

Use of Ureteral Catheters in Colonic and Rectal Surgery*

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Injury to the ureters is a serious complication of colonic and rectal surgery. The experience of the authors with routine use of ureteral catheters to minimize this complication is reviewed. It was found that there are minimal complications associated with their use. Injuries to the ureters were not completely avoided. However, unrecognized injuries (except ischemia) did not occur. [Key words: Injury, ureteral; Ureteral Catheters; Complications; Surgery, colonic, rectal]

THE MOST FREQUENT extraintestinal complications after operations on the colon and rectum are urologic. Injury to the ureters is probably the most serious of these and can be devastating to the recovery of the patient. Routine preoperative intravenous pyelograms (IVP) have been advocated to alert the surgeon to possible difficulties but are not reliable in preventing problems.¹

The reported incidence of operative ureteral injuries in surgery on the rectum and distal left colon varies between 1 and 10 per cent.¹⁻⁴ Most series deal with injury during abdominoperineal resection (APR) for cancer of the rectum. Because IVPs are not routinely obtained postoperatively unless complications develop, the true incidence of ureteral injury is probably higher.

Because of the inherent danger of ureteral injury during colonic surgery, it has been the practice, for many years, of the senior authors to use ureteral catheters routinely on all intra-abdominal operations on the rectum and left colon. Catheters were also used in right colon and other intra-abdominal surgery when it was anticipated that identification of the ureters might be difficult.

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Materials and Methods

To assess the effectiveness of the routine use of ureteral catheters, a retrospective review was undertaken of patients having catheters placed during the period July 1977 to June 1980. The charts were reviewed for IVP findings, indications for surgery, operation performed, the success rate of catheterization, and intraoperative and postoperative complications that might be related to placement of the catheters. The use of antibiotics and their effect on urinary tract infections were also reviewed.

The vast majority of the catheterizations were performed by two urologists. Cystoscopy was done in the dorsal lithotomy position. A Brown-Buerger # 21 cystoscope was used. In general, size 5 Bard ureteral catheters were used. An attempt was made to catheterize both ureters unless the surgeon felt that only one was at risk. The procedure added about ten minutes to the anesthetic time. Patients were placed routinely in the lithotomy position to irrigate the distal rectum in procedures on the left colon and rectum; thus an extra change in position was not required. When the EEA stapler was used, the patient remained in the same position for the entire operation. One catheter was removed at the end of the operation. The second was removed the following morning if there was sufficient urinary output.

Patient Population: There were 198 patients involved in the study. The indications for surgery are seen in Table 1. Over two-thirds of the patients had carcinoma, 17 per cent had diverticulitis, and 11 per cent had inflammatory bowel disease.

The operations performed appear in Table 2. Only 15 per cent had APR, which forms the basis of many

TABLE 1. *Indications for Surgery*

Disease	Number of Patients	(Per Cent)
Carcinoma	134	(67.7)
Diverticulitis	34	(17.2)
Inflammatory bowel disease	22	(11.1)
Polyps	7	(3.5)
Other	1	(0.5)

studies on ureteral injury. However, over 50 per cent of the operations involved the extraperitoneal rectum.

An IVP was obtained preoperatively on 181 (91.4 per cent) of the patients. The study was normal in 78 per cent; this includes patients who had prostatic enlargement or bladder residual. Abnormal IVPs were seen in 14 per cent. The major abnormalities are listed in Table 3.

Thirty-eight patients (19 per cent) had either previous pelvic or colonic surgery or a mass that made identification of the ureters difficult.

Results

Both ureters were successfully catheterized in 167 (84.3 per cent) patients (Table 4). There were an additional 11 patients who either had only one kidney or where no attempt was made to catheterize the second ureter. This is an overall success rate of 90 per cent. In only two patients could neither ureter be catheterized. One of these had catheters placed through the bladder during surgery.

Of the 31 patients who were not successfully catheterized, the following was noted. In the 13 patients in whom the left ureter was not fully catheterized, it was not tried in five, two had a positive IVP and previous surgery or a mass, two had a normal IVP and no previous surgery. All four patients with partial passage had either adhesions or a mass blocking the catheter.

