




# Analysis of risk factors of abdominal wound dehiscence after radical cystectomy

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## SUMMARY

**OBJECTIVE:** Wound dehiscence is associated with high morbidity and mortality. This study aimed to analyze the risk factors and comorbidities in the patients undergoing radical cystectomy with early postoperative wound dehiscence.

**METHODS:** In all, 539 patients with bladder cancer who underwent radical cystectomy and urinary diversion at a single center between January 2008 and January 2022 were included in the study. The data related to the demographics, medical history, and perioperative clinical features were reviewed. Univariate and multivariate regression analysis was performed to identify risk factors for wound dehiscence.

**RESULTS:** The mean age of the patients was 64.2 years (22–91). The mean body mass index was 26.4 kg/m<sup>2</sup> (18.7–35.4). Wound dehiscence was observed in 43 (7.9%) of 539 patients. The patients with wound dehiscence had significantly higher mean BMI (27.8 vs. 26.3,  $p=0.006$ ), ASA scores ( $p=0.002$ ), history of chronic obstructive pulmonary disease (30.2 vs. 14.3%,  $p=0.006$ ), diabetes mellitus (44.2 vs. 17.9%,  $p=0.003$ ), previous abdominal surgery (18.6 vs. 7.7%,  $p=0.014$ ), and postoperative ileus (58.1 vs. 16.9%,  $p=0.006$ ). In the multivariable regression model, diabetes mellitus (odds ratio [OR] 4.9, 95%CI 2.3–10.1;  $p<0.001$ ), postoperative ileus (OR 8.1, 95%CI 4.1–16.5;  $p<0.001$ ), and chronic obstructive pulmonary disease (OR 2.6, 95%CI 1.2–5.7;  $p=0.013$ ) were independent predictors of abdominal wound dehiscence following radical cystectomy.

**CONCLUSION:** Diabetes mellitus, chronic obstructive pulmonary disease, and postoperative ileus were strongly associated with abdominal wound dehiscence following radical cystectomy. Both potential preventive and therapeutic interventions may decrease the risk of wound dehiscence.

**KEYWORDS:** Urinary bladder neoplasms. Postoperative complications. Surgical wound dehiscence. Cystectomy. Risk factors.

## INTRODUCTION

Bladder cancer is the second most common urological malignancy, with urothelial carcinoma accounting for approximately 90% of all primary bladder tumors<sup>1</sup>. The worldwide incidence rate is 9.5 for men and 2.4 for women (per 100,000 person-years)<sup>2</sup>. At the time of diagnosis, 70–75% of patients have a disease localized to the mucosa or submucosa, while 25–30% of patients have a muscle-invasive tumor<sup>3</sup>. Radical cystectomy is the gold standard treatment option for muscle-invasive and high-risk non-muscle-invasive bladder cancer unresponsive to intravesical therapy. Radical cystectomy may lead to serious complications, particularly in the perioperative period. Although radical cystectomy can be performed with minimally invasive methods such as laparoscopic and robot-assisted laparoscopic methods, open radical cystectomy is still the most common treatment method<sup>4,5</sup>.

Open radical cystectomy surgery is performed through an abdominal midline incision. An abdominal wall surgical incision is created by cutting through all layers of the abdominal wall. The incidence of abdominal wound dehiscence after open

radical cystectomy ranges between 3.5 and 9%<sup>6,7</sup>. Abdominal wound dehiscence is a severe postoperative complication of abdominal surgeries with high morbidity and mortality rates. Despite technological advancement in materials, by constantly improving surgical techniques and precautionary measures, wound dehiscence continues to occur. Moreover, evisceration may occur as a result of abdominal wound dehiscence, requiring immediate surgical treatment. Wound dehiscence can lead to an increase in treatment costs, hospitalization, and re-intervention/readmission rates<sup>8–10</sup>. Several retrospective studies have been conducted to investigate the risk factors for this complication, but the results are contradictory<sup>6,11</sup>. This study aimed to analyze the predictors of the wound dehiscence of the abdominal wall in patients undergoing open radical cystectomy and urinary diversion.

## METHODS

A single-center, retrospective study was conducted. We reviewed the electronic data and records of the patients with bladder

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Conflicts of interest: the authors declare there is no conflicts of interest. Funding: none.

