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# Evaluation of Risk Factors of Surgical Wound Dehiscence in Adults After Laparotomy

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## ABSTRACT

**Objectives:** The percentage of patients with difficult and prolonged healing of the wound is still high, while the immediate complications such as wound dehiscence occurs in up to 3% of all treated patients in abdominal surgery. The aim of study was to analyze the risk factors and comorbidities in the group patients undergoing laparotomy and associated with early postoperative wound dehiscence. **Methods:** The retrospective study included all patients treated surgically at Clinic of General and Abdominal surgery, Clinical Center of the University of Sarajevo in the period from January 1, 2013 until January 1, 2016, with clinically verified surgical wound dehiscence. **Results:** The results showed statistically proportion of male patients (70%) compared to female (30%). The largest number of respondents were in age group 71-80. Surgical wound infection was evident in 61% of patients, malignant staining in 52%, hypoproteinemia was found in 50% of patients, anemia in 43%, peritonitis in 36% and diabetes in 14% of respondents. Of the total respondents with surgical wound dehiscence, 30 (68%) had comorbidities present. By analyzing the prevalence of comorbidity and risk factors recorded in relation to comorbidity, it was noted that hypertension is most often associated with hypoproteinemia ( $X^2=4.399$ ;  $p=0.036$ ), wound infection ( $X^2=4.112$ ;  $p=0.043$ ) and malignant diseases ( $X^2=4.016$ ;  $p=0.045$ ). The frequency of the anemia, peritonitis and diabetes in the sample was not different in relation to the comorbidity conditions ( $p > 0.05$ ). **Conclusions:** The risk factors occurrence of surgical wound dehiscence in our study were identified as hypoproteinemia, malignant disease, anemia and peritonitis. The highest incidence of dehiscence was in patients operated on in medical emergencies, and in patients with malignant disease.

**Key words:** surgical wound dehiscence, risk factors.

## 1. INTRODUCTION

Despite constantly improved knowledge of the physiology of wound healing process, as well as the advances in surgical technique and application of modern technologies and materials in surgery, wound healing problem remains to be, and the immediate complications such as wound dehiscence continue to occur despite all the precautions taken. Surgical wound of the abdominal wall is artificially-made cut through all the layers of the anterior abdominal wall (skin, subcutaneous tissue, fascia, muscles and peritoneum). This incision initiates a cascade of mechanisms at the cellular

level, which are aimed at healing at the site of incision (1). Healing can take place as primary type (per primam—adequately surgically reconstructed wounds) or secondary type (per secundam—wound with divided edges for any reason). Secondary healing occurs whenever there is an extensive loss of cells and tissue in the projection section, inflammatory processes, abscesses formed, and the like. Both processes take place cascading through three stages: exudative phase, proliferation phase, and phase of reparations.

Frequency of wound dehiscence in the relevant literature cited in the range of 0.2% to 6% (2), with a

mortality ranges from 9 to 50% (3). Factors affecting the abdominal wall wound healing are numerous and relating to the characteristics of the patient, its comorbidities, type of pathology and method of surgical treatment. Several retrospective studies have examined the problem of identifying risk factors for this complication, but with discordant results (4, 5).

**2. AIM OF THE STUDY**

The aim of this study was to analyze the risk factors and comorbidities in the group patients undergoing laparotomy and associated with early postoperative wound dehiscence.

**3. MATERIALS AND METHODS**

We performed a retrospective, descriptive analysis of all clinically operative wound dehiscence in patients surgically treated at the Clinic for General and Abdominal Surgery, Clinical Center of the University of Sarajevo (CCUS) in the period from January 1, 2013 until January 1, 2016. The main sources of data in this study were operational protocols and disease histories of patients in the mentioned period. The study included all patients with clinically verified signs of the operative wound dehiscence, regardless of the type of surgery, treatment and final outcome. This study did not include patients in whom the documents were incomplete. Before surgery all patients were familiar with the type of surgery and the possible complications and all patients had signed informed consent for surgery. The study monitored variables: age, sex, diagnosis, time the appearance of wound dehiscence, wound infection, comorbidities, and presence of risk factors.

**3.1. Statistical analysis**

Data were analyzed by statistical package IBM SPSS v 79.0 (Chicago, of Illinois, USA). The analysis included calculating the percentage, mean values, the arithmetic mean with standard deviation and range values. To test the difference Yates test were used to test small samples, Fischer exact test for tables and one-way analysis of variance (ANOVA). P-values less than 0.05 were considered statistically significant.

**4. RESULTS**

In the observed three-year period 44 patients were verified with surgical wound dehiscence. In the same period, the Clinic for General and Abdominal Surgery of CCUS has taken care of the 3504 surgical patients, and the percentage of patients with surgical wound dehiscence is 1.25%. In the sample was 70% of male patients and 30% of female patients (sex ratio 2.33 : 1). The highest number of patients were in the age group 71-80 years (32%), while the next highest incidence of dehiscence was observed in the group of 61-70 years (23% of respondents) (Table 1).