TABLE 2. *Operation Performed*

	Number	Per Cent
APR	30	15.1
LAR	65	32.8
Sigmoidectomy	57	28.7
Left colectomy	13	6.5
Subtotal colectomy	10	5.05
Right colectomy	6	3.03
Hartmann closure	6	3.0
Other	11	5.5

TABLE 3. *Abnormal IVP*

Double ureters	6
Deviation of ureter	6
Absent or nonfunctioning kidney	3
Obstruction or hydronephrosis	5
Mass effect	2
Stones	3
Congenital abnormalities	3
Colovesical fistula	1

In the 16 patients who had only the left ureter catheterized, it was not tried in six, seven had a normal IVP and no previous surgery or a mass, two had a mass, and one had an abnormal IVP.

The two patients in whom neither ureter was catheterized had positive IVPs showing deviation of the ureter. One had previous surgery as well as tumor involving the bladder.

Among the 27 patients with abnormal IVPs, both ureters were catheterized in 16 (59 per cent). In five it was not attempted. In six patients, it was not possible to fully pass both catheters. In two, the ureter was blocked by carcinoma or a stone. In three, there was displacement of either the ureter or the bladder. In one, there was a duplicated ureter.

Of the 38 patients with either a mass or previous surgery, only seven could not have the ureters catheterized.

Of the 31 patients not fully catheterized, 24 had carcinoma, four had diverticular disease, and three had inflammatory bowel disease.

There was injury to the ureters in four patients. One patient had ureteral cutaneous fistula caused by devascularization of the right ureter. This patient underwent closure of a very low Hartmann, had massive adhesions, was markedly obese, and had radiation therapy. He ultimately needed ligation of his ureter proximal to the fistula.

Two left ureters were injured during division of the mesenteric vessels. In one, both the right ureter and left ureter were caught in the tie, but only one was partially cut. This was recognized and repaired. In the second, a large tumor mass was present, and the

TABLE 4. *Success of Catheterization*

	Number	Per Cent
Both ureters	167	84.3
Right only	13	6.5
Left partial	5	2.5
Left only	16	8.8
Neither	2	1

smaller size 4 catheter could not be felt. The injury was recognized and repaired.

The fourth ureter was divided during resection of a large diverticular mass. It was recognized and repaired with a ureteroneocystostomy. One year later, IVP showed normally functioning kidneys and ureters.

Complications: In evaluating the benefit of using ureteral catheters, one must ascertain any added risk to the patient. Two areas were assessed for complications. One was operative damage to the urinary system, and the other was possible introduction of infection.

Operative: There were no instances of catheter perforation in this series. The only complication directly related to the catheters was a single instance of anuria secondary to ureteral edema after removal of the catheters. This occurred in a 73-year-old woman after low anterior resection (LAR). The anuria necessitated recatheterization on two separate occasions and the use of a ureteral stent for one month. She incurred no permanent renal damage. After this case, it became the practice to remove only one catheter at a time.

Infections: For the first two years of the study, parenteral antibiotics, usually a cephalosporin, were given until oral fluids were started. In addition, the patients were placed on an oral antibiotic, usually sulfisoxazole, for two weeks. In the third year of the study, the patients were given parenteral antibiotics perioperatively and were not given oral antibiotics unless repeated bladder catheterization was necessary, a urinary tract infection was present, or the patient had marked prostatism (Table 5).

Routine urine culture was obtained in 126 (63.6 per cent) patients when the Foley catheter was removed. There were positive cultures for 15 (11.9 per cent) of patients. Four had antibiotics for one day and 11 for longer periods of time. Six patients were observed to have urinary tract infections after discharge, four of whom had had long-term antibiotics in the hospital as well as oral antibiotics on discharge.

There were no instances of pyelonephritis noted. Ten patients had preoperative urinary tract infections.

Discussion

When operating on the colon and rectum, one must be well aware of the anatomy and the danger zones where the ureter can be injured. These are: (1) ligation of the inferior mesenteric vessels; (2) ovarian fossa, where the ureter comes into close proximity to the adnexa; (3) near the retrovesical pouch or cul-de-sac, where the ureter crosses the vas deferens and the promontory of the sacrum; (4) division of the lateral

TABLE 5. *Antibiotic Usage*

Days on Intravenous Therapy	Percentage
1	24.7
2-4	6.5
5-7	48.1
Over 7	20.7
Oral antibiotic	
None	32
Some	68

ligaments; and (5) during reperitonealization when the ureter may be included in the stitch.

