

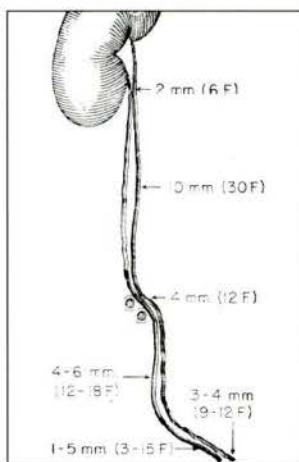
Ureteral plastic surgery

BARNABÁS RUSZINKÓ, M.D.

Department of Urology, Uzsoki Hospital, Budapest

SURGICAL ANATOMY The ureter is a 24-30 cm long, thin duct that connects the renal pelvis and the bladder. The ureteral wall consists of an inner epithelial layer, smooth muscle, and adventitia. The muscle has a superficial longitudinal, a circular medial and a longitudinal deep layer. The upper (abdominal) ureters lie in the perirenal fat, more distally near the Gerota fascia. At the level of the third and fifth lumbar vertebrae, the infundibulopelvic ligaments containing the ovarian vessels cross over the ureters lying posterior to the mesentery of the descending colon on the left, and behind the cecum and ascending colon on the right. Distally they run on the psoas muscle and cross the iliac vessels just below the bifurcation of the common iliac vessel on the right, and just above it on the left. Below the pelvic brim (pelvic ureters), they run on the lateral pelvic wall, inferior to the infundibulopelvic ligaments attached to the medial leaf of the broad ligament. Before passing through the vesicouterine ligaments (ureteral tunnel), the uterine arteries cross over the ureters lateral to the cervix at the level of the internal os. The ureters terminate in the trigone of the bladder (Figure 1, 2, 3).

Figure 1. Anatomy of the ureter



URETERAL INJURY Albeit not common, injury to the ureter invariably occurs during gynecologic surgical procedure, and is of particular concern when performing radical hysterectomy. The most common sites of ureteral injuries include 1. pelvic brim where the ureter lies close and inferior to the infundibulopelvic ligament, 2. lateral to the cervix at the level of the

internal os where the uterine artery cross over the ureter, and 3. lateral to the vagina where the ureter is in close proximity when entering the bladder (Figure 4). Injury to the ureters is by no means less common during vaginal hysterectomy because of the significant changes in the anatomy, owing to the pulling down effect of the uterus (Figure 5).

Coliform pain in the ipsilateral lumbar region, similar to renal colics caused by ureteral stones, is the primary symptom of ureteral occlusion. The significantly dilated proximal urinary tract above the obstructed ureter, can easily be detected on the ultrasonography. Occasionally, decreased gastrointestinal motility may accompany ureteral occlusion.

The incidence of injuries to the ureters in the Department of Gynecology and Obstetrics of the Uzsoki Hospital during the past 30 years, have recently been reviewed (1-2).

Figure 2. Intravenous pyelography. Closed arrows indicate the crossing of the iliac vessels.

I upper, II middle, and III lower ureter
UPJ ureteral-pyelon junction UO ureteral orifice

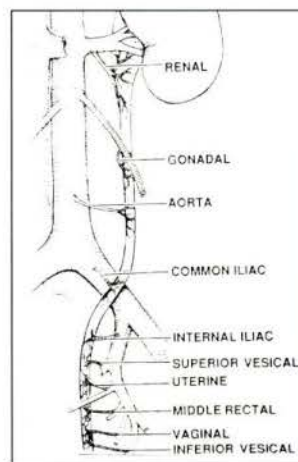


Figure 3. The blood supply of the ureters. The blood supply is segmental, highly variable and is provided by different arteries. The ascending and descending branches of the supplying arteries form a rich longitudinal anastomotic plexus in the adventitial tissue of the ureters. Because of the segmental blood supply and rich arterial plexus, it is possible to ligate some of the supplying arteries without compromising the ureteral blood supply. The adventitial sheath, however, may not be damaged.



Address correspondence to:

Barnabás Ruszinkó, M.D.

Department of Urology

Uzsoki Hospital

1145 Budapest, Uzsoki u. 29.

Phone (36 1) 251 7333 Fax (36 1) 251 4533

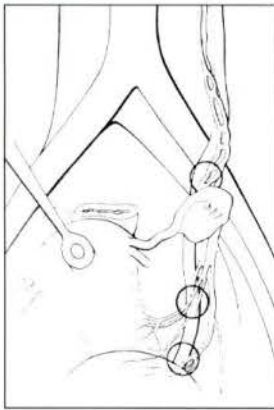
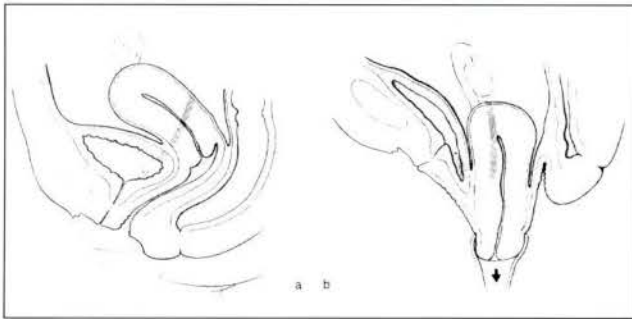


