นิพนธ์ต้นฉบับ

Surgical injuries of the ureter.

Samrit Laornual* Reungchai Vajarapong*
Pichai Bunyaratavej* Apichat Kongkanand*
Kreangsak Prasopsanti* Ravit Smavatkul*

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During the years from 1986 to 1990, 22 patients sustained surgical injuries of the ureter (two bilaterally). In eight patients, the injuries were associated with gynecologic procedures for benign diseases and five with colorectal surgery. Seven injuries were incurred during ureteroscopic calculous manipulation. In 18 patients, the injuries were recognized and remedied intra-operatively with uneventful outcomes. Of the six patients whose injuries were diagnosed post-operatively, only one was successfully managed with ureteric catheter stenting. To avoid this serious complication, the ureter should be visually identified and retracted out of the operative field.

Key words: Ureter, Injury

Reprint request: Laornual S, Department of Surgery, Faculty of Medicine, Chulalongkorn University. Bangkok 10330, Thailand.
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* Department of Surgery, Faculty of Medicine, Chulalongkorn Univercity,

สัมฤทธิ์ ลออนวล, เรืองชัย วัชรพงศ์, พิชัย บุณยรัตเวช, อภิชาติ กงกะนันท์, เกรียงศักดิ์ ประสบสันติ, ระวิทย์ ศมาวรรตกุล. บาดเจ็บท่อไตจากการผ่าตัด. จุฬาลงกรณ์เวชสาร 2534 พฤศจิกายน, 35(11) : 713-719

บทคัดย่อ : จากการศึกษาย้อนหลังตั้งแต่มกราคม 2529 ถึง ธันวาคม 2533 มีผู้ป่วย 22 รายได้รับบาดเจ็บของท่อไตจากการผ่าตัด ในจำนวนนี้ 8 รายการบาดเจ็บเกิดจากการผ่าตัดเพื่อให้การรักษาโรคที่ไม่ใช่มะเร็งทางนรีเวชวิทยา อีก 5 รายจากการผ่าตัดลำไส้ใหญ่ และ 7 รายในการใช้กล้องส่องเพื่อรักษานิ่วในท่อไต บาดเจ็บของท่อไตตรวจวินิจฉัยได้ 16 รายในระหว่างการผ่าตัดนั้น ๆ ซึ่งการรักษาซ่อมทันทีได้ผลดี อีก 6 รายที่การบาดเจ็บวินิจฉัยได้หลังการผ่าตัด มีเพียงรายเดียวที่สามารถให้การรักษาสำเร็จด้วยการใส่สายสวนท่อไตคาค้างไว้ชั่วระยะเวลาหนึ่ง เพื่อหลีกเลี่ยงอันตรายบาดเจ็บต่อท่อไตในระหว่างการผ่าตัดควรเลาะแยกท่อไตออกให้เห็นอย่างชัดเจนจากบริเวณที่ผ่าตัด

Accidental injury of the ureter may complicate any operation within the abdominal cavity. Gynecologic, colorectal and reoperative surgery in the pelvis and the retroperitoneum are particularly vulnerable to this complication. While not common, injuries of the ureter can be a perplexing problem for reconstruction or repair. Prompt intraoperative recognition is most important so remedial procedures can be carried out immediately with generally good results and uneventful recovery, delay in recognition and treatment jeopardizes the patient's course and the function of the urinary tract. "The venial sin is injury to the ureter, but the mortal sin is failure of recognition," statement by Higgins[1] still serves well to stress this point. The injury may consist of complete transection, ligation with suture material, excision of a complete segment or a portion of the ureteric wall, devascularization of ureteric segments, or accidental crushing injuries from surgical clamps.

The purpose of this paper is to record experiences with surgical injuries of the ureters encountered by the urological service at Chulalongkorn Hospital, and to present certain conclusions therefrom which may be helpful in the avoidance of such injuries.

Materials and methods

All patients studied were found through a retrospective charts review of ureteral injuries incurred in all disciplines of surgery from January 1986 through December 1990. Each chart was reviewed for sex, age of the patient, disease process and pastmedical and surgical history, type of operative procedure, operative complication and specialty of the surgeons involved. The ureteric injuries were examined for the location, the type, when and how the injury was recognized, method and time of repair and the results.

Result

Twenty-nine ureters sustained surgical injuries in 27 patients (two patients suffered bilateral injury) during this five-year period. Of these, two ureters were damaged by gunshot, and three were injured by radiotherapy for carcinoma of the cervix uteri. (hese instances will be described in a later report.)

As for the remaining 24 ureters (22 patients), the injuries were incurred during various operative procedures (Table 1).

