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Original Research Article

Ureteric injuries during cancer surgery presentation and management over a 20-year

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ABSTRACT

Background: Iatrogenic ureteral injury rare 0.3-1.5%. complication of abdominopelvic cancer surgery. We aimed to study the risk and management of ureteral injury among cancer patients.
Methods: Diagnosis can be achieved retrograde pyelography, ureteroscopy, CT, or intravenous urography.
Results: Years 2000 to 2020, 2904 patients in the Department of Surgical oncology, Assuit University, and 47 ureteral injury cases were identified. (1.62), 4/231 cervical cancer, 9/611 ovarian cancer and 7/462 endometrial cancer.,11/818 colon cancer,12/620 rectal cancer, 1/11 prostatic cancer, 3/151 retroperitoneal sarcoma. 34% (radical abdominal hysterectomy 8.5% Wertheim hysterectomies 4%), colorectal surgery colectomy 25.5%, low anterior resection2.1% in radical prostatectomy and 6.4% in retroperitoneal tumor, intraoperative diagnosis 48.9%, 8.5% in laparoscopic surgeries, the distal third (53.2%),23.4% catheterization, complete transection 31.9%; partial 14.9%, ligation 8.5%, laceration in 19.1%, resection. 8.5%; and devascularization in 17%. Fever in 14.9%, abdominal or flank pain in 38.5%. Oligura in 6.4%, ileus in 19.3%, urinary leakage (vaginally or via abdominal wound) in 10.6% rise creatinine in 10.6%, hydronephrosis in 6.4%, urinoma in 27.7%, extravasation in 8.5% asymptomatic in 4.3%, 40.4% percutaneous nephrostomy. 19.1%primary repair Ureteroneocystostomy in (17%) Boari flap in 12.7%, Psoas hitch in 23.4% stenting in 14.9%, 8.5% ileum interposition, anastomosis to contralateral ureter in 4.3%, ureteral stricture 6.4%, ureterovaginal fistulas in 10.6%, acute renal failure 2.1%, peritonitis 4.3, urinary tract infection in 14.9%.
Conclusions: The recognition and immediate repair of ureteral injuries early during the same procedure was highly desirable and to avoid a second operation.

Keywords: Iatrogenic ureteral injury, Oncological surgery, Morbidity

INTRODUCTION

Ureter injury is the risk of any pelvic or abdominal surgery, during gynecologic, urologic, and colonic operations.[1] Malignancy has been established as risk factor for iatrogenic ureteric injury the overall incidence of ureteral injury varies between 0.5% and 10%.[1] Iatrogenic in 75% of all ureteric injuries ureteric injuries most commonly occurs during gynecological procedures (0.075-1.7%), followed by colorectal procedures (0.25-1.1%). most frequently occurs during proctectomy (abdominoperineal resection and low anterior resection) and sigmoidoscopy.[2-4] Minimal access surgery is associated with higher risk of ureteric injury than open

surgery risk factors are pelvic malignancy, huge pelvic masses, congenital anomalies of the urinary system, previous abdominopelvic surgery, and radiation therapy.[5]

Difficulty in visualization because of distorted anatomy, excessive hemorrhage at surgery time and rarely congenital abnormalities i.e., duplication of ureter are the usual causes of inadvertent injury.[6] Visualization of the ureter during the procedure is reliable and cost effective.[6] Ureteric injuries for abdominal hysterectomy were reduced from 0.7 to 0.2% when the ureters were thus exposed.[7] In a systematic review of 90 studies, electrosurgery was the most ureteral injury cause (33 percent).[8] Other modes of ureteral injury intraoperatively include crushed with a clamp, lacerated during sharp/blunt dissection using a source of energy, devascularization or denervation, or resection.[4,8]

Potential consequences of lower UTI include ureteral obstruction (resulting in hydronephrosis and possible irreversible injury which, if bilateral, can lead to renal failure), genitourinary fistula and urinoma. Any of these consequences can lead to readmission, sepsis, and death vesicovaginal fistula and ureteric stenosis.[8,9] Intraoperative identification and repair are recommended.[2] Early identifications of the injury and prompt repair are advocated in order to minimize postoperative morbidity.[2] However, most cases of ureteric injuries are recognized late. Patients may present with prolonged ileus, flank pain, ascites, and azotemia etc. with 5% patients present very late with hydronephrosis and non-functioning kidney.[10]

So, this work was to study the etiology, clinical features and treatment of iatrogenic ureteric injuries in cancer surgery.

