

## ORIGINAL ARTICLE

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# Pelvic intraoperative iatrogenic oncosurgical injuries: single-center experience

Constantin Octavian Neagoe, Octavian Mazilu

Second Department of General Surgery and Oncology, University of Medicine and Pharmacy, Timisoara, Romania.

### Summary

**Purpose:** Iatrogenic events are more likely to occur during surgical treatment of malignant conditions. Gynecologic and colorectal cancers account for most of the cases that require surgical treatment within the pelvic area. The purpose of this study was to analyze the incidence of intraoperative accidents and the most frequently encountered injuries during surgery for cancers of the pelvic area.

**Methods:** The records of 2702 patients admitted to our clinic over a 15-year period, (January 2000-December 2014), were analyzed for type and frequency of intraoperative accidents.

**Results:** Urinary tract lesions were the most common injuries seen in this series (63.1%), followed by enteral (28.1%) and vascular (8.8%) injuries, with an overall incidence of

2.9% for the whole group. Iatrogenic injuries showed a statistically significant difference in incidence depending on the type of primary malignancy ( $p < 0.002$ ). Cervical cancer was associated with a higher rate of ureteral lesions, whereas enteral injuries occurred predominantly during surgical resection for ovarian cancer. The use of neoadjuvant radiotherapy or chemotherapy has been associated with a significantly lower risk of surgical iatrogenic injuries ( $p = 0.004$ ).

**Conclusion:** Immediate recognition of the lesion and prompt treatment are recommended in order to lower postoperative complications and to avoid a second operation.

**Key words:** enteral injuries, iatrogenic, intraoperative accidents, urinary tract injuries, vascular injuries

### Introduction

Colorectal and gynecological cancers account for the majority of pelvic malignancies treated surgically, excluding the endoscopic approach of prostate and bladder cancer [1].

The evolution, dissemination pattern and late diagnosis of these cancers, considering the loco-regional anatomy, entail not only the invasion of other pelvic structures, but also the involvement of extrapelvic organs, exposing them to either direct (anatomical) or indirect (functional) injuries in the process of surgical excision of the primary tumor and its regional extent [2].

The incidence of intraoperative accidents and postoperative complications during pelvic surgery varies largely between authors with reported

values between 1.85% and 9.8% [3-5], and 13.7% for postoperative morbidities [4]. Malignancy has been established as an independent risk factor for iatrogenic intraoperative lesions [6-8].

Intraoperative incidents and accidents, as well as postoperative complications, may be favored or generated by certain factors, such as locoregional particularities (congenital or acquired), particularities of the disease (primary or secondary) and particularities of the operative technique (intentional or non-intentional) [9].

Surgical treatment for oncologic conditions is associated with a higher risk of iatrogenic events. In the surgical effort for loco-regional radical resections of pelvic cancers, the occurrence of iatro-

**Table 1.** Frequency of intraoperative iatrogenic injuries in relation to neoadjuvant therapy

	No. of patients	Intraoperative incidents, %
With neoadjuvant therapy	1713	2.4
Without neoadjuvant therapy	252	5.9

genic lesions may impact short and long term results, affecting not only patient survival, but also the quality of life.

The aim of this study was to analyze the incidence of intraoperative accidents and the most frequently encountered injuries, in an attempt to improve the approach and management of this kind of patients.

## Methods

In this retrospective study the records of 2702 patients admitted to the Department of General Surgery II and Surgical Oncology Clinic at the Emergency City Hospital (Timisoara, Romania) for a primary malignancy located within the pelvic area were reviewed. These patients covered a period of 15 years (January 2000-December 2014).

On admission to our clinic all patients signed informed consent. The study started after approval by the hospital's Ethics Committee.

All patients underwent surgical treatment with either curative or palliative intent for cancers of genital (2332 patients), rectal and rectosigmoid junction (363 patients), or pelvic-subperitoneal sarcoma of ischio-rectal fossa (7 patients) origin.

Data regarding patient demographics, tumor type and stage, pathology reports, type of oncologic treatment received (neoadjuvant or adjuvant), surgical details such as macroscopic tumor invasion, loco-regional anatomical particularities, intraoperative incidents and postoperative complications were extracted from patient files, surgical records and hospital database.