Received on July 31, 2022. Accepted on August 03, 2022.

cancer who underwent radical cystectomy and urinary diversion between January 2008 and January 2022 in our department. The patients were divided into two groups based on the presence of abdominal wound dehiscence. The data related to the demographics, medical history, and perioperative clinical features were reviewed. Diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), and hypertension (HT) were defined as comorbidities and were recorded. Patients smoking cigarettes in the year before admission for surgery were considered smokers. Postoperative ileus (POI) was defined as the insertion of a nasogastric tube for nausea, abdominal distension, vomiting, or failure to tolerate a solid diet in the postoperative period. The American Society of Anesthesiologists (ASA) scores were evaluated by the anesthesiologists.

All radical cystectomy and urinary diversion surgeries were performed with a midline incision. Radical cystectomy included the bladder, seminal vesicles, and prostate in men and the bladder, uterus, both ovaries, and the anterior vaginal wall in women. Pelvic lymphadenectomy was performed in all cases, with the upper limit of lymphadenectomy extending to the common iliac vessels. Abdominal fascial closure was performed in all patients by or under the supervision of experienced urologists. Synthetic absorbable 0 polydioxanone monofilament sutures with running technique and mass closure method were used for all fascial closures. Abdominal dehiscence was defined as a partial or total separation of wound edges after the operation with or without intact fascia.

### Statistical analysis

Data were analyzed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). Determination of statistically significant factors was made by univariate and multivariate analysis. Statistical analyses were carried out using an unpaired t-test and the Mann-Whitney U test for univariate analysis. The main analysis of the study was multivariable analysis. Logistic regression analysis was used to estimate the association between categorical variables and postoperative wound dehiscence, and multivariate analysis using linear regression was used for the continuous variables. For each correlation, the odds ratio (OR) with a 95% confidence interval was calculated and reported. A  $p < 0.05$  was considered statistically significant.

## RESULTS

Overall, 539 patients who underwent radical cystectomy and urinary diversion were identified. In descriptive analyses, 492 (91.3%) were male and 47 (8.7%) were female. The mean age of the patients was 64.2 years (range 22–91 years). The mean

body mass index (BMI) was 26.4 kg/m<sup>2</sup> (range 18.7–35.4 kg/m<sup>2</sup>). Patients with and without wound dehiscence were compared for demographic data, comorbidities, and perioperative outcomes, as reported in Table 1. Urinary diversion included

**Table 1.** Patient characteristics.

Characteristics	Wound dehiscence (-) (n=496)	Wound dehiscence (+) (n=43)	p-value
Age (years)	64.2±9.3	65.3±8.9	0.429
BMI (kg/m <sup>2</sup> )	26.3±3.4	27.8±2.3	0.006
Gender, n (%)			
Male	456 (91.9)	36 (83.7)	0.067
Female	40 (8.1)	7 (16.3)	
ASA score, n (%)			
ASA 1	167(33.7)	4 (9.3)	0.022
ASA 2	305 (61.5)	34 (79.1)	
ASA 3	24 (4.8)	5 (11.6)	
Diversion type, n (%)			
Ileal conduit	437 (88.1)	37 (86)	0.225
Studer neobladder	25 (5)	5 (11.6)	
Ureterocutaneostomy	33 (6.9)	1 (2.6)	
Hypertension, n (%)			
Yes	102 (20.6)	7 (16.3)	0.507
No	394 (79.4)	36 (83.7)	
Diabetes mellitus, n (%)			
Yes	89 (17.9)	19 (44.2)	0.003
No	407 (82.1)	24 (55.8)	
COPD, n (%)			
Yes	71 (14.3)	13 (30.2)	0.006
No	425 (85.7)	30 (69.8)	
POI, n (%)			
Yes	84 (16.9)	25 (58.1)	0.001
No	412 (83.1)	18 (41.9)	
Previous surgery, n (%)			
Yes	38 (7.7)	8 (18.6)	0.122
No	458 (92.3)	35 (81.4)	
Status of smoking, n (%)			
Yes	188 (37.9)	14 (32.6)	0.487
No	308 (62.1)	29 (67.4)	
Operative time (min)	336±41.4	339±40.6	0.731
Length of hospital stay (days)	15.4±3.7	25.6±3.1	0.001

BMI: body mass index; ASA: American Society of Anesthesiologists; COPD: chronic obstructive pulmonary disease; POI: postoperative ileus.

ileal conduit in 474 (87.9%), ileal neobladder in 31 (5.7%), and ureterocutaneostomy in 34 (6.3%) patients. The mean operation time was 337 min (range 210–450 min).

