

Staying out of trouble: Urinary tract complications in pelvic surgery

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Urinary tract complications in pelvic surgery are not uncommon. Many of these complications can be avoided by an excellent knowledge of surgical anatomy and insight into possible complex pathologies requiring the involvement of a multidisciplinary team.

This is a review a few basic principles to avoid and manage urological injuries.

General principles

Numerous studies have reported a decrease in complications with experience in laparoscopic pelvic surgery. Awareness of this learning curve should allow prudent case selection for laparoscopic procedures based on complexity of the clinical problem.

Avoiding ureteric injuries

Although the position of the ureter at the pelvi-ureteric junction (approximately the level of the 2nd lumbar vertebra) is quite consistent, the path of the ureter along the psoas muscle is quite variable. The point where the ureter crosses the bifurcation of the iliac vessels to enter the pelvis is also quite consistent. Within the pelvis it runs in the bed of the ovary along the pelvic side wall then medially in the base of the broad ligament below the uterine artery and lateral to the cervix, before entering the bladder. Numerous pathological processes may alter the expected path of the ureter in the pelvis.

In cases of a large pelvic mass, a large uterus or endometriosis, other strategies to identify and avoid the ureter may be necessary. The ureter has a few unique features which distinguish it from other tubular structures in the pelvis. It has characteristic small adventitial blood vessels which are visible through the peritoneum in thin patients. Due to the movement of the kidney with respiration, the ureter also moves up and down with respiration. Ureteral peristalsis can be elicited by touching it gently with an instrument. During dissection in the retro-peritoneum, the ureter tends to move medially with the peritoneum.

The following applied anatomical principles should be considered when the ureter is encountered surgically. The ureteric blood supply enters from medial aspect above the pelvic brim and from lateral sources below the pelvic brim. The capillary network of the ureter lies within the ureteric adventitia. It is imperative that the ureter is not skeletonised as this would render the ureter ischaemic and at risk for stricture or breakdown of repaired injuries. The

inter-capillary anastomoses within the capillary network are reliable above the pelvic brim but unpredictable below the pelvic brim. We therefore tend to do ureteric re-implantation directly into the bladder for injuries below the pelvic brim and end-to-end anastomosis for injuries above the pelvic brim.

There are numerous congenital renal anomalies which should be considered if "odd" anatomy is encountered. Duplications of the ureter are not uncommon. Complete duplication of the ureter is associated with two ureteric orifices. However, the ureter may also bifurcate above the bladder. Duplex ureters have a common blood supply and separating them may damage the common blood supply. They are therefore usually re-implanted in a common sheath. Horseshoe kidneys are the commonest congenital renal anomaly and occur in approximately 1:400. The fusion of the lower poles prevents complete ascent of the kidneys. The kidneys are positioned lower than the expected position and the ureters run anterior to the isthmus connecting the lower poles. Ectopic kidneys may be situated in the pelvis and can be confused with a pelvic mass. The ureters of ectopically positioned kidneys tend to enter the bladder in the normal position.

Ureteric injuries often occur in the emergency "train wreck" procedure with significant haemorrhage and where pathological processes make identification of anatomy challenging. In these cases it should always be remembered that repair of ureteric repair has an excellent outcome. Delayed early repair is preferable over a rushed repair in a shocked, unstable patient.

Although the reported incidence of ureteric injuries during laparoscopy is low, these injuries are usually missed intra-operatively. Thermal injuries to ureters from sealing devices during relatively uncomplicated laparoscopic procedures, classically present at 5-7 days after surgery. As thermal injuries cause ischemia and delayed necrosis, debridement of the ureter is essential to ensure good outcome.

Intra-operative cystoscopy may be useful to exclude ureteric injury. Although retrograde pyelography is the gold standard to exclude an injury, clear jets of urine from ureteric orifices will usually exclude significant injury.

In challenging cases, pre-operative ureteric stenting may assist in identification of the ureters and will assist in intra-operative diagnosis of injuries. Stenting has not been shown to decrease the risk of ureteric injuries. Although it is tempting to open the bladder or perform ureterotomy to intubate a ureter during a difficult procedure, both should

be avoided. Poor wound healing related to complicated surgery will increase the risk of stricture or leak. Intra-operative cystoscopy will allow insertion of ureteric catheters. This can be done in a supine patient using a flexible cystoscope which could avoid changing position to lithotomy intra-operatively.