Table 1. Number of patients with ureteric injury in relation to types of operative procedure (1986-1990)

Operative procedures (No.)		No. patients with Ureteric injured (%)
Cesarean section	(13,163)	1
Intra-abdominal gynecologic (for benign disease)	(12,696)	8 (0.06)*
Colorectal	(370)	5 (1.4)*
Vascular in retroperitoneum	(47)	1 (2.2)
Ureteroscopic**	(167)	7 (4.2)

Notes : Referred from another institution, * one patient suffered bilateral injury, **From January 1987-December 1990 only.

Of the nine patients with ureteric injuries incurred during obstetric-gynecologic surgery, eight were associated with intra-abdominal procedures for benign disease and one ureter was injured in the course of a cesarean section. Five involved the left ureter alone, three involved the right ureter only and in one patients the ureters were ligated bilaterally (Table 2). Four ureters injured at the pelvic brim region were recognized and remedied immediately with end-to-end anastomosis (urete-

roureterostomy) with good results (Table 3). The other five injuries involved the deep pelvic portion of the ureter and were discovered post-operatively, three were because of urinary fistulae and two because of ureteric obstruction. One bilateral ureteric obstruction was recognized and deligated two days after the original surgery, and one ureterovaginal fistula was successfylly managed with ureteral stenting catheter for 27 days. The remaining three whose ureteric injuries were recognized late (one obstruction and two ureterovaginal fistulae) were reconstructed with ureteroneocystostomy at 226, 97 and 254 days, respectively, after the original surgery; the results were good. (Table 4)

Table 2. Location of ureteric injuries.

Type of operation	Pelvic brim portion	Deep pelvic portion	Side of injury Rt.	Lt.	Bil.
Cesarean section	0	1	-	1	-
Gynecologic	4	4	3	4	1
Ureteroscopic	1	6	4	3	-
Colorectal	2	3	-	4	1
Vascular	1	0	1	-	-
Total	8	14	8	12	2

Table 3. Methods of intra-operative management.

Type of operation	Location (No.)	Management (No.)
Gynecologic	Pelvic brim (4)	U-ureterostomy (4)
Ureteroscopic	Pelvic brim (1)	Explore/suture (1)
	Deep pelvic (6)	U. stent (4)
		U-neocystostomy(2)
Colorectal	Pelvic brim (2)	U-ureterostomy (2)
	Deep pelvis (2)	U-neocystostomy (1)*
		Trans-uretero-Ureterostomy (1)
Vascular	Pelvic brim (1)	U-ureterostomy (1)

Note: *Bilateral ureteroneocystostomy

Table 4. Methods and time of delayed management.

Type of operation	Symptom	Management (No.)		Days post initial surgery
Obstetric	F	U-neocystostomy	(1)	97
Gynecologic	O	Deligation	(1)	2*
	O	U-neocystostomy	(1)	226
	F	U-neocystostomy	(1)	245
	F	U. stent	(1)	27
Colorectal	O	Jejunal subs.	(1)	51

Notes: O = obstruction, F = Urinary fistula, * = Bilateral

All six ureteric perforations and one distal ureteric mucosal sleeve inversion incurred during ureteroscopic manipulation of calculi were recognized during the procedure. Three ureteric perforations required immediate operative intervention because of the inability to pass the ureteric stent catheter beyond the point of injury. Three ureteric perforations and the one eversion of the distal ureteric mucosa were successfully managed by ureteric stenting with uneventful recoveries (Table 3).

The six ureters in five patients were accidentally damaged during the anterior and low anterior resection of the colon; four involved the left ureter alone and one bilaterally (table II). Two injuries were incurred near the pelvic brim region which were recognized intra-operatively and corrected by uretero-ueterostomy with uneventful outcomes. The remaining four injuries involved the pelvic portion of the ureter, three were discovered intra-operatively in which two were managed successfully with ureteroneocystostomy and one transureteroureterostomy (Table 3). The only one ureteric injury recognized post-operatively and resulting from extensive loss of ureteric segment causing upper urinary tract obstruction was managed successfully with jejunal substitution 51 days following the original surgery (Table 4).

One ureter was transected during a repeat operation for abdominal aortic grafting. This ureter was bound in a dense fibrosis but was successfully freed and reanastomosed over a ureteric stenting catheter with uneventful outcome.

Discussion

Eisenkop[2] reported 0.09% (7/7527) incidence of ureteric injury in association with cesarean sections performed during the years 1976-1980, and concluded that the main factor attributed to those injuries was the extension of a uterine incision into the broad ligament or the vagina from difficulties experienced during surgery in trying to deliver large or infants lying abnormally, causing profuse bleeding; hemostasis was obtained at the expense of ureteric injury. No ureteric damage was incurred in over 13,000 cesarean sections performed in this institution during the period being reviewed. The one case of ureteric damage sustained during the course of cesarean section in this report (table I) was a referred case from another institution for further care of an uretero-vaginal fistula.

Eight patients sustained ureteric damage (one bilaterally ligated) in 12,696 intra-abdominal gynecologic procedures for benign diseases during the period under review producing an incidence of 0.06 percent (table I), which is much lower than that of 0.2-2.5 % reported previously by others.[3-8] Fifty-one radical hysterectomies were also performed during this same period with no damage done to the ureter.