### Statistics

Statistical analyses were performed using SPSS software for Windows, version 17. Descriptive analysis of continuous data was described as mean and range and quantitative data was presented as frequencies (percents). Evaluation and comparison of the type and frequency of intraoperative complications were performed with Fisher's exact one-tailed test and Pearson's  $\chi^2$  test. A  $p$  value < 0.05 was considered as statistically significant.

## Results

From the 2702 patients assessed in our study, 138 (5.1%) were male and 2564 (94.9%) female. Sex distribution showed a predominance of fe-

male patients with a M/F ratio of 0.054, due to the high incidence of gynecological cancers in our country and the large number of female patients that addressed to our clinic. The median age of the studied group was 57.3 years (range 29-91). In this series 1713 (87.2%) patients underwent neoadjuvant therapy, consisting of preoperative radiotherapy, chemotherapy or chemoradiotherapy. In this group, intraoperative complications were seen in 42 cases (2.4%). Of 252 (12.8%) patients who did not receive any kind of neoadjuvant therapy, iatrogenic lesions were encountered in 15 (5.9%) cases (Table 1). The difference between the two groups was statistically significant ( $p=0.004$ ).

The main pathologies that required pelvic surgical oncological treatment were as follows in order of frequency: cancer of the uterus (cervical 62.1% and endometrial 8.2%), ovarian cancer 15.5%, rectal and rectosigmoid junction cancer 8.6% and mesodermal cancer (pelvic sarcoma) 0.5% in women; and rectal and rectosigmoid junction cancer 4.9% and mesodermal cancer 0.2% in men.

Gynecological cancers accounted for 86.3% (2332 patients) of the cases, including 14 cases of sarcoma with uterine (9 patients) and adnexal (5 patients) location, followed by rectal and rectosigmoid junction cancer representing 13.4% (363 patients) from the sum of patients and ischio-rectal fossa sarcomas with 0.2% (7 patients).

Excluding the 14 sarcoma cases, genital cancers had the following distribution: cervical cancer 71.9% (1677 patients), ovarian cancer 18% (420 patients) and endometrial cancer 9.5% (222 patients).

From the total of 2702 cases, large resections of the primary pelvic tumor was possible in 1965 patients, with a resectability rate of 72.7%; the remaining 737 patients underwent surgery with diagnostic intent or surgical palliation with minimal cytoreduction or digestive by-pass.

For ovarian cancer 123 total hysterectomies with unilateral or bilateral adnexectomy were performed, with omentectomy and pelvic lymphadenectomy according to case particularities, the resectability rate rising up to 29.3%.

In case of cervical cancer, a total of 1483 total hysterectomies and unilateral or bilateral adnex-

**Table 2.** Types of iatrogenic lesions

Types of iatrogenic injury		No. of cases	%	%
Urinary tract (Total=36)	Ureteral kinking	5	8.8	
	Partial ureteral sectioning	6	10.5	63.1
	Complete ureteral sectioning	9	15.8	
Enteral (Total=16)	Bladder opening	16	28.1	
	Opening of the rectum	4	7.0	28.1
	Perforations of the small bowel	12	21	
Vascular (Total=5)	Hypogastric vein lesions	5	8.8	8.8

ectomy associated or not with pelvic lymphadenectomy were performed, with a resectability rate of 88.5%.

A total of 204 total hysterectomies with unilateral or bilateral adnexectomy were performed for endometrial cancer, in which pelvic lymphadenectomy was associated with primary tumor stage and/or presence of pelvic lymphadenopathy, the resectability rate being 91.7%.

For rectal and rectosigmoid junction cancer 144 surgical resections were performed (66 anterior resections by using the Dixon procedure and 78 rectal amputations) with a 39.7% resectability rate.

