

# Predictors of 30-Day Complications after Radical Cystectomy

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Submission: 📅 December 12, 2017; Published: 📅 January 19, 2018

## Abstract

The authors studied the influence of various predictors on the development of complications arising after radical cystectomy in 182 patients. Bacteriological monitoring demonstrated a high level of infection of the abdominal cavity after RC (54.4%). After RC in 98 (53.8%) patients, the development of various complications in the Clavien system was recorded. The most frequent categories of complications were gastrointestinal (26.9%) and infectious (25.8%). The development of complications is affected by anemia before surgery, body weight deficiency, intraoperative blood loss intra-abdominal infection.

**Keywords:** Bladder cancer; Radical cystectomy; Complications

**Abbreviations:** RC: Radical Cystectomy; OR: Odds Ratio; BMI: Body Mass Index

## Introduction

In the past decade, there has been clear progress in the surgical technique of radical cystectomy (RC), as well as in anesthesia and perioperative management of patients, which was manifested in a significant reduction in the number and severity of complications associated with this operation. However, the proportion of complications is still high, and develops in approximately 58% of patients and causes death in 1.6%-3.9% of cases within 30 days after surgery [1-10]. An analysis of the causes of their development and the search for effective ways to prevent them is topical.

**Objective:** To determine the most significant predictors of complications after RC.

## Materials and Methods

The present study is retrospective and is based on an analysis of the results of treatment of 182 patients exposed to the RC from 2014 to 2016. The operations were performed in the Privolzhsky District Medical Center of the FMBA of Russia in Nizhny Novgorod. Preoperative preparation and postoperative management of patients did not differ. All operations were performed by one surgeon. To be included in the study, patients had to undergo RC for bladder cancer; other pelvic tumors with germination in the bladder and microcystis of various etiologies. For the purpose of bacteriological monitoring, a lavage liquid was taken from the abdominal cavity at the end of the operation for microbiological analysis. This condition was also mandatory for inclusion in the

study. Those patients who did not undergo lavage fluid studies were excluded from the study. Patients were selected from 9 September 2014 to 31 December 2016. All patients operated on for malignant tumors of the pelvic organs performed an enlarged and in some cases super-dilated (up to renal vessels) retroperitoneal lymphadenectomy. Then the standard stages of radical cystectomy were performed. The next stage of the operation was the realization of the most favorable for the patient method of urine derivation. Then the final hemostasis was carried out. The abdominal cavity was washed with a sterile liquid with the evacuation of blood clots and fragments of adipose tissue. Twice lavage fluid from the abdominal cavity was performed for microbiological analysis (before washing and after evacuation). For the analysis and stratification of the results, RC used the classification of surgical complications in the Clavien system [11]. The statistical analysis of the material was carried out on a personal computer using the IBM SPSS Statistics Version 14.0.1 license package. The effect of different predictors on the incidence of complications in 30 days after the operation was analyzed. To identify independent predictors of complications in the postoperative period, we conducted a one-factor and multivariate regression analysis. The relationship between each quality of the indicator and its potential was analyzed with graphical and Kruskal-Wallis test. The odds ratio (OR) was estimated using regression analysis (logistic regression). The critical level of significance in testing statistical hypotheses was assumed to be 0.05.

## Results

The study included 182 operated patients. 152 patients (83.5%) males and 30 (16.5%) females with a mean age of 62.3 years (range, 31-84 years) were enrolled in this study. Indications for the performance of RC in 169 (92.8%) cases were bladder cancer: 38 (20.9%)-non-invasive muscle cancer, 131 (72%)-muscle-invasive cancer (T2a-33 (18.1%), T2b-42 (23.1%), T3a-11 (6%), T3b-16 (8.8%), T4a-29 (16%). In 9 (4.9%) patients, the bladder was removed for other pelvic tumors with bladder germination. 4 (2.2%) patients underwent surgery for microcystis of different etiology. External urinary diversion was used in 43 (23.65%) patients: Briker operation-38, ureterocutaneostomy-3, heterotopic reservoir with "dry" urostoma-1. Urine discharge into the sigmoidectal reservoir in Mainz-spider II was performed in 1 (0, 55%) of the case. Most patients have an orthotopic urinary diversion-138 (75.8%): Studer-73, Y-shaped reservoir-45, from ileocecal angle in various modifications-11, VIP-7, Camey II -1, Reddy-1. In connection with the prevalence of patients of the older age group, the proportion of concomitant pathology associated with age was quite high. The most frequent were cardiovascular diseases-69.8%, gastrointestinal tract-34%, chronic obstructive pulmonary disease-18.1%, obesity-24.7%, diabetes mellitus-13.7%. Various types of nutritional status disorders by the body mass index (BMI) were recorded in 113 (62%) patients.