Taking into account the aforementioned diagnosis in our group of patients, it was found that most of dehiscence was recorded in patients with colorectal carcinoma (40,1%). In 13 patients operated in the emergency of acute abdominal conditions wound dehiscence was

Variable	Abdominal wound dehiscence (n = 44)	
Age, years	62.1 ± 7.5 (28-80)	
<40	12% (5)	
41-50	12% (5)	
51-60	21% (9)	
61-70	23% (10)	
>70	32% (14)	
Male	70% (31)	
Female	30% (13)	
Hospital receiving a diagnosis	Adenocarcinoma colon	18 (40.1%)
	Acute abdomen	13 (29.5%)
	Ileus	5 (11.0%)
	Ulcerative colitis	2 (2.0%)
	Acute pancreatitis	2 (2.0%)
	Gastric cancer	4 (9.0%)

Table 1. Characteristics of the study population

recorded (29.5%) and in 11% of cases the patients with verified preoperative bowel obstruction, 2% in the case of inflammatory bowel diseases and acute pancreatitis, while 9% of the waste dehiscence patients with gastric cancer. The largest number of wound dehiscence was evidenced clinically on the fourth postoperative day (34%), with 75% of all cases presented in the first 7 postoperative days (Table 2).

In the analysis of comorbidity it was found that in the total sample of 22 patients had hypertension (50%), 5 pa-

Postoperative day	2	3	4	5	7	9
Number (%) of patients (n=44)	8 (18%)	10 (22.7%)	15 (34%)	7 (16%)	2 (4.5%)	2 (4.5%)

Table 2. Time to occurrence of surgical wound dehiscence

tients were with verified chronic obstructive pulmonary disease (11%) and in three patients a pronounced preoperative thrombocytopenia was found (7%) (Table 3). By analyzing the correlation of the present comorbidities and wound dehiscence time phenomena no significant difference was observed (F = 1.811; p = 0.161).

In the analysis of risk factors in the total sample, wound surgery infection was found in 27 patients (61.3%),

Comorbidities	Number of patients (%)	Risk factors	Number of patients (%)
HOPD	5 (17%)	Wound infection	27 (61%)
HBP	22 (73%)	Malignancy	23 (52%)
DM	6 (14%)	Hypoproteinaemia	22 (50%)
		Anemia	19 (43%)
Peritonitis			16 (36%)

Table 3. Comorbidities and risk factors in the study group patients. HOPD-chronic obstructive pulmonary disease; HBP-high blood pressure; DM-diabetes.

among them 22 or 50% hypoproteinemia, in 19 patients (43.1%) anemia, 23 patients (52.2%) had a malignancy, 6 patients or 13.6% were diabetics, and 16 (36.3%) patients; during the first intraoperative procedure were verified diffuse peritonitis. By analyzing the relation of present comorbidities and risk factors recorded, it was noted that hypertension usually occurs with hypoproteinemia (X<sup>2</sup> = 4.399; p = 0.036), wound infection (X<sup>2</sup> = 4.112; p

	Hypoproteinaemia 22 (50%)		Wound infection 27 (61%)		Malignancy 23 (52%)	
	Yes	No	Yes	No	Yes	No
HBP	14	8	12	10	7	15
	63.6%	36.4%	70.6%	37%	33.3%	65.2%
HOPD	3	2	3	2	4	1
	13.6%	9.1%	11.1%	11.8%	17.4%	4.8%
Thromboc- itopenia	1	2	2	3	2	1
	4.5%	9.1%	11.8%	11.1%	9.5%	4.3%
$\chi^2=4.399$ ; $p=0.036$		$\chi^2=4.112$ ; $p=0.043$		$\chi^2=4.016$ ; $p=0.045$		

Table 4. Prevalence of risk factors in relation to comorbidity in patients undergoing laparotomy with surgical wound dehiscence. HBP-high blood pressure; HOPD-chronic obstructive pulmonary disease.

= 0.043) and malignant diseases ( $X^2 = 4.016$ ;  $p = 0.045$ ) (Table 4).

The frequency in the sample was not statistically significantly different compared to the comorbid conditions ( $X^2 = 0.848$ ;  $p = 0.357$ ). Also, the incidence of peritonitis ( $X^2 = 2.514$ ,  $p = 0.113$ ) and diabetes ( $X^2 = 3.189$ ;  $p = 0.074$ ) was not significantly different in respect to the presence of comorbidities.