Wound dehiscence was observed in 43 (7.9%) of 539 patients. The median day of diagnosis of wound dehiscence was 7.4 days (range 5–10 days) after the operation. Notably, 14 (32.5%) patients underwent a surgical revision for abdominal evisceration. The mean length of hospital stay was significantly longer in patients with wound dehiscence ( $25.6 \pm 3.1$  days vs.  $15.4 \pm 3.7$  days,  $p < 0.001$ ).

The patients in the wound dehiscence group had higher mean BMI (27.8 vs. 26.3 kg/m<sup>2</sup>,  $p = 0.006$ ) and ASA score ( $p = 0.002$ ). History of COPD (30.2 vs. 14.3%,  $p = 0.006$ ), DM (44.2 vs. 17.9%,  $p = 0.003$ ), previous abdominal surgery (18.6 vs. 7.7%,  $p = 0.014$ ), and POI (58.1 vs. 16.9%,  $p = 0.006$ ) were also higher in this group. There was no difference between the two groups in terms of the history of HT, duration of operation, type of urinary diversion, and status of smoking. In the multivariable regression model, DM (OR 4.9, 95%CI 2.3–10.1;  $p < 0.001$ ), POI (OR 8.1, 95%CI 4.1–16.5;  $p < 0.001$ ), and COPD (OR 2.6, 95%CI 1.2–5.7;  $p = 0.013$ ) were independent predictors of abdominal wound dehiscence following radical cystectomy (Table 2).

## DISCUSSION

Although the use of minimally invasive techniques such as laparoscopic and robot-assisted laparoscopic radical cystectomy has been increased in the past two decades, open radical cystectomy is still the gold standard treatment for muscle-invasive and high-risk non-muscle-invasive bladder cancer unresponsive to intravesical therapy. Radical cystectomy is a complicated procedure with a high rate of risk and significant morbidity. Abdominal wound dehiscence is a rare but laborious postoperative complication after radical cystectomy. Our study indicated the importance of prognostic factors in abdominal wound dehiscence. The major finding of our study was that POI and comorbidities such as DM and COPD were the independent prognostic factors associated with abdominal wound dehiscence.

**Table 2.** Risk-adjusted analysis of predictors of wound dehiscence after radical cystectomy.

Variables	Odds ratio	95% confidence interval	p-value
DM	4.9	2.3–10.1	<0.001
COPD	2.6	1.2–5.7	0.013
POI	8.1	4.1–16.5	<0.001
Previous surgery	1.9	0.7–4.9	0.172

Dehiscence is the partial or complete separation of previously approximated wound margins caused by a failure of adequate wound healing. The basis of wound dehiscence is similar to the causes of inadequate wound healing and includes infection, increased abdominal pressure, DM, smoking, and obesity<sup>12,13</sup>. We found that POI is also an important predictive factor in the etiology of wound dehiscence since it increases intra-abdominal pressure in the postoperative period. We found the incidence of wound dehiscence following radical cystectomy to be 7.8%, which was similar to that found by the previous studies<sup>7,11</sup>.

Obesity increases the risk of wound dehiscence. The association between obesity and wound healing has long been determined in the literature<sup>14</sup>. We found that patients with a higher BMI have the highest rates of wound dehiscence. Prior to surgery, the patient's nutrition intake should be optimized to reduce the risk of wound dehiscence. These patients may benefit from dietary supplementation with vitamins and zinc<sup>14</sup>. DM-related microvascular dysfunction may impair regular blood flow, resulting in poor wound perfusion. Hyperglycemia also raises the risk of wound infection, which slows the healing process<sup>15</sup>. In our study, we found that DM was a predictor of wound dehiscence. Preoperative blood glucose control and postoperative blood glucose level monitoring appear to be effective in preventing wound complications. Moreover, it is well established that older patients are at greater risk of complications after radical cystectomy<sup>16</sup>. However, a large series of radical cystectomies showed that patients' age did not predict postoperative wound complications<sup>6,11</sup>. Age was not found to have a significant effect on our cohort. This finding may be explained by the fact that patients undergoing radical cystectomy are mostly within the same decade of age. Furthermore, a recent predictive model emphasized the five-factor model (i.e., male gender, infection, COPD, smoking, and overweight) for estimation of the incidence of wound dehiscence risk following radical cystectomy<sup>17</sup>.

