequate submucosal tunnel to prevent VUR; iii) Implantation of the ureter into an immobilised part of the bladder to prevent kinking during filling and emptying of the bladder [5, 6].

In contrast to intravesical techniques for ureteric reimplantation, the psoas hitch procedure is also well suited for children with megaureters, as it can be combined with mobilisation of the ureter up to the kidney, so that secondary kinking of the ureter can be resolved. Tapering of a megaureter is rarely required, given that the diameters of the middle and proximal thirds of the ureter are usually smaller than that of the distal part, permitting creation of a submucosal tunnel for anti-refluxing ureteric implantation.

The psoas (bladder) hitch technique is an almost universal approach for ureteric reimplantation whatever the problem of the distal ureter. If this technique is not possible, an additional Boari flap may be useful.

At the end of the nineteenth century, Boari described a bladder flap substitution of the distal ureter [7]. The surgical technique was developed to bridge lesions of the distal ureter arising from surgical interventions (mainly gynaecological complications) or tuberculosis [8–11]. A modification by Übelhör is a deviation from the formal flap technique.

Planning and Preparation

Indications

• High-grade reflux with dilated ureter not suitable for an extravesical reimplantation.
• Obstructive and/or refluxive megaureter.
• Double system not suitable for extravesical reimplantation.
• Distal ureteric defects up to 5–8 cm above the ureteric orifice (for higher defects an additional Boari-flap may be used).
• Ureteric trauma, ureteric fistula, obstruction of the distal ureter or distal (solitary, low grade) urothelial cancer of the ureter.

Specific Instruments and Materials

• Optical loupes (2.5–3.5, 50-cm focal length).
• Small Langenbeck retractors.
• 6/0 or 7/0 glyconate monofilament absorbable sutures for ureteric reimplantation (Monosyn® or Monocryl®).
• 4/0 and 5/0 poly-p-dioxanone monofilament absorbable sutures (e.g. Monoplus® or PDS®) for bladder closure.
• 4/0 or 5/0 glyconate or polyglytone monofilament rapidly absorbable sutures for fixation of stents, cystostomy (e.g. Monosyn Quick® or Caprosyn®).
• 3/0 poly-p-dioxanone monofilament absorbable sutures (e.g. Monoplus® or PDS®) for bladder fixation at the psoas muscle.
• 4, 6 or 8 F polyurethane/polypropylene ureteric stents.
• 10 F pigtail cystostomy catheter.

Patient Preparation
Confirmation of adequate bladder capacity should be obtained preoperatively to allow a tension-free anastomosis.

In patients with severe ureteric pathology, which might extend towards the middle or upper third of the ureter, bowel preparation is advisable in the event of intestinal ureter substitution becoming necessary.

Acute UTI must be treated preoperatively.

Patient Positioning
The patient is placed supine on the table with $15^\circ$ overextension. A Foley transurethral catheter is inserted, which must provide intraoperative access for filling the bladder during the operation.
Figure 1

A supra-inguinal ‘hockey stick’ incision is made where the length of the cranial extension (hockey stick handle) depends on the patient’s size and the expected length of the ureteric defect. In cases with an unexpected length of pathology, a primary smaller incision may be extended cranially as needed.
The ureter is exposed through an extraperitoneal approach. After division of the inferior epigastric vessels and, in female patients, division of the round ligament of the uterus (in males mobilisation the spermatic cord and the spermatic vessels), the medial umbilical ligament (umbilical artery) is identified. If there is severe scarring after previous surgery or radiotherapy, the ureter is most readily identified behind the branching of the umbilical artery from the hypogastric artery (internal iliac artery) or alternatively at its crossing with the common iliac artery. The ureter is lifted up by a vessel loop to ease further preparation. Care must be taken to preserve the perireteric adventitial tissue with its inherent blood supply of the ureter.
The ureter is mobilised towards to the bladder as far as possible, transected and its distal stump ligated. In cases with a ureteric fistula or an iatrogenic obstruction, the ureter is transected above that level. A stay suture is placed into the proximal ureteric stump at the 6 o’clock position.