**Table 1:** Categories and types of complications after radical cystectomy.

Categories of Complications	Types of Complications	Number, %
Gastrointestinal complications	Gastrostasis, prolonged intestinal paresis, intestinal obstruction, gastrointestinal bleeding, vomiting, incompetence of interintestinal anastomoses, and others	49 (26.9%)
Infectious complications	Fever of unknown origin, urinary tract infection, infected lymphocele, sepsis	47 (25.8%)
Bleeding	Anemia requiring hemotransfusion, significant intra- and postoperative bleeding (> 1000ml)	19 (10.4%)
Wound complications	Limforei, asymptomatic lymphocele, divergence of wound margins, event	16 (8.8%)
Thromboembolic complications	Deep vein thrombosis, pulmonary embolism, phlebitis	4 (2.2%)
Electrolyte complications	Acidosis, dehydration and others	4 (2.2%)
Genitourinary complications	Renal failure, leakage of urine (from anastomoses), urinary fistulas, urinary retention	3 (1.6%)
Heart complications	Myocardial infarction, heart failure	3(1.6%)
Pulmonary complications	Pneumothorax, pneumonia, pulmonary insufficiency	2 (1.1%)
Neurological complications	Cerebrovascular complications, delirium/anxiety (psychosis)	1(0.55%)

To find the most significant predictors of complications in the 30-day period after the operation, one- and multifactorial regression analysis was performed (Tables 2 & 3). It has been established that the incidence of complications after RC is affected by the body mass

We performed preoperative correction of the revealed concomitant pathology of these patients together with profile specialists as concomitant diseases are important factors which influence the development of complications of RC. Patients with the highest values on the ASA scale and the Charlson Comorbidity Index were prepared for the operation even in the pre-hospital stage together with an anesthesiologist and resuscitator.

In microbiological analysis of fluid culture from the abdominal cavity revealed the presence of infection in 54.4% of patients. The most frequent agents in cultures from the abdominal cavity were *Esherichia coli*-42.4%, *Enterobacter spp.*-21.2%, *Enterococcus spp.*-26.3%. Extended-spectrum beta-lactamases produced 2% of bacteria. MRSA in 1% of cases, *Pseudomonas aeruginosa*-in 3%. Washing of the abdominal cavity with a sterile liquid significantly reduced the titer of microbial contamination of 45.1% of infected patients ( $t=3.975$ ,  $p<0.001$ ). The high level of infection abdominal cavity, indicates that RC refers to contaminated and sometimes "dirty" operations. In our study, 84 (46.2%) patients had no complications in the 30-day period after RC. The rest 98 (53.8%) patients recorded the development of various undesirable deviations in the postoperative period. The most frequent categories of complications were gastrointestinal and infectious (Table 1).

index ( $p=0.008$ ), anemia before surgery ( $Hb<90g/l$ ), ( $p=0.034$ ), blood loss (>600ml.) ( $P=0.003$ ) and infection of the abdominal cavity ( $p<0.001$ ).



**Table 2:** Single-factor regression analysis of predictors of the incidence of complications after RC.

Factor	OR (95% CI)	p
Age	1.003 (0.974-1.033)	0.86
Sex	0.708 (0.323-1.553)	0.389
Duration of the disease	1.007 (0.996-1.018)	0.237
Body mass index	0.936 (0.881-0.994)	0.031
Status T	1.39 (1.05-1.84)	0.021
Status N	1.873 (0.887-3.953)	0.10
Status M	1.833 (0.703-4.781)	0.215
Status G	1.115 (0.706-1.761)	0.641
Cardiovascular diseases	1.412 (0.75-2.658)	0.285
Diabetes	0.598 (0.239-1.50)	0.273
Diseases of the lungs	1.400 (0.649-3.021)	0.391
The Charlson Comorbidity Index	1.096 (0.993-1.209)	0.68
The initial level of Hb before surgery	0.336 (0.177-0.638)	0.001
Bacteriuria before surgery	1.082 (0.581-2.013)	0.804
Duration of anesthesia, min	1.002 (0.996-1.009)	0.451
Duration of operation, min	1.002 (0.996-1.008)	0.514
Type of urine derivation	1.417 (0.790-2.540)	0.242
Blood loss	1.778 (1.152-2.744)	0.009
Infection of the abdominal cavity	3.026 (1.648-5.556)	<0.001
Hydronephrosis	1.616 (0.801-3.262)	0.18
Glomerular filtration rate	0.994 (0.983-1.005)	0.263