METHODS

A retrospective study involved patients managed in the department of Surgical Oncology south Egypt Cancer Institute Assuit University. ureteric injuries for Malignant conditions during 20years from December 2010 to December 2020. During this period, a total of 47 ureteric injuries patients were treated. The various investigations done included: chest X-ray ultrasound of the urinary tract, serum creatinine, Intravenous Urogram (IVU)/computed tomography (CT) scan, cystoscopy and retrograde pyelography (RGP) IVU demonstrates ureteric injury and hydroureteronephrosis, with cutoff of the contrast at the injured site of the ureter and contrast leak. Antegrade nephrostogram was studied postoperatively on the patient with a nephrostomy tube, CT and MR urography are used increasingly for detection of ureteric injuries and demonstrates hydroureteronephrosis due to ureteric stricture and ureterovaginal fistula. and creatinine in drainage liquid, extravasated urine may appear as a well-defined water-density fluid collection of variable size or as ascites present with a retroperitoneal collection of urine (urinoma), A number of pathologic conditions can distort the anatomy of the ureter, especially as it relates to the female genital tract: Malignancies such as ovarian cancer often encroach on and occasionally encase the ureter changes in management, e.g. the use of pelvic or para-aortic lymph node sampling/dissection in uterine cancer, When a high-risk situation is encountered, critical preventive steps include: adequate exposure, competent assistance, exposure of the path of the ureter through the planned course of dissection. Direct visualization of the ureters in the pelvis helps reduce ureteric injury risk, the ureter should be carefully isolated to diminish the risk of damage to the blood supply, Ureteral stents are sometimes placed in order to aid in identification and dissection of the ureters during surgery. However, stents didn't clearly reduce the injury risk while, in some cases, may risk increase due to false sense of safety and subject the ureter to adventitial injury during difficult dissection.

At our institution, placement of ureteral stents before cancer operation is not standard and is left to the discretion of the individual surgeon. The ureter may be injured be ligation or kinking by a ligature, crushing by a clamp, division, devascularization. Blind clamping of blood vessels has been identified as the predominant cause of ureteric injury in obstetric procedures. Thus, the control of bleeding is likely to reduce this risk.

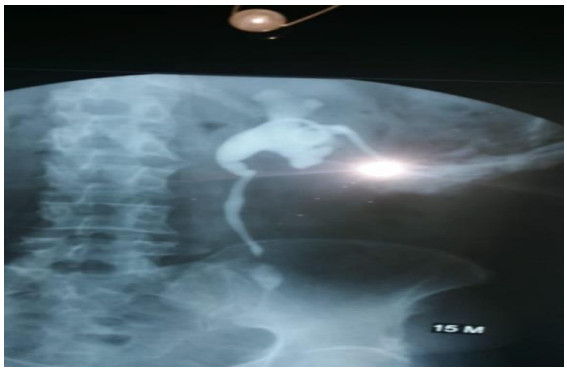

Figure 1: Intravenous urogram (IVU) left lower third injury.

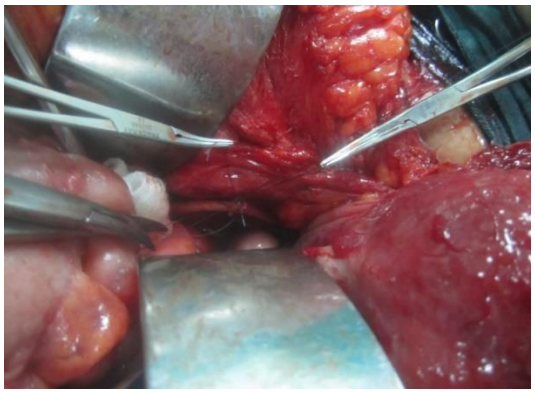

Figure 2: Intraoperative lower third left ureteric injury after radical hysterectomy primary anastomosis over ureteric stent.