How to find the ureter intra-op

Look for the characteristic appearance and movement, as described earlier, just above the pelvic brim. You may see it through the peritoneum. It may be easier to find where it crosses the iliac bifurcation to enter the pelvis. If you have already dissected the retroperitoneum ensure that it is not being retracted medially with the peritoneum. If all else fails, cystoscopy and ureteric stents will allow identification.

How do “missed” ureteric injuries present?

Although most patients will present with a urine leak, they may also present with less obvious symptoms like pyrexia, sepsis, flank pain and renal dysfunction. If copious clear fluid drains from a drain, send the fluid for creatinine measurement. If it is higher than serum creatinine, it is urine.

How to confirm a ureteric injury

The hallmark of a ureteric injury on contrast-enhanced computed tomography scan (CT) is contrast leak from a ureter. Request delayed images or “CT-IVP” as without delayed contrast-enhanced images, the injury may be missed. Hydronephrosis, urinomas and ascites may also suggest ureteric injury.

Intravenous pyelogram may not identify a significant injury, especially if the ureter involved is obstructed.

Retrograde pyelography is the gold standard for diagnosis of ureteric injuries.

How to manage/repair a ureteric injury diagnosed intra-operatively

If the patient is unstable, definitive repair can be delayed for a few days. In such cases the ureter should not be mobilised to preserve vascularity. A small feeding tube can be inserted into the kidney through the ureteric injury and brought out through the skin to temporarily drain the kidney. This tube can be secured to the ureter with a purse-string suture with a non-absorbable suture. Alternatively the ureter can be tied off and percutaneous nephrostomy can be done post-operatively. It may take a few days for the kidney to dilate enough for this to be done.

In the stable patient, management is dictated by the location of the injury, the extent of the injury and the extent of ureteral loss or devascularisation. Usually injuries below the pelvic brim are repaired by direct re-implantation into the bladder due to concern about the vascularity of the ureter.

A simple injury with minimal devascularisation <2cm and less than 50% of the diameter transected can be repaired by end-to-end anastomosis over a double-J stent.

More extensive injuries and thermal/energy source instrument-induced injuries should be debrided and repaired by “end-to-end” anastomosis. Omentum can be mobilised and be used to wrap the repaired ureter. The omentum is useful as it is easily mobilised off the transverse colon and assists healing by improving vascularity around the ureteric repair site.

The basic principles of end-to-end ureteric repair are as follows:

- Debride the ends of the ureter
- Spatulate the ureteric ends
- Restrict crushing the ureter due to manipulating it with instruments by using a strict “no touch” technique
- Complete a tension-free end-to-end anastomosis with absorbable sutures over a double-J ureteric stent for internal drainage
- Place a pencil drain or other non-suction type drain over the area of the repair
- Isolate the repair with peritoneum or omentum
- If a repair cannot be done without tension then a Psoas hitch, Boari flap, transuretero-ureterostomy or Monti-Yang ileal interposition may be necessary

How to manage a ureteric injury diagnosed post-operatively

If diagnosis is made post-operatively, cystoscopy and retrograde will confirm the injury and allow assessment of the nature and extent of the injury. If a DJ stent can be placed past the injury, it may be reasonable to allow a period of conservative management. Although these injuries may heal with internal drainage, many will heal with stricture. If a stent cannot be passed, definitive repair should be done. If there is a contra-indication to formal repair at that time, percutaneous nephrostomy should be done to relieve obstruction, if present, until definitive repair can be done.

Avoiding bladder injuries

The bladder is boat-shaped with a base, dome and lateral walls. Note the relation of the trigone/ base of the bladder to the cervix during a trans-abdominal approach to the bladder. Injuries which are presumed to involve the dome often involve the base of the bladder where the injury or attempted repair may involve the ureter. During the vaginal approach it should be noted that injuries more than 2,5cm from the external urethral meatus may involve the trigone. Intra-operatively the bladder neck can be identified by palpating the bulb of the urethral catheter. Prolapse may significantly alter the expected location of the bladder neck.