**Table 3:** Multivariate regression analysis of predictors of the incidence of complications after RC.

Factor	OR (95% CI)	p
Body mass index	0.601 (0.414-0.874)	0.008
Status T	1.189 (0.864-1.637)	0.287
The initial level of Hb before surgery	0.983 (0.967-0.999)	0.034
Blood loss	2.201 (1.311-3.696)	0.003
Infection of the abdominal cavity	3.400 (1.742-6.637)	<0.001

Predictors of development of the intestinal paresis were male sex (p=0.019) and infection of the abdominal cavity (p=0.004). In men, the chance of developing an intestinal paresis was 5.8 times higher than that of women (OR=5,888). Intestinal paresis in patients with a positive lavage culture flush is almost 3 times higher than in patients whose flushes were sterile (OR=2.96). The presence of intra-abdominal infection, proved by bacteriological analysis (positive flushing), is a significant independent predictor

of the development of infectious complications in the postoperative period (p=0.001) (Table 4). The development of infectious complications in patients who have a “positive” flush is 3.7 times greater than in patients whose flushes were sterile (OR=3.773). There was also a tendency (0.05<p> 0.06) that anesthesia time (p=0.059) and operation time (p=0.056) may be predictors of the development of infectious complications.

**Table 4:** Predictors of the development of infectious complications (single-factor regression analysis).

Factor	OR (95% CI)	p
Bacteriuria before surgery	1.766 (0.839-3.716)	0.134
Duration of anesthesia, min	1.007 (1.000-1.014)	0.059
Duration of operation, min	1.007 (1.000-1.015)	0.056
Type of urine derivation	0.938 (0.475-1.852)	0.854
Infection of the abdominal cavity	3.773 (1.682-8.465)	0.001

### Discussion

Complications associated with RC can be directly related to both concomitant diseases of the patient, and to the peculiarities of surgical intervention and methods of urine diversion. [12,13]. According to the literature, adverse events of any degree occur in approximately 58% of patients and lethality reaches 3.9% within 30 days after surgery [1-10, 14-18]. The results of our study correspond to these data. In our study, complications were recorded in 53.8% of cases, the lethality was 1.64%. The number and severity of postoperative complications of RC are influenced by the experience of the surgeon and the institution where these operations are performed [9,15]. This is confirmed by the analysis of the results of an earlier series of our RC, carried out in the period from 2008 to 2011. Of the 174 patients in the 30-day period after the operation, complications were recorded in 71.8% of patients, the 30-day mortality was 6.3% [2].

In the structure of complications of RC, according to various authors, gastrointestinal and infectious complications prevail [1,19-21]. Paresis of the stomach and intestine occurs in 22.7% of patients, intestinal obstruction occurs in 8.7% of cases [1]. Complications of infectious nature range from 20.5 to 33% [1,19,22-25]. According to Haraz AM et al. [24] Among 1000 analyzed patients who underwent RC, one of the most frequent complications was urinary tract infection, intestinal obstruction [24]. Even after laparoscopic and robot-assisted cystectomy complications of an infectious nature can reach up to 41% [20,21]. These data coincide with the results of this study. Gastrointestinal and infectious complications were most frequent and amounted to 26.9% and 25.8%, respectively.

In multivariate analysis, we proved that the development of complications in the 30-day period after the RC is influenced by factors such as the presence before the operation of anemia (less than 90g/L), body weight loss, intraoperative Blood loss (more than 600ml) of intraoperative infection of the abdominal cavity 3). All these factors are interrelated: in patients with locally

advanced tumors, hemorrhage (haematuria) is observed for a long time before the operation, which leads to anemia in patients. RC in this category of patients is associated with intraoperative blood loss. As a result, malnutrition (body weight deficiency) and anemia lead to deficiency of lymphocytes, hypoalbuminemia, hypercatabolism, negative energy balance, the barrier function of the intestinal mucosa is also lost, motor-evacuator function is slowed down, immune defenses decrease. These data coincide with the results of recent studies in which it is reported that low BMI, hypoalbuminemia [26,27], bleeding [28] and patient infection [22,23] are predictors of complications in the postoperative period [29].

## Conclusion

RC is associated with a high risk of developing various complications in the early stages after the operation. In this study, the main causes of complications were anemia before surgery, weight loss, intraoperative blood loss, intra-abdominal infection. Research in the field of etiology and prevention of complications in the RC should continue.

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