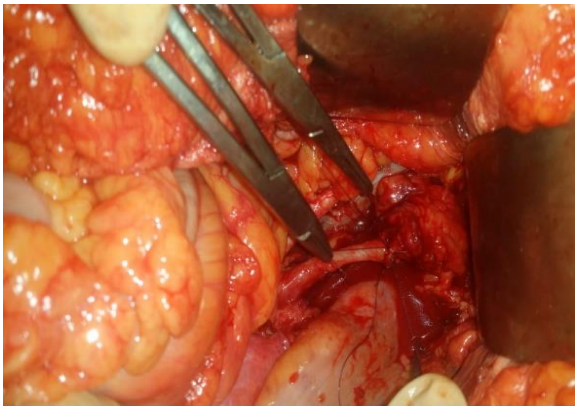

Figure 3: Ovarian cancer intraoperative discover injury left urter reimplaination to urinary bladder.

The ureteric injuries management depends on their nature, and time of discovery, as well as the patient's overall condition, intraoperative identification and repair are recommended. With the improvement in endo-urologic procedure, most of these can be managed by stenting. With the advent of ureteric reimplantation, nephrostomy, even complete transactions, diagnosed late postoperatively were also managed effectively. Partial transections are typically corrected by suture repair or resection of the affected segment. Frequently, a ureteral catheter is inserted through anastomosis to serve as stent (Figure 1). The majority of strictures are seen in the distal 3rd of ureter, below the pelvic brim and can be repaired with ureteroneocystostomy (Figure 2, 3).

Transureteroureterostomy is realized by mobilizing the donor ureter, ileal segment, to replace lower part of ureters and to form a cystoplasty. follow-up within the first month of performing the procedure, monthly ultrasonography for 2 years, whereas others advocate 6-monthly IVUs for 1 year (or until these are normal). In our unit, we remove the stent after 6 weeks, following intravenous or CT urography.

Statistical methods

SPSS version 25.0 was used in data management. Mean and standard deviation with median and range were used for numerical data description. Number and percentages described qualitative data

RESULTS

From October 2000 to October 2020, a total of 2904 cases of Surgical oncology operations were performed in our Institute. Of all these patients, 47 (1.62%) had Ureteric injury, including 16males and 31females, the mean age was 58.5 years (34–78-year-old). the ureteral injury was unilateral in all cases. cancer of the uterus cervical 4/231, 1.73% and endometrial 7/462, 1.52%, ovarian cancer 9/611, 1.47%, colon cancer 11/818 1.34%, rectal cancer 12/620 1.94%. Prostatic cancer 1/11 9.09% and mesodermal cancer (retroperitoneal sarcoma) 3/151 1.99%, as shown in Table 1.

Table 1: Ureteric injury by type of primary tumor.

	Total cases	Ureteric injury	Percentage	P value
Cervical cancer	231	4	1.73	0.558
Colon Cancer	818	11	1.34	
Endometrial cancer	462	7	1.52	
Ovarian cancer	611	9	1.47	
Prostatic Cancer	11	1	9.09	
Rectal Cancer	620	12	1.94	
Retroperitoneal Sarcoma	151	3	1.99	
Total	2904	47	1.62	

Table 2: Incidence and timing of diagnosis of ureteric injury.

	Number	Percent
Ureteric Injury		
Radical abdominal hysterectomy (RAH)	16.0	34.0
Wertheim's procedure	4.0	8.5
Colectomy	11.0	23.4
Anterior resection	12.0	25.5
Radical prostatectomy	1.0	2.1
Retroperitoneal tumor excision	3.0	6.4
Total	47.0	100.0
Timing of Diagnosis of ureteric injury		
Intraoperative	23	48.9
Postoperative	24	51.1
Total	47.0	100.0

Regarding, gynecological operations involving 34% of ureteric injuries, occur in Radical abdominal hysterectomy with an 8.5% with radical wertheim hysterectomies, 23.4% occur in colorectal surgery colectomy, 25.5% in low anterior resection, 2.1% in radical prostatectomy and 6.4% in retroperitoneal tumor excision. Also, injury diagnosed intraoperatively in 48.9%, but 51.1% are diagnosed postoperatively. With an average time from surgery to diagnosis of 4–23 days. As shown in Table 2.

Whereas, 8.5% of injury with laparoscopic surgeries (laparoscopic hysterectomies, laparoscopic colorectal surgery. While, 91.5 % occur with open procedures. We do 143 laparoscopic surgeries ureteric injury 2.8% and in open surgery 43/2761, 1.6%. Concerning, location of injury, the distal (lower) 3rd of the ureter is most prone to injury (53.2%), followed by the middle third (34%) and the proximal (upper) third (12.8%). The left ureteric injury occurred frequently 66% following surgery, the left ureter bringing it closer to the pelvic structures, the right ureter less to iatrogenic injures 34%. As shown in Table 3.