The ureter is carefully mobilised cranially to avoid any injury to the longitudinal ureteric vessels. In patients (mostly children) with an obstructive megaureter, the middle and/or proximal third of the ureter are usually smaller in diameter than the distal third and can be re-implanted without tailoring in most cases.
Before commencing its mobilisation, the bladder is filled with 50 mL (infants) to 200–300 mL (adults) of saline through the Foley catheter to ease dissection. The peritoneum is dissected from the surface of the bladder. In patients with a long ureteric defect extending higher up, bladder mobilisation is extended and both the median umbilical ligament (urachus) and the ipsilateral medial umbilical ligaments (and occasionally also the contralateral medial umbilical ligament) have to be divided. The aim is to allow a tension-free fixation of the bladder at the psoas muscle at least 2–3 cm above the common iliac vessel.
Psoas Hitch

Figure 5

For the psoas hitch procedure, the bladder is opened using a 4–5 cm oblique incision between two stay sutures. In patients with a ureteric defect extending higher up and being too wide to bridge by this technique, a Boari flap may be developed [7] or a modified Übelhör procedure may be performed (see Figures 13–16).
Figure 6

With open bladder, the ipsilateral most cranial aspect of the bladder is elevated with the index finger inside the bladder to check if the raised flap easily reaches the intended point of fixation at the psoas muscle. The level of fixation at the psoas muscle is determined by the length of the proximal ureter plus additional length for creation of a submucosal tunnel. In cases where the bladder can only be brought to the psoas muscle with tension, the oblique bladder incision is extended to obtain a longer bladder flap (white arrows).
For fixation of the bladder at the psoas muscle, two to three 3/0 poly-p-dioxanone monofilament absorbable sutures (e.g. Monopius® or PDS®) are placed preferentially through the tendon of the psoas muscle above the common iliac artery and the femoral branch of the nervus genitofemoralis. The sutures must encompass the whole detrusor muscle thickness without mucosa. The sutures must not be tied at this stage of the operation.
For dissection of the submucosal tunnel for ureteric re-implantation, fine scissors (e.g. Metzenbaum scissors) are used; the dissection plane is between the mucosa and the detrusor muscle (submucosal tunnel) in direction of the original ureteric orifice. Two stay sutures are placed through the bladder wall at the entrance of the tunnel and a further two stay sutures at the end of the tunnel to facilitate tunnel preparation. If the assistant lifts the mucosa with two forceps this manoeuvre further enhances rapid and safe preparation of the tunnel. The length of the tunnel should be about 4–5 cm. As during tunnel dissection the tissues are stretched, the resulting tunnel length after fixation of the bladder and pull-through, the ureter is usually shorter than anticipated. In case of adherence of the bladder mucosa to the bladder, e.g. from prior inflammation, radiotherapy or bladder surgery, tunnel dissection can be eased by injecting a few milliliters of saline between the detrusor and the mucosa at the intended tunnel site. The width of the tunnel is checked by opening the branches of the scissors. The end of the tunnel is opened by a transverse incision and, to avoid obstruction of the neo-orifice, an oval segment of the bladder mucosa is excised.
With the Overholt clamp inserted retrogradely through the tunnel, the ureter is pulled on its stay suture into the tunnel. The psoas hitch sutures are tied down thereafter. After bladder fixation, the ureter should enter the bladder in a straight course without kinking at the entrance; sometimes it is necessary to widen the tunnel at the entry of the ureter by gentle dissection with scissors. Excess ureter length is excised if necessary, so that ureteric neo-orifice fits snugly.
A. The ureter is spatulated at the 12 o’clock position and two anchor sutures encompassing ureteric wall, bladder mucosa and detrusor are placed at the 7 and 5 o’clock positions with 5 or 6/0 glyconate monofilament absorbable sutures for ureteric reimplantation (Monosyn® or Monocryl®).

B. The remainder of the ureteric orifice is completed with 6/0 or (in infants) 7/0 glyconate monofilament absorbable sutures encompassing the ureter wall and bladder mucosa only. At the entrance of the ureter into the submucosal tunnel, the adventitia of the ureter is anchored to the detrusor by one or two 5/0 to 7/0 glyconate monofilament absorbable sutures to avoid postoperative gliding of the ureter within the tunnel. After completion of the reimplantation, urine should freely ejaculate from the orifice. If this is not the case, the course of the ureter should be checked for any kinking or obstruction. Finally, the ureteric stent is placed and anchored to the bladder mucosa with 4/0 or 5/0 glyconate or polyglytone monofilament rapid absorbable sutures (e.g. Monosyn Quick® or Caprosyn®).
Before closing the bladder, the ureteric stent is passed through the anterior bladder wall and a cystostomy catheter (e.g. 10 F pigtail) is placed into the bladder, both of which are anchored to the detrusor at the outside with fast-absorbing sutures.