What steps can be taken to avoid injury to the ureter? During operation, certain precautions should be taken: (1) prior to ligating the inferior mesenteric vessels, it is necessary to define the left ureter and to keep it well out of harm's way; (2) during division of the lateral ligaments, the ureter should be retracted laterally to the proposed line of resection (this is more important on the left than the right); (3) the ureter should be carefully identified during dissection near the ovarian fossa; (4) care needs to be taken during reperitonealization to not take big bites that may include the ureter.

What advantage, if any, does the use of ureteral catheters afford the surgeon? How do our results compare with those of other series?

Kramhøft *et al.*,¹ in a review of 362 APRs and 207 LARs for cancer, found ten ureteral injuries, one bilateral, five on the left, and three on the right. Four were complete transections. Only three were recognized at the time of surgery.

Tank *et al.*,² in a review of 150 APRs for cancer, found eight injuries, an incidence of 5.3 per cent. Two were recognized intraoperatively and repaired. Two developed ureterocutaneous fistulas, and two had bilateral ischemic injuries.

Baumrucker and Shaw,³ studying a series of 105 APRs, reported six definite injuries and two probable injuries.

Graham and Goligher⁴ reviewed 1605 operations and found an incidence of just under 1 per cent. However, most of these injuries were not recognized at the time of surgery, and significant complications, including kidney loss as well as death from uremia, occurred.

With these studies as a comparison, what conclusions can be drawn from our study (Table 6)? First, our study shows that the use of ureteral catheters is safe. The incidence of urinary infection does not differ from that encountered when using an indwelling

TABLE 6. *Collected Series on Ureteral Injuries*

Authors	Number of Patients	Number of Injuries	Per Cent
Kramhøft <i>et al.</i> ¹	569	10	1.8
Tank <i>et al.</i> ²	150	8	5.3
Baumrucker and Shaw ³	105	8	7.6
Graham and Goligher ⁴	1605	15	0.9
Rubin and Salvati	198	4	2.0

bladder catheter which is a necessary part of these operations. The one episode of anuria secondary to the edema associated with the ureteral catheters is quite a low frequency and is probably avoidable if the catheters are removed one at a time over a period of 24 hours. Second, there were no unrecognized injuries to the ureters other than those due to ischemia. In Campbell's *Textbook of Urology*,⁵ a review of 30 ureteral injuries showed that only seven (23 per cent) were discovered in the operating room, while 64 per cent were discovered over 48 hours later (Table 7). Our one instance of ischemic damage and subsequent urinary fistula may have been avoided if the catheter on the affected side had been left in for an extended period of time.

The two injuries that occurred during ligation of the inferior mesenteric vessels should have been avoided. Even though they were cut by a resident, it would be unjust to blame inexperience alone for the injury.

The patient in whom the ureter was divided during resection of a diverticular mass illustrates a situation where a catheter is most useful. On several occasions, division of the ureter was avoided or made less likely because palpation of the catheter alerted the surgeon

TABLE 7. *Ureteral Injury*

Time from Injury to Diagnosis	Number	Per Cent
Immediate (in operating room)	7	23
4-12 hours later	1	3
12-48 hours later	3	10
Over 48 hours later	19	64

to the ureter's presence in the face of altered anatomy. Most importantly, even if the catheters do not prevent cutting the ureters entirely, they allow one to recognize the injury and repair it at the time of the initial surgery. The only kidney lost in the series was in the patient with ischemic damage.

Conclusions

Even though the senior authors use catheters routinely, it is unrealistic to believe that everyone will or should adopt this method. Are there any guidelines to determine which patients would benefit most from catheters? This study, as well as others, shows that the IVP is not reliable enough to use as the sole determining factor. However, there are certain cases in which trouble can be anticipated and catheters placed preoperatively. These are patients with previous pelvic or colonic surgery, complicated diverticulitis, Hartmann closure, and large rectal cancers. If catheters are used in these cases, the incidence of injury will be lowered, and unrecognized injuries (except ischemia) will not occur.

Moreover, it should be kept in mind that, if one encounters a difficult dissection that was not anticipated preoperatively and thus catheters were not placed, one can still pass catheters intraoperatively. This can be done through the bladder, as was the case for one of our patients, or through the ureter, as described by Remington.⁶

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