Table 3: Ureteric injury with laparoscopic surgeries.

	Number	Percent
Laparoscopic surgeries		
Laparoscopic surgery	4	8.5
Open surgery	43	91.5
Total	47.0	100.0
Location of injury		
Proximal ureter	6	12.8
Mid ureter	16	34.0
Distal ureter	25	53.2
Total	47.0	100.0
Site of injury		
Left ureter	31	66.0
Right ureter	16	34.0
Total	47.0	100.0

Table 4: Prophylactic ureteric catheterization and forms of ureteric injury.

	Number	Percent
Prophylactic ureteric catheterization		
Stent	11	23.4
No stent	36	76.6
Total	47.0	100.0
Forms of ureteric injury		
Ligation	4	8.5
Laceration	9	19.1
Partial transection	7	14.9
Complete transection,	15	31.9
Resection.	4	8.5
Devascularization	8	17.0
Total	47	100

In the current study, 23.4% ureteric injury patients had preoperative prophylactic ureteric catheterization while 76% not applied ureteral stents. Injury forms were complete transection 31.9%; partial transection, in 14.9%, ligation 8.5%, laceration in 19.1%, resection. 8.5%; and devascularization in 17%. As shown in Table 4.

Regarding, symptoms and signs of ureteric injury, The most common postoperative symptoms of fever in 14.9%, abdominal or flank pain in 38.5%. Oligura in 6.4%, abdominal distension with ileus in 19.3%, urinary leakage (vaginally or via abdominal wound) in 10.6% rise in serum creatinine in 10.6%, leukocytosis in 25.5%, hydronephrosis was found in 6.4%, urinoma in 27.7%, extravasation in 8.5% while asymptomatic iatrogenic ureteric injuries in 4.3%. As shown in Table 5.

Table 5: Symptoms and signs of ureteric injury..

	Number	Percent
Fever	7	14.9
Abdominal or flank pain	18	38.5
Oligura	3	6.4
Asymptomatic	2	4.3
Abdominal distension with ileus	9	19.3
Urinary leakage (vaginally or via abdominal wound)	5	10.6
Rise in serum creatinine	5	10.6
Leukocytosis	12	25.5
Hydronephrosis	3	6.4
Urinoma	13	27.7
Extravasation	4	8.5

Concerning, treatment modality of ureteric injury, 40.4% required initial percutaneous nephrostomy. 19.1%, treated with primary repair ureteroneocystostomy was performed in (17%) as the involved part of the ureter was under the level of the pelvic brim, Boari flap in 12.7% and Psoas hitch was required in 23.4% cases. endoscopic stenting in 14.9%, 8.5% used the ileum as the interposition graft, anastomosis to contralateral ureter in 4.3%. As shown in Table 6.

Table 6: Treatment modality of ureteric injury.

Treatment modality	Number	Percent
Nephrostomy	19	40.4
Primary repair	9	19.1
Ureteroneocystostomy.	8	17.0
Psoas hitch	11	23.4
Boari flap,	6	12.7
Endoscopic stenting	7	14.9
Ileal ureter replacement	4	8.5
Anastomosis to contralateral ureter.	2	4.3

In our study, complications of ureteric injury follow up revealed ureteral stricture development in 6.4% cases, ureterovaginal fistulas in 10.6%, acute renal failure 2.1%, peritonitis in 4.3, Metabolic acidosis in 4.3%, urinary tract infection in 14.9% and wound infection in 8.5%. As shown in Table 7.

Table 7: Complications of ureteric injury.

Complications of ureteric injury	Number	Percent
Strictures	3	6.4
Ureterovaginal fistula (UVF)	5	10.6
Uremia	1	2.1
Peritonitis	2	4.3
Metabolic acidosis	2	4.3
Urinary infection	7	14.9
Wound infection	4	8.5