Figure 4. The most common sites of ureteral injuries during gynecologic surgery

Figure 5. The position of the ureter - dash line - has changed as a result of pulling down the uterus. Injury to the ureter may easily occur unless the bladder and the ureter are dissected far away from the uterus. (a) normal anatomy (b) anatomical changes when the uterus is pulled down at the time of vaginal hysterectomy



During this period, 13 ureteral injuries occurred. Of these, one was bilateral, 9 were on the left, two occurred on the right side and one was associated with an additional injury to the bladder. The ureter was injured five times during dissection of an adnexal mass, twice during radical hysterectomy, and in six instances at the time of simple hysterectomy for uterine fibroids. In 7 cases the injuries were identified intraoperatively and during the postoperative period in six patients. Management of the ureteral injuries included removal of the obstructing stitch in six patients, ureterolysis in two, ureterouretero anastomosis in three cases and two nephrectomy were performed more than 20 years ago.

URETERAL ANASTOMOSIS There are various surgical techniques for ureteroureterostomy, (Figure 6) but the principles are similar: 1. the lacerated or necrotic portion of the ureter should be excised, 2. there should be no tension on the anastomosis, 3. the anastomotic site should be dissected free of the peritoneum, 4. the blood supply should be adequate, 5. the anastomosis should be watertight but not ischemic, and 6. the urine should be drained. In the past, prior to the introduction of stents, the anastomosis was protected with transrenal drainage (Figure 7). Today the anastomosis is made over an ureteral stent (Figure 8). The ureteral anastomosis should be performed using 3-0 or 4-0 absorbable suture. The sutures are placed 1-1.5 mm apart from each other. Skilled and gentle technique is essential, with no tension on the stitches. Uretro-ureterostomy is mostly indicated for injuries of the middle and upper ureter. Anastomosis of the lower segment of the ureter, 4 to 5 cm above the bladder, is more difficult and likely to be unsuccessful.

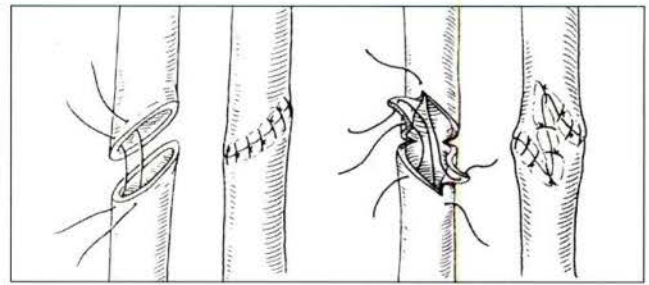


Figure 6. Various techniques of ureteral anastomoses

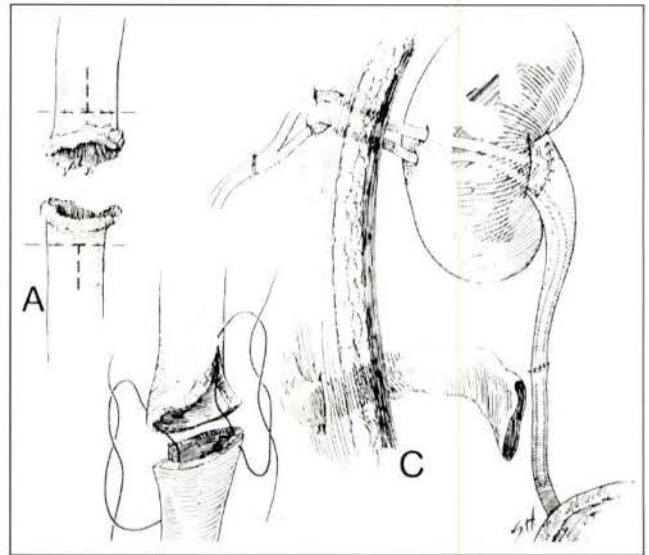


Figure 7. Ureteroureterostomy A The damaged edges of the ureter are cut, and the ureteral ends are spatulated to provide greater anastomotic diameter. C In the past, the anastomosis was protected by transrenal drainage. Another drain is placed at the site of the anastomosis



Figure 8. Ureteroureterostomy A double J ureteral catheter has been passed through the ureter extending from the renal pelvis to the bladder, to protect the site of the anastomosis.

The stent is usually removed after 3 to 4 weeks by extracting the distal end from the bladder with optical forceps.