In our study, the risk of wound dehiscence increased in patients with COPD, which was consistent with the previous studies<sup>6</sup>. Wound healing may be impaired in patients with COPD since they have low oxygen levels and are usually long-term smokers<sup>18</sup>. Moreover, patients with COPD have a high risk of postoperative atelectasis and pneumonia, which may cause intense cough<sup>19</sup>. This intense cough in the postoperative period causes an increase in intra-abdominal pressure, which may lead to wound dehiscence. In the treatment of these patients, regional anesthesia should be used whenever possible since it provides both postoperative lung rehabilitation and pain management<sup>20</sup>. Similar to COPD, smoking can lead to both impaired wound healing and pulmonary complications

in the postoperative period. To prevent complications due to intense cough in the postoperative period, quitting smoking for 4–6 weeks before the operation reduces postoperative pulmonary complications<sup>21</sup>.

The type of abdominal closure may play an important role in wound complications. In our experience, we use slowly absorbable monofilament (polydioxanone) sutures with continuous technique and mass closure method for abdominal wall closure after laparotomy. In a Cochrane review of 55 randomized trials (19,174 patients), no evidence was found that suture absorption (absorbable vs. nonabsorbable sutures, or slow vs. fast absorbable sutures), closure method (mass vs. layered), or closure technique (continuous vs. interrupted) resulted in any difference in the risk of wound complications<sup>22</sup>. However, only about one-half of the included trials (26) enrolled patients who underwent midline incisions exclusively. Preventive strategies such as negative pressure wound therapy and prophylactic retention sutures in patients undergoing radical cystectomy seem feasible<sup>23,24</sup>.

The incidence/definition of POI after radical cystectomy is highly variable, and the incidence of POI ranges from 1.5 to 23.5%<sup>25</sup>. POI is characterized by abdominal distention and bloating, nausea, vomiting, and delayed passage of flatus and defecation. Increased intra-abdominal pressure due to prolonged POI causes more strain on the wound margins, causing the sutures to injure the muscles and fascia. The choice of anesthesia and postoperative analgesia method also affects the development of prolonged POI. It has been shown that patients with epidural catheters have been found to have reduced recovery time to return to normal gastrointestinal function<sup>26</sup>. Moreover, patients who receive alvimopan (a selective peripherally acting mu-opioid receptor antagonist) after radical cystectomy had quicker bowel recovery<sup>27</sup>.

The study has certain limitations, the most important being its retrospective nature. Considering the small number of patients with these risk factors, another limitation is the lack of information about hypoproteinemia, preoperative steroid use, and wound infection, which are shown to be risk factors for wound dehiscence. Another limitation is that although the same closure technique is used in each patient, this procedure may be performed by different surgeons.

## CONCLUSION

Wound dehiscence is a severe complication with a low incidence but significant morbidity, and it increases treatment costs and length of hospital stay. In the literature, there is a lack of evidence about prognostic factors for abdominal wound dehiscence in patients undergoing radical cystectomy. This study adds new data about the predictors of wound dehiscence risk after radical cystectomy. We identified POI and comorbidities such as DM and COPD as independent risk factors for abdominal wound dehiscence following radical cystectomy. Preoperative identification of these risk factors and taking necessary precautions may help prevent this challenging complication after radical cystectomy.

## AUTHORS' CONTRIBUTION

**SK:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **KKE:** Formal Analysis, Investigation, Writing – original draft. **FK:** Formal Analysis, Investigation, Resources. **BY:** Data curation, Project administration, Supervision. **AS:** Project administration, Supervision.

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