DISCUSSION

In gynecologic surgery, where they have a reported incidence ranging from 0.07% to 1.70%. In contrast, colorectal operations are the second most common cause of Ureteric injury, with a reported incidence of 0.24% to 1.95%.[11] by the type of primary tumor, with a maximum of 10.5% for ovarian cancer, followed by 2.7% for cervical cancer, 2% for rectal and rectosigmoid junction cancer and with no lesions recorded for endometrial cancer in our study cancer of the uterus (cervical 4/231, 1.73% and endometrial 7/462, 1.52%), ovarian cancer 9/611, 1.47%, colon cancer 11/818 1.34%, Rectal Cancer 12/620 1.94%.[2] Prostatic cancer 1/11 9.09% and mesodermal cancer (retroperitoneal sarcoma) 3/151 1.99%. The incidence of ureteric injury varies between 0.1% and 30%, depending on the type of surgery.[12] Ureteric injury occurs in radical Wertheim hysterectomies (1–30%).[13] Hoffman et al reported a 2.2% incidence with radical total hysterectomies, 2.4% for rectosigmoid colectomy 2 radical hysterectomy was associated with highest incidence of 2.5%,low anterior resections, 0.24% have been reported.[14,15] In our study Iatrogenic urinary lesions have an overall incidence of 1.6%, with a 34% of them with radical total hysterectomies, 8.5 % Werthiem's hysterectomy, 23.4% for colectomy, 25.5% in the case of anterior resection, 2.1% for radical prostatectomy and 6.4% retroperitoneal tumor excision.

Intra-operatively recognized injuries are usually more easily repaired at the time without the need for a second surgical intervention. The delay in the diagnosis leads to increase in morbidity, prolonged hospital stays and repeat surgery.[14] Most lesions of the ureter (60–70% of cases) are detected during the late period (from 3 to 33 days).[16] Half of the cases were diagnosed intraoperatively and repaired immediately. The other half were diagnosed and treated after a variable delay of an average of 13.1 days (range 1–29).[17] 70% were postoperative diagnosed.[18] In our study intraoperative injury diagnosed in 48.9%, but 51.1% are diagnosed postoperatively. With an average time from surgery to diagnosis of 4–23 days depending on the presenting clinical picture.

Ureteral stents are sometimes placed in order to aid in identification and dissection of the ureters during surgery. Hoff man, believe that However, stents didn't clearly reduce the injury risk while, in some cases, may risk increase due to false sense of safety and subject the ureter to adventitial injury during difficult dissection.[9]

In our study 23.4% ureteric injury patients had preoperative prophylactic ureteric catheterization while 76% not applied ureteral stents.

Laparoscopic gynecological surgery is now responsible for the highest rate of ureteric injuries (64%), compared with 26% for general surgery and 11% for urological procedures. 3 laparoscopic surgeries have increased the incidence of urologic injuries 14 ureteric injury 0.5 and 1.5% as complication of open gynecologic surgery and 0.5–14% in laparoscopic surgeries, 5 laparoscopic colectomies corroborated significant differences in incidences of 0.66% and 0.15% in laparoscopic and open cases, respectively 15 a 7.5-fold increase of injury.[3] In our study 8.5% of ureteral injury occur with laparoscopic surgeries (laparoscopic hysterectomies, Laparoscopic colorectal surgery) while 91.5 % occur with open procedures. We do 143 laparoscopic surgeries ureteric injury 2.8% while in open surgery 43/2761, 1.6%. We are in our in the early phase of training we found greater difficulty identifying the ureter a steeper learning curve more frequent use of energy to hemostatic ally divide pedicles, with the potential for thermal injury, less traction–countertraction, resulting in dissection closer to the ureter. Iatrogenic injuries involve the upper, middle, and lower 3rd of ureters in 2%, 7%, and 91% of cases, respectively. 3 Injury found in lower 3rd of ureter (51%), upper 3rd (30%) and middle 3rd (19%). 18 in our study the distal (lower) 3rd of ureter is most prone to injury (53.2%), followed by the middle third (34%) and the proximal (upper) third (12.8%).

The left ureteric injury occurred frequently following surgery, the left ureter bringing it closer to the pelvic structures, the left ureter more to iatrogenic injures.[5] In our study the left ureteric injury occurred frequently 66%. The placement of ureteric stents preoperatively wasn't decreasing the ureteric injuries risk as demonstrated by Kuno et al. In fact, the presence of the ureteric stents may actually make the ureter less pliable and more rigid thereby increasing the injury risk during dissection to mobilize it.[7] Several studies suggest ureteric catheters lower the overall injury rate during complex surgery by improving visualization of the ureter through the peritoneum, and/or allowing more frequent or timelier identification of such injuries. Others do not find any clear benefit of using ureteric catheters.[13] In our study

23.4% ureteric injury patients had prophylactic ureteric catheterization. Injury forms were complete transection in 61%; ligation in 7%; partial transection in 3% and excision in 29%. While, Nerli et al.12 found partial transection by 3%, complete transection by 61%; ligation by 7%, excision by 29%. In our study, complete transection found in 31.9 %; partial transection in 14.9%, ligation in 8.5%, laceration in 19.1%, resection in 8.5%; and devascularization in 17%.