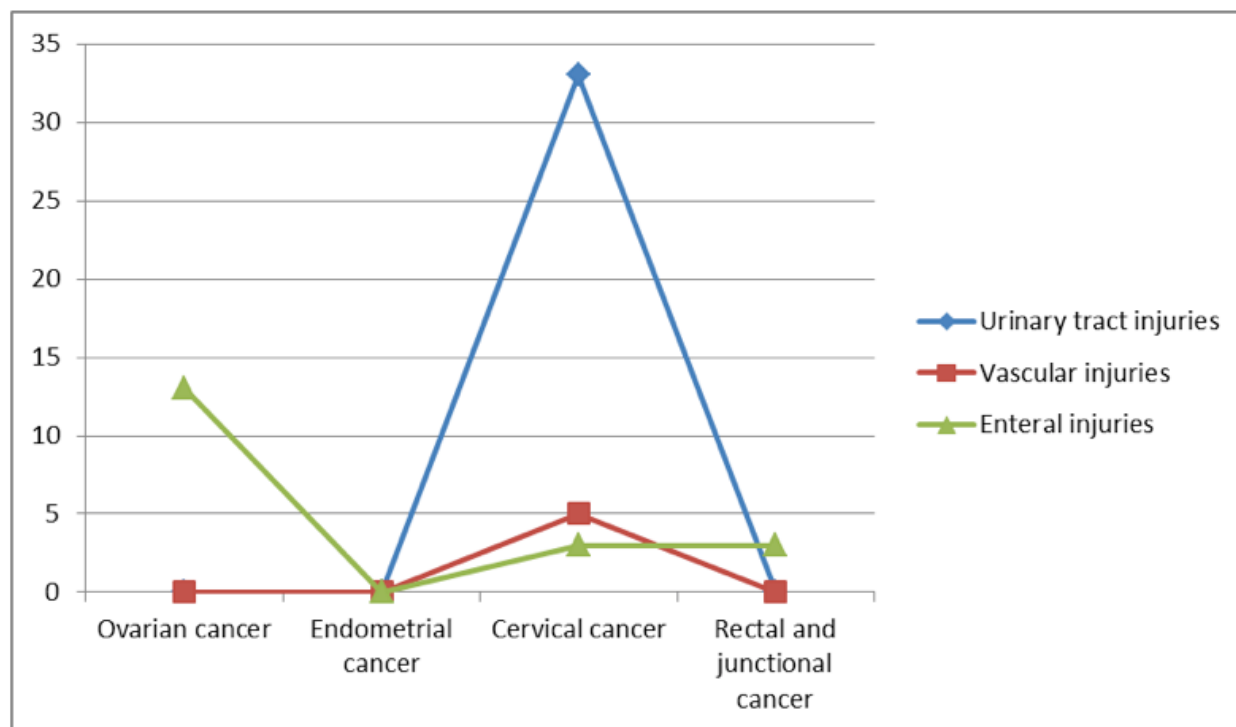
In case of pelvic sarcomas 10 total hysterectomies and one bilateral adnexectomy with pelvic lymphadenectomy were performed (11 of the 14 genital sarcoma cases), with a resectability rate of 52.4%. None of the extragenital sarcomas (7 cases) could be resected.

Major intraoperative incidents and accidents summed up to a total of 57 (2.9%) cases. These were represented by ureteral-vesical injuries in 36 (63.1%) cases (ureteral kinking due to partial ligation 5 cases; bladder opening 16 cases; partial ureteral sectioning 6 cases; complete sectioning of the ureter 9 cases). Enteral injuries occurred in 16 (28.1%) cases (opening of the rectum 4 cases; perforations of the small bowel adherent to the pelvic space 12 cases; and vascular injuries, such as partial sectioning of the hypogastric vein 5 cases), representing 8.8% of the total iatrogenic lesions (Table 2).

Of these complications 52 (91.2%) were detected during the operation, leading to immediate corrective procedures to repair the lesions, and only 5 cases were diagnosed in the postoperative period, requiring surgical treatment.

Surgical resections for endometrial cancer were eventful, unlike rectal and rectosigmoid junction malignancies in with 3 bladder injuries were recorded that required cystorrhaphy. During resectional surgery for ovarian cancer intraoperative accidents were enteral injuries (the rectum was affected in 4 cases – in 2 patients the lesion could be managed by in situ suture and in the other 2 patients anterior resection of the rectum was required), small bowel injuries were encountered in 9 cases due to parietal perforation or rupture, the repair of which required in situ sutures in 5 patients and segmental enterectomy in 4 cases. Intraoperative accidents and incidents are more frequently seen during surgical resections for cervical cancer. Although variable types of injuries may occur during surgery for this kind of genital cancer, lower urinary tract are the most common iatrogenic injuries encountered.