The most vulnerable area of the ureter that may sustain accidental injury during operative gynecologic procedures is the distal ureter where the uterine artery crosses ventrally to enter the uterus which is only 1.5 centimeters lateral to the cervix uteri.[6] In this study, injuries occurred equally, i.e. four each at the pelvic brim and the deep pelvic portion of the ureter. This is in contrast with the commonly suggested idea above. Incomplete mobilization of the bladder from the cervix in total hysterectomy, done vaginally or abdominally, invites accident by retaining the ureter too close to the field of clamps and ligatures.[7] The best way to prevent ureteric injury during the operative gynecologic procedure is by direct visualization; the lateral pelvic peritoneum should be routinely opened, and the ureter should be visually identified on the medial leaf of the broad ligament, isolated proximally from infundibulopelvic ligament and should be followed visually and palpably on its course into the bladder.[7] All four injuries to the pelvic ureter associated with operative gynecologic procedures in this study were diagnosed post-operatively in contrast to the other four injuries at the pelvic brim that were recognized intra-operatively. This indicated that during such procedures the pelvic portion of the ureter was never visually identified and retracted out of the operative field.

The incidence of ureteric injury in colonic surgery has varied from 0.3 to 6 percent[9,10] Of 370 colorectal surgeries performed during this five-year review period, five patients (1.4%) suffered iatrogenic ureteric injury. All injuries were documented as having occurred during either low anterior resection or abdomino-perineal resection of a rectal malignancy similar to those previously suggested.[9,11]

During colorectal surgery, the ureter is equally liable to be injured on either side below the brim of the pelvis. Above the pelvic brim there is an additional hazard for the left ureter because of its close relationship to the inferior mesenteric

vessels. Contrary to the fact stated above, in this report all ureteric injuries except one involved the left ureter only. The explanation of this is the anatomic orientation of the distal colon toward the left side of the pelvis and perhaps the left colon being on the opposite side of the operating surgeon's dominating hand.

Because of the extremely close proximity to the inferior mesenteric vessels, the distance between the two structures being often only an inch or less apart for two inches or so of their course, surgeons may easily hook up the left ureter in the process of isolating and ligating the superior pedicle.[11] To avoid this potential injury, the left ureter should be carefully defined in this part of its course before and attempt is made to tie the inferior mesenteric vessels.

Injury to either ureter during division of the lateral ligaments of the rectum is the most common site of ureteric injury,[9] especially in cases involving large adherent rectal tumors containing adhesions which draw the ureter medially. This can be prevented by exposing the ureter in the pelvis and retracting it laterally before division of the lateral ligament. When the identity of a structure is not know during a dissection, the ureter should be identified proximally and distally and traced through the area.

We may have had more instances of ureteric injury that were asymptomatic and not discovered during routine post-operative care since the symptoms of unilateral ureteric obstruction may be minimal, undifferentiable from the expected post-operative course and thus unrecognized. No routine post operative urogram was obtained, and the kidney subsequently succumbs to so-called silent renal death. This phenomenon has also been suggested by others.[6,12,15]

Prophylactic ureteric catheter placement prior to a planned surgery of pelvic or retroperitoneal organs is not innocuous, and the presence of a catheter in the ureter does not prevent injury.[16] Perhaps the best that can be said about their use is the recognition of an overt ureteric injury is probably more likely to occur if the ureter is divided with a catheter in it. However, inlying catheters may increase the ureteral injury rate.[17]

Three ureteric perforations in association with ureteroscopic calculous manipulation that required immediate operative intervention occurred in the early period of implementation of this procedure. With advanced skill and smaller sized instruments, no similar experiences have been encountered since.

Management of ureteric injuries recognized during the concurrent surgical procedure is unquestionably immediate and definitive. However, for injuries recognized post-operatively, conservative non-operative therapy with or without ureteric stenting is indicated when a ureteric catheter can be passed and when ureteric continuity can be demonstrated. But when one is confronted with a ureteric obstruction or fistula without the possibility of passing a ureteral catheter or a loss of ureteric continuity, the controversy arises whether to proceed with definitive repair without delay or to wait for a period of time, generally, 3-6 months, before attempting surgical correction.

Several authors[18-21] recently reported early and definitive repair with results comparable to the standard delayed repair. Our approach to this situation is similar to the majority of other urologic surgeons, that is to wait 3-6 months before carrying out the definitive repair.

In conclusion, surgical injuries of the ureter mostly complicate the gynecologic (for benign diseases) and colorectal operative procedures. The pelvic portion is the most vulnerable part of the ureter. To avoid this serious complication, the ureter must be visually identified and retracted out of the operative field. Injury to the ureter recognized intra-operatively can be repaired effectively with uneventful outcomes.

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