The bladder is closed in two layers by a running 5/0 glyconate monofilament absorbable suture for the mucosa and 4/0 poly-p-dioxanone monofilament absorbable suture for the detrusor.
A and B. After the bladder has been closed, a small Overholt clamp should be used to calibrate the ureteric entrance into the tunnel for its width. Perivesically a 12 or 16-F gravity drain is placed and sutured to the skin. Both the ureteric stent and the cystostomy catheter are also brought out and sutured to the skin.
Boari Flap

Figure 13

For ureteric defects longer than 6–8 cm, which cannot be bridged by the psoas hitch technique, the Boari flap offers an option for a tension-free ureteric anastomosis.

The ureter is exposed through an extraperitoneal approach in the same technique described for the psoas hitch technique. In a case of redo surgery, a transperitoneal approach may be preferable depending on the amount of scarring and fibrosis. After radiation therapy of the pelvis or after multiple previous operations, the ureter is easier identified at its crossing with the common iliac artery or higher, in a healthy area. The bladder is filled through the Foley catheter and maximum mobilisation of the bladder is performed, including division of the median umbilical ligament (urachus) and both medial umbilical ligaments (umbilical arteries). The classical rectangular Boari flap of about 3–4 cm in width is marked by stay sutures with its base at the posterior lateral bladder wall above the original ureteric orifice and its tip at the contralateral anterior bladder wall.

In the Übelhör modification, the bladder is incised on the affected side slightly oblique and this incision is anteriorly and distally extended to the contralateral site. This results in a wide rhombic flap with a broad basis, which can be rotated to the psoas muscle.
For fixation of the bladder flap to the psoas muscle, two to three 3/0 poly-p-dioxanone monofilament absorbable sutures (e.g. Monoplus® or PDS®) are placed preferentially through the tendon of the psoas muscle. The sutures must encompass the entire detrusor muscle thickness without mucosa. The sutures must not be tied at this stage of the operation.
After creation of the submucosal tunnel an Overholt clamp is inserted retrogradely into the tunnel and the ureter is pulled on its stay suture into the tunnel. Thereafter the fixation sutures to the psoas muscle are tied. After bladder fixation, the ureter should enter the Boari flap in a straight course without kinking at the entrance. The ureter is re-implanted into the bladder flap using the same technique as for the psoas hitch.
Before closing the bladder, the ureteric stent is passed through the anterior bladder wall and a cystostomy catheter (e.g. 10 F pigtail) is placed into the bladder, both of which are anchored to the detrusor on the outside with fast-absorbing suture. The bladder is closed in two layers. Firstly the mucosa is closed with a 4/0 or 5/0 glyconate monofilament absorbable running suture (e.g. Monosyn® or Monocryl®). The detrusor is closed with another running 3/0 or 4/0 poly-p-dioxanone monofilament absorbable suture (e.g. Monoplus®). A paravesical gravity drain is placed in the vicinity of the anastomosis.
Postoperative Management

Medication
Antibiotics (i.e. cephalosporines) are started at the time of surgery and are continued as long as the stent is in situ.
The perivesical drain is removed on day 1 or 2 and as soon as the urine is almost clear, the indwelling Foley catheter is removed.
Depending on the difficulty of the procedure, the ureteric stent is removed between day 7 and 10 (in complicated cases or after Boari flap on day 10). After removal of the stent, the cystostomy is clamped and the patient starts to void. The upper tract is checked by ultrasonography on the following day (in adults upper tract imaging is achieved by IVU). The cystostomy is removed after bladder emptying without residual urine has been achieved.

Surgeon to Surgeon
In some patients, dilatation of the upper tract persists postoperatively. This usually resolves within 3–6 months. If there is any concern about persisting obstruction, a MAG3 clearance with furosemide should be obtained. In children antibiotic prophylaxis should be continued as long as there is increased dilatation of the upper tract as compared with preoperatively.
In patients with a symptomatic postoperative ureteric obstruction a JJ catheter is placed antegrade through a percutaneous nephrostomy tract and left for 3 months. In case of persistent obstruction from implantation stenosis, redo-surgery may be performed not earlier than after 3 months.
If the ureter cannot be re-implanted into the Boari flap without tension, an additional 3–5 cm of ureteral length can be gained. If ureteric reimplantation remains impossible by bladder bridging techniques, intestinal ureter substitution or kidney autotransplantation remain an option. Both procedures can be performed through the same access, should psoas hitch or Boari flap ureteric reimplantation unexpectedly be infeasible.

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