A total of 13 cases were recorded. Among them in 9 cases the lesion was located at the level of the bladder dome requiring cystorrhaphy, while 4 patients required partial cystectomy and ureteral reimplantation due to lesions of the bladder trigone. In 3 cases segmental enterectomy was performed due to lesions of the small bowel (adherences in the pouch of Douglas). During pelvic lymphadenectomy partial sectioning of the hypogastric vein occurred in 5 cases, requiring in situ sutures (3 cases) and ligation of the hypogastric pedicle (2 cases). The ureter was involved in injuries seen in 20 patients, either as partial ligation (5 cases with lesions identified during the operation and corrected in the same operative time/2 cases), or as ureterolysis/3 cases, repaired in a later operation, or complete sectioning/9 cases, that required reimplantation or partial resection/6 cases, that were resolved through in situ suture on an



**Figure 1.** Distribution of intraoperative incidents by type of primary cancer and type of injury.

intraluminal guidewire/5 cases, or by abandoning of the injury (one case with ureterohydronephrosis with a double J stent and urographically mute kidney).

Analysis of iatrogenic lesions showed significant differences in incidence according to the type of the primary malignancy ( $p < 0.002$ ). In our series cervical, rectal and rectosigmoid junction cancers were accompanied with a significantly lower risk for intraoperative complications as compared to ovarian cancer ( $p < 0.0001$  and  $p < 0.004$ , respectively). Urinary tract lesions represented the predominant iatrogenic injury encountered, showing a greater and significant incidence in resectional interventions for cervical and rectal cancer compared to enteral complications encountered in resectional surgery for ovarian cancer ( $p < 0.001$ ) (Figure 1).

## Discussion

Ranking third in cancer incidence worldwide, colorectal cancer is the most frequent pelvic malignancy in male patients after prostate cancer. Gynecologic malignancies account for the most cases of pelvic cancers in female patients, ovarian cancer being responsible for the highest mortality rate [1,10-12]. In this setting, adding the surgical effort for loco-regional radical excision, the risk

of direct or indirect damage to the surrounding organs (translated into intraoperative incidents and accidents and postoperative complications) represents a real concern when considering the general risks, surgical approach and possible future outcomes.

In the oncologic pelvic surgery the most common iatrogenic lesions are those of the urinary tract, ureteral injuries accounting for the majority of the cases, followed by the bladder and more rarely the urethra [13]. Although most injuries occur in patients without significant risk factors, the incidence of urinary tract lesions increases in patients with obesity, extensive pelvic disease, inflammatory bowel disease or a history of previous pelvic surgery [13,14]. Iatrogenic urinary lesions have an overall incidence of 1.1% as reported by Retterman et al. [15], with ureteral and bladder injuries occurring in up to 1.2% and 4.8% respectively of the cases according to Marin et al. [2], and with a 1.7% overall incidence seen in our study group. Hoffman et al. reported a 2.2% incidence with radical total hysterectomies, 2.4% for rectosigmoid colectomy and 1.4% in the case of primary ovarian cancer cytoreductive surgery [14]. Ureteral injuries include ligation, kinking, partial or complete sectioning, devascularization and electrocautery accidents. Intraoperative identification and repair are recommended. For partial lesions



primary closure and stenting may be sufficient, while for ureteral ligation removal of suture is necessary in order to assess tissue viability and choose an appropriate course of action. For uncomplicated lesions of the upper and middle third of the ureter uretero-ureteral anastomosis over a double J stent is the procedure of choice, but transureterostomy, ureteroileal interposition or, in some cases, nephrectomy can be used. Ureteroneocystostomy with a psoas hitch or a Boari bladder flap are indicated for lesions of the lower third of the ureter, renal lowering may be required for a tension free anastomosis or in order to gain enough length. For lesions diagnosed in the postoperative period, adequate healing can be achieved through double J stent placement in the case of incomplete injuries or through open surgery for more complex lesions. Iatrogenic bladder injuries of the anterior wall, dome or the posterior wall at a distance from the ureteral orifices can be closed by cystorrhaphy. For small extraperitoneal lesions of the bladder without complications Folley catheter placement for 7 to 14 days may be sufficient. Interposition of omentum or perivesical fascia may be necessary in patients with a high risk for developing a urinary fistula. Urethral injuries are only rarely seen, repair can range from multiple layer sutures to reconstruction from various tissue flaps or even to suprapubic catheter placement and delayed repair in the case of severe or extensive damage. Minimizing urinary tract lesions require careful preoperative consideration and attention to anatomical particularities. Early identification of the injury and prompt repair are advocated in order to minimize postoperative morbidity [2,13,16,17].