## 5. DISCUSSION

A retrospective analysis of data showed that in the total sample of all surgically treated patients at the clinic for General and Abdominal Surgery CCUS in the three-year period (a total of 3504 patients) 44 of them were with clear surgical wound dehiscence which accounted for 1.25% of the total sample. This information is in line with the relevant medical literature and published results of similar studies which indicate that the percentage of patients with wound dehiscence ranges from 0.6-6% (6). Analysis of the gender structure pointed to a slightly higher proportion of male patients who were represented with a ratio of 2.33: 1 to female patients, which is consistent with the results reported in the relevant literature (4). Analysis of the age structure indicated the predominance of dehiscence in patients in their seventh decade. Also in another study age was registered as one of the risk factors of surgical wound dehiscence (7), confirming a higher percentage share of the elderly population of patients from the seven to the eighth decade of life. Most of the study states greater significance of the biological age of the patient relative to the actual number of years of life (4). The explanation for this may lie in the deterioration mechanism of tissue repair in the elderly. Especially during the first few days of wound healing process, the immune system plays a key role. Functional changes adversely affect the influx of cells and compounds that are essential for tissue regeneration (8). Anemia is a risk factor related to increased perioperative stress, blood transfusions and reduce blood oxygenation, all of which affects the immune system of the wound healing process (9).

Dehiscence in our sample occurred mostly the fourth postoperative day. However, recorded in dehiscence of the second to ninth postoperative day, with 75% of all cases occurred in the first seven postoperative days. Van Ramshorst and his associates found that 90% of all dehis-

cence occurs before the 15th postoperative day. The median duration of hospitalization in patients with abdominal postoperative wound dehiscence was 36 days, with a significantly higher mortality rate compared to patients who did not appeared dehiscence surgical wound (10). Relevant literature indicates the data that correspond to the results obtained in our study. The largest number of operative wound dehiscence in our sample was found in patients who have been treated for cancer of the colon and rectum, and in patients with signs of acute abdominal events. Emergency operations in some studies showed an important factor in the appearance of postoperative wound dehiscence (3, 11, 12). Patients who underwent emergency surgery in general are in a worse general and nutritional condition and the likelihood of contamination of the surgical field is higher than in elective surgery. In addition, the performance of surgeons can be worse at night, which could lead to sub-optimal closure of the abdomen at the end of the operation.

From a total of 44 patients with dehiscence in our study, the majority of them had signs of infection, 61%. For wound infection is considered confirmed production of pus, positive bacterial culture or "abscess" the operative field before the diagnosis of abdominal wound dehiscence within 30 days after surgery. The infection has expressed a destructive effect on the wound healing process. Bacterial toxins and enzymes can lead to disorder at all levels of the process of wound healing. Also, the products of the local inflammatory response, cytokines and interleukins further disrupt the cellular and biochemical processes of wound healing. Various studies indicate different data, but generally the proportion of patients with wound dehiscence in which and wound infection was found is around 50% (13, 14).

More than half of the patients (52.2%) had malignant disease and the hypoproteinemia elements, anemia is a risk factor verified in 43% of patients, while peritonitis was found in 36% of patients with this postoperative complication. Numerous studies have shown that there is a statistically significant correlation between operative wound dehiscence and malnutrition with hypoproteinemia. Up to 80% of patients with early signs of disruption has evident hypoproteinemia (4). Malnutrition, weight loss up to 20%, lack of albumin and lack of amino acids (cysteine, arginine and methionine) significantly affect the extension of the inflammatory phase of wound healing process with a disorder of collagen synthesis (15). Study Dubai and associates pointed out that the poor wound healing significantly associated with low hematocrit and low serum albumin, as well as the lack of certain vitamins and minerals such as vitamins A, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, C, and zinc and copper (8).

Wound infection, hypoproteinemia, anemia and malignant disease, as the most common risk factors in our patients who developed postoperative abdominal wound dehiscence, were most often associated with hypertension as well as comorbidity. Diabetes in this study did not show a risk factor for the development of surgical wound dehiscence. Van Ramshorst and associates (11) also did not identify association between diabetes and

dehiscence of abdominal surgical wounds, as no association between malignancy and sepsis with this surgical complication was found, while other studies have associated malignancy with dehiscence of the surgical wound (7, 16).

Our research indicates that the profile of the patients and elements such as age, sex, nutritional status, preoperative condition, and various comorbidities influence the occurrence of dehiscence of the surgical wound. This is one of the first studies of dehiscence risk factors of the surgical wound in our country. It refers to a shorter period of observation and presented the experience of a surgical center. Future research could be a multi-center with a large number of patients for more accurate identification of high-risk patients for the development of dehiscence of the surgical wound, and the possibility of application of minimally invasive surgery in general surgery practice.

## 6. CONCLUSIONS

On the basis of this study we can conclude that the largest occurrence of surgical wound dehiscence was found in the patients treated in the emergency and in patients with malignant disease. As dehiscence risk factors of the surgical wound, we identified wound infection, malignancy, hypoproteinemia, anemia, and peritonitis. These results indicate that the risk of developing a wound dehiscence of abdominal surgical wound can reduce the application of adequate perioperative measures and wound infection treatment.

- **Conflict of interest:** none declared.
- **Authors contribution to specific components of research:** all authors were included in all phases of preparing this article, including final proof reading.

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