URETERONEOCYSTOSTOMY "En masse" ligature may be treated by simple removal of the stitch or stitches during the secondary laparotomy, unless the ureter is lacerated or necrotic. In the presence of serious ureter damage, reimplantation of the ureter

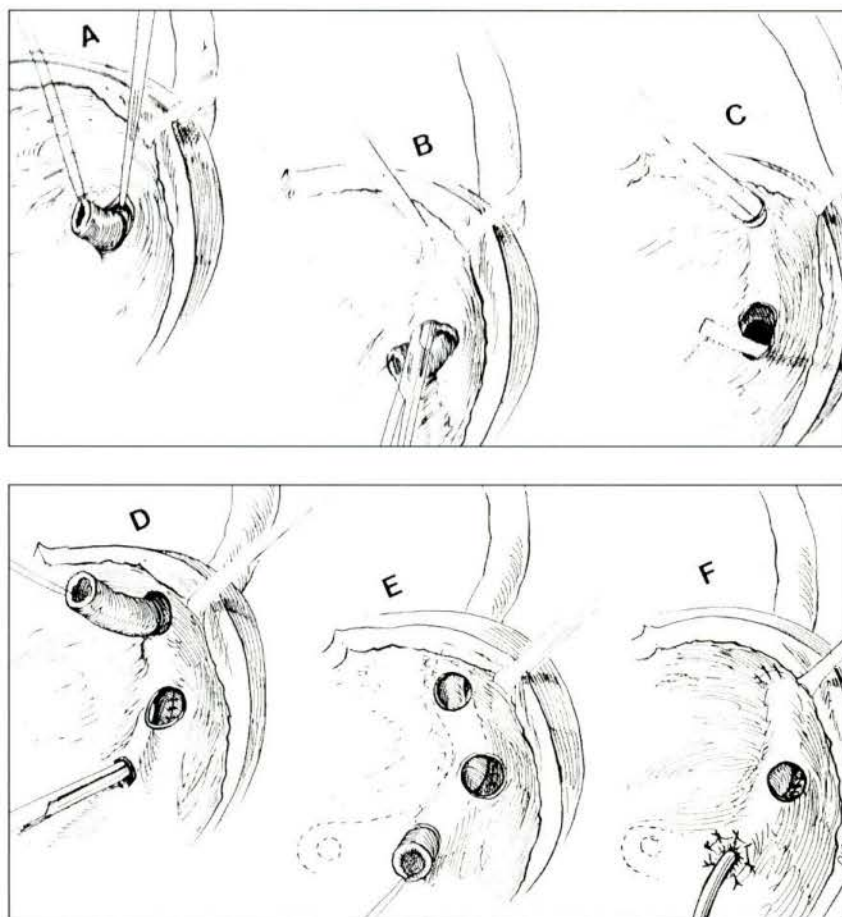


Figure 9. and 10. Ureteroneocystostomy (see text)

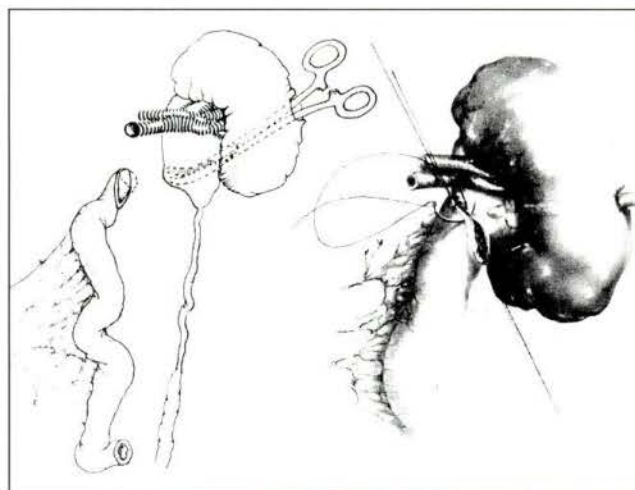


Figure 11. A segment of the ileum is used to replace the ureter

into the bladder is recommended. We utilise the Politano-Leadbetter technique. After opening the bladder, a clamp is used to create a submucosal tunnel through the bladder wall. We pull the ureter through the submucosal tunnel and fix it with a uretero-mucosal sutures. To stabilise the anastomosis, the ureter is sewn to the outer bladder wall (vesico-ureteral sutures). Spint catheter is used to protect the ureter implantation (Figure 9, 10).

URETEROVAGINAL FISTULA Partial opening of the ureter with forceps, scissors or stitches which has not been repaired may result urine leakage. The extravasated urine into the surrounding connective tissue will find its way toward the site of the vaginal closure, resulting in a ureterovaginal fistula. This is followed by relief of the lumbar pain and resolution of the dilatation of renal pelvis and the ureter. The urine leaks continuously into the vagina day and night. Attempt to pass a catheter into the ureter fails beyond 3 to 5 cm from the uretero-vesical junction. Surgical repair is usually recommended and includes reimplantation of ureter into the bladder. If the ureteral length is insufficient, the psoas hitch may be utilised. With more extensive injury or ureteral weakness, a segment of the ileum can be used for repair. With this

technique, the entire ureter can be replaced from the pyelon to the lower bladder dome (Figure 11). I have performed this procedure only once in my practice.

CONCLUSION In conclusion, it is important to emphasise that ureteral injury should be avoided whenever possible. The three major points in this context are: 1. adequate preoperative workup; including passing an ureteral catheter in the presence of upper urinary tract dilatation, 2. skilled surgeon, and 3. very gentle (atraumatic) surgical technique.

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