The second most frequent injuries in female patients are enteral lesions due to either pelvic adhesences or tumor invasion, with an incidence of up to 2.9% [2,15] (0.8% in our study), and in male patients urethro-vesiculo-prostatic lesions in up to 0.4% of the cases (0% in our group of patients) [18] due to direct invasion from rectal cancer. Data in the literature regarding iatrogenic injuries of the bowel in pelvic surgery are limited [19,20].

Vascular injuries are uncommon occurring in only 0.8% of the cases [2], due to the fact that in most cases major vessel infiltration is considered as an inoperability criterion. In our study we recorded a 0.2% incidence for vascular injuries. These types of lesions are commonly unrelated to the primary tumor resection and are seen during

pelvic lymphadenectomy, especially when lymphatic structures are adherent to local vasculature [5]. Although rare, vascular injuries may cause important postoperative complications [21].

The use of neoadjuvant radiotherapy or chemotherapy (87.2% of the patients in our study group) has been associated with a significant lower risk of surgical iatrogenic injuries ( $p=0.004$ ), due to the local effect of tumor mass reduction (mainly, reducing the risk of loco-regional invasion), allowing a surgical resection within a relatively preserved anatomy. This issue has been debated in the sense that although it may ease the surgical intervention, neoadjuvant therapy may lead to the transfer of iatrogenic risk from the surgical field to the oncological complications (delayed iatrogenic impact) to which acute post-neoadjuvant therapy complications can be added, as well as the cases that do not have a favorable response to this kind of treatment [22-24].

Iatrogenic lesions may compromise the initial surgical outcome, impact the patients' quality of life or may lead to secondary invasive procedures, therefore immediate repair is recommended [14,15,21]. The treatment of iatrogenic lesions that occurred during pelvic surgery for malignant pathologies could be done in our series at the time of the first intervention in 91.2% of the cases or in a second surgery (8.9%), when the lesion was not identified during the time of the surgery and manifested itself as an immediate postoperative complication or when the generating mechanism was indirect. The outcome of iatrogenic lesions following surgical excision of pelvic malignancies depends on the affected organ, type and severity of the injury, with the possibility of an auto-limited evolution, when in our opinion a conservative approach is recommended, as seen in one case (1.7%) in our study, or with a persistent and aggravating evolution requiring invasive procedures, as seen in 56 of our patients where 89.5% underwent immediate surgical correction and 8.8% were treated in a secondary surgery [25].

Comparing the number of intraoperative incidents and accidents to the total of surgical interventions, it can be noticed that the risk of iatrogenic unwanted events during resectional procedures is not generated by the type of approach, but 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.

## Conclusions

Despite their low incidence (2.9%), intraoperative incidents and accidents occurring during surgery for pelvic malignancies represent an event worth taking into account, requiring surgical repair in most of the cases (98.2%).

The high prevalence of pelvic malignancies of genital origin (86.3%), along with a good rate of resectability (78.4 vs 38.9% for extragenital pelvic cancers), places urinary tract injuries on top of iatrogenic lesions, especially in the cases with neoadjuvant radiotherapy, due to perilesional fibrosis or tumor volume shrinkage that changes the local anatomy mostly at the level of the termi-

nal portion of the ureter and posterior wall of the bladder, followed by enteral lesions and vascular injuries. It should be mentioned that the frequency of these lesions may vary depending on the origin of pelvic cancer. Thereby, if enteral injuries are almost exclusive in the case of ovarian cancer, urinary tract lesions are the most common type of intraoperative accidents seen in digestive, mesodermal and cervical/endometrial cancers, with significant differences among them.

The use of neoadjuvant therapy contributes to achieving a significant benefit by lowering the risk of major intraoperative incidents, and by improving not only patient survival, but also the possibilities for surgical intervention.

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