Unfortunately, in most cases, diagnosis of urological injuries, especially to the ureter, is made postoperatively. A high index of suspicion must be maintained in patients with unexplained hematuria, fever, abdominal or flank pain and poor urine output. Stanhope et al. observed that there was a mean rise in serum creatinine of 71 mmol/L (range, 27-124 mmols/L) 36-48 hours postoperatively from preoperative levels in patients with unilateral ureteric obstruction. It should be noted that typical symptoms may be absent in up to 50 % of women.[7] In our study the most common postoperative symptoms of fever in 14.9%, abdominal or flank pain in 38.5%. oligura in 6.4%, abdominal distension with ileus in 19.3%, urinary leakage (vaginally or via abdominal wound) in 10.6% rise in serum creatinine in 10.6%, leukocytosis in 25.5%, hydronephrosis was found in 6.4%, urinoma in 27.7%, extravasation in 8.5%, while asymptomatic iatrogenic ureteric injuries in 4.3%.

Shoemaker introduced the Ileal ureter replacement and was popularized by Goodwin et al.[19] Some studies found high success rate with ureteroneocystostomy.[5] In all injuries of ureteric percutaneous nephrostomy drainage recovered of ureter in 80% cases.[10] Lask et al ureteric injuries patients under percutaneous nephrostomy, out of these 16 (80%) had complete spontaneous recovery of injured ureter after 14–66 days.[20,10] Also, Al-Awadi et al reported a success rate of 59.4% with "JJ" stent insertion in their series of 75 patients with ureteral injuries.[1] Ureteroneocystostomy was performed in most cases (70 %) as the involved part of the ureter was under the level of the pelvic brim 1758.1% underwent ureteroneocystostomy. Ureteroneocystostomy with Boari flap and Psoas hitch was required in 6.9% cases.[10] In our study 40.4% required initial percutaneous nephrostomy. 19.1%, Treated with primary repair ureteroneocystostomy was performed in (17%) as the involved part of the ureter was under the level of the pelvic brim, Boari flap in 12.7% and psoas hitch was required in 23.4% cases. endoscopic stenting in 14.9%, 8.5% used the ileum as the interposition graft, anastomosis to contralateral ureter in 4.3%. Postoperative complications involving the urinary tract which included urinary tract infection (UTI) (5/337 patients, 1.48 %), acute renal failure (2/337, 0.6%), and ureterovaginal fistulae (1/337 patients, 0.3%) 6% ureteral stricture after ureteroneocystostomy.[13] Selzman et al reported that ureterovaginal fistulas resolved in all seven patients treated with an internal ureteral stent.[1] Tanagho et al. found that after persistent reflux, five patients experienced progressive renal deterioration.[19] In our study complications of ureteric injury follow up revealed ureteral stricture development in 6.4% cases, ureterovaginal fistulas in 10.6%, acute renal failure 2.1%, peritonitis in 4.3, metabolic acidosis in 4.3%, urinary tract infection in 14.9% and wound infection in 8.5%.

Limitations

There were some limitations in this study is its retrospective design, which may have resulted in incomplete data. Second, is the low number of patients. Our center is not a urological surgery center; thus, the number of eligible patients is low. the sample size was small, which may have introduced bias in the results. The short-term follow-up is another limitation of the study, and the results are therefore preliminary. Follow-up of these patients is ongoing. Therefore, a prospective study should be planned to clarify the magnitude of ureteric injury post cancer surgery finally.

CONCLUSION

Iatrogenic ureteral injuries constitute a major complication that may be experienced even by experienced surgeons. more in laparoscopic surgery than conventional surgery. No benefit from prophylactic ureteral catheterization, Early diagnosis is important to avoid more morbidity Because oncosurgery most of the risk factors, an increased awareness by surgeon, as well as meticulous technique, may help in reducing the ureteric injuries.

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