How to diagnosis bladder injuries intra-operatively

Few bladder injuries will declare themselves by clear fluid in the operative field and a visible catheter bulb. Small bladder injuries are easily missed on simple inspection, especially during laparoscopic procedures. Distension of

the catheter drainage bag with gas during laparoscopy is an obvious sign of bladder injury however instillation of dilute methylene blue through the urethral catheter may be required to confirm a suspected bladder injury. Although clear urine in a urine drainage bag is comforting to surgeons, the lack of haematuria does not exclude an injury. Frank haematuria should prompt intra-operative assessment to exclude bladder or ureteric injury.

Cystoscopically an injury may be suggested by an obvious breach of the mucosa with dark spaces visible between detrusor muscle fibres, or visible fat or a frank defect into the peritoneum with bowel and other peritoneal contents visible. An inability to distend the bladder and progressive abdominal detention strongly suggests an intra-peritoneal bladder injury. In doubtful cases, an intra-operative cystogram can be done by filling the bladder with dilute contrast and using a C-arm for fluoroscopy in the AP and oblique plane.

How do “missed” bladder injuries present?

Haematuria and copious amounts of clear fluid draining from a drain, wound or from the vagina are obvious signs of bladder/ureteric injury. Decreased urine output, ascites and progressive abdominal distension are also common signs of a urinary leak. Urinary ascites may present with a relatively benign feeling distended abdomen without peritonitis. Urinary ascites or retroperitoneal urinomas often cause ileus. Renal dysfunction may be caused by obstructive uropathy or by urinary ascites where the urine filled peritoneum acts as a dialysis membrane causing increases in serum potassium, urea and creatinine. Sepsis from an infected collection may also be a presenting sign. Patients may present at 5-7 days post operatively with signs of a leak due to ischaemic necrosis of the bladder or ureter.

How to diagnose bladder injuries post-operatively

Bladder injuries are missed more often during laparoscopic surgery than during open surgery. The use of energy sources close to the bladder or thinning the bladder during dissection may increase the risk of late leaks due to ischaemic necrosis. Elderly women may have extremely thin bladders which are more prone to injury.

Fluid draining from wounds or drains may be sent for creatinine measurement to determine whether the fluid is urine. Investigation should include assessment of the bladder and the ureter as injuries to both are not uncommon.

Contrast-enhanced CT and intravenous pyelogram are insufficient to exclude a bladder injury if passive bladder filling is used. Ultrasound of the abdomen may identify suggestive features of a bladder injury, such as a collection or ascites, but will not diagnose the bladder injury.

CT cystogram or standard cystography will identify the injury and confirm whether an intra-peritoneal or extra-peritoneal injury is present. On standard cystography

an extra-peritoneal injury is confirmed by flame-shaped leak of contrast from the bladder. Intra-peritoneal leak of contrast from the bladder is characterised by contrast visible around loops of bowel.

How to manage a bladder injury

Intra-peritoneal injuries should be repaired. Extra-peritoneal injuries, except complicated/large injuries should be managed conservatively with prolonged catheter drainage.

Two layer vesicorrhaphy with absorbable sutures is recommended. Ensure a mucosa-mucosa anastomosis and closure of the detrusor. Ensure good drainage with a catheter of at least 18Fr or larger. If severe haematuria is present, consider inserting a larger catheter which is less likely to become blocked by clots. A blocked catheter will cause over-distension of the bladder and breakdown of the repair. Place a pencil or other non-suction type drain close to the repair. Consider placing omentum or a Martius flap over the repair. The catheter can be removed at 7-10 days in uncomplicated cases. Consider control cystography prior to catheter removal in complex cases.

Martius flap-“the omentum of the perineum”

The Martius flap is a vascularised labial fat pad which can be used as a second layer over closure of bladder and urethral injuries. It is commonly utilized during vesico-vaginal fistula and urethral diverticulum repair. It improves vascularity and creates a second watertight layer over the repair. It also facilitates dissection if delayed secondary procedures are necessary. It is easily mobilised and, surprisingly, causes little asymmetry of the labia.

Summary

Many urological injuries are inevitable due to the underlying pathological process. Most injuries can be repaired with few long-term sequelae. Repairs will heal if well vascularised, tension free, done with absorbable sutures and drained well internally and externally for an appropriate amount of time. Managing complications can be challenging and are best managed in the setting of a multi-disciplinary team.

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