



Risk Factors Related to the Patient for Postoperative Wound Complications in Common Elective and Emergency Abdominal Operations

Milorad Paunović*

University of Belgrade, Clinical Center of Serbia, Belgrade, Serbia

Abstract

Complications related to postoperative wound healing occur with varying frequency depending on the underlying disease, the patient's condition and surgeon's technical skills. In emergency operations, the percentage of complications is higher. The aim of this study was to identify and evaluate the risks factors for occurrence of postoperative complications: infection and wound dehiscence.

Research is organized by type of retrospective-prospective studies between January 2017 and September 2018 at the Clinic for General Surgery in Nis where 630 patients was operated. Of the total number, there were 461 (73.2%) elective and 169 (26.8%) emergency operations.

In elective surgery operations: smoking, comorbidity, blood loss, and type of operation were independent risk factors. Multivariate subgroup analysis of the association between smoking and complications disclosed that smoking was independently associated with surgical site infections, as well wound dehiscence. In emergency surgery: male gender, peritonitis, operation, and multiple operations were independent risks factors. Postoperative blood loss is proved in all cases to be a significant risk factor.

Risk factors known to affect the process of tissue and wound healing, like smoking, diabetes, cardiovascular disease, lung disease, male gender, contamination of the surgical site, blood loss, and the operation itself, were independent risk factors of wound and tissue complications, with the morbidity and mortality still very high. Those were the reasons to identify and clarify the risk factors, since recognized before and during the surgery, they are possible to prevent and eliminate.

OPEN ACCESS

*Correspondence:

Milorad Paunović, University of Belgrade, Clinical Center of Serbia, Belgrade, Serbia,
E-mail: miloradpaunovic@yahoo.com

Received Date: 22 Nov 2018

Accepted Date: 14 Dec 2018

Published Date: 17 Dec 2018

Citation:

Paunović M. Risk Factors Related to the Patient for Postoperative Wound Complications in Common Elective and Emergency Abdominal Operations. *Ann Surg Case Rep.* 2018; 1(2): 1009.

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Introduction

Complications related to postoperative wound healing up occur with varying frequency depending on the underlying disease, the patient's and surgeon's technical skills. In emergency operations, the percentage of complications is higher. Surgical site infections and wound and tissue dehiscence are well-known postoperative complications in gastrointestinal surgery, and general surgery as well. Evisceration is a complication associated with high morbidity, and high mortality as well, and the percentage in colorectal surgery still remains 2-3, 5% [1,2]. The infection is certain in 5% to 10%. The rupture of the abdominal wall occurs in 1% of the cases, however with a high mortality rate (15% to 45%) [3]. Severity of these complications embraces mild cases needing local wound care and antibiotics to serious cases with multiple reoperations and a high mortality rate. In most cases, such complications prolong hospitalization, with a substantial increase in cost of care [4].

Traditionally, local factors such as the degree of contamination and the surgical technique have been regarded as strong pre-risks for surgical site infection and wound dehiscence [5].

More recent studies, however, have disregarded the significance of surgical technique, and others have identified systemic factors such as high age, gender, lifestyle, and coexisting morbidity as playing a significant role in the pathogenesis of these complications [6]. The significant risk factors that could lead to postoperative complications were the age over 65, lung diseases, hemodynamic instability, intrabdominal pressure (coughing, vomiting, and distension). Significant systemic risk factors were hypoproteinemia, systemic infections, obesity, uremia, malignant diseases, ascites, steroid use and hypertension. There is a positive correlation between risk factors and the tissue and

Table 1: Baseline characteristics connected with post operation complication.

	Elective surgery n=461	Emergency surgery n=169
Anamnestic variables		
Age (median, interquartile range)	59 (44-73)	59 (29-75)
Male gender	268 (58.1)	123 (72.8)
Family status (single or widow)	109 (23.7)	60 (35.5)
Employed	134 (29.1)	78 (46.2)
Dependent functional status	46 (10.0)	96 (56.8)
Smoker	178 (39.3)	103 (60.9)
Alcohol abuse (more than 5 drinks per day)	28 (6.1)	26 (15.4)
Diabetes, Cardiovascular disease or lung disease	204 (44.3)	109 (64.5)
Liver cirrhosis or previous myocardial infarction or stroke	37 (8.0)	22 (13.0)
Physiologic variables		
Systolic blood pressure (<110 or >130 mm Hg)	66 (14.3)	32 (18.9)
Pulse (<50 or >80 beats per minute)	138 (29.9)	114 (67.5)
Electrocardiogram (not sinus rhythm)	25 (5.4)	27 (16.0)
Hemoglobin (<6.8 or >10.2 mmol/L)*	35 (7.6)	42 (24.9)
Leukocyte count (>10.1 or < 4.0 billion/L)*	40 (8.7)	127 (75.1)
Kalium (<3.5 or >5 µmol/L)*	39 (8.5)	61 (36.1)
Natrium (<135 µmol/L)*	33 (7.2)	61 (36.1)
Creatinine (>125 mol/L)*	23 (5.1)	34 (20.1)
Operative variables		
Hernia surgery	331 (71.8)	73 (43.2)
Gallbladder surgery	82 (17.8)	29 (17.2)
Gastric or duodenal surgery	3 (0.6)	31 (18.3)
Intestinal surgery	26 (5.6)	51(30.2)
Appendix surgery	11 (2.4)	83 (49.1)
Colon or rectum surgery	74 (16.1)	55 (32.5)
Operative severity (difficult or very difficult)	84 (18.2)	61 (36.2)
Multiple operations	19 (4.1)	19 (11.2)
Blood loss (>100 ml)	92 (19.9)	49 (29.9)
Peritonitis (serous fluid, local or diffuse)	3 (0.6)	90 (53.3)
Malignancy	75 (16.3)	35 (20.7)
Reoperation	39 (18.5)	42 (24.8)

*Values are absolute with percentages structure in brackets

wound complications in digestive surgery.

The aim of this study was to identify and assess the pre-risks factors of postoperative tissue and wound complications when adjusting for potential confounders through multiple logistic regression analysis.

Methods

The study was performed from January 2017 through September 2018, at the Clinic for General Surgery in Nis, and during that period 630 of patients was operated. The operations included herniotomy, gastric, duodenal, pancreatic, and biliary surgery, as well as operations on the small bowel, appendix, colon, and rectum. Laparoscopic, anal, and perianal operations were excluded. Variables as listed in Table 1, with possible relation to postoperative complications were assessed. Data regarding patient history: family status, employment, smoking and drinking habits and comorbidity were defined as a medical disease in current treatment, and were collected from questionnaires

completed prior to operation by the patient or surgeon. These data and data from the operation and clinical record were recorded on a database sheet by the surgeon pre- or postoperatively. Postoperative tissue and wound complications were defined as surgical-site infections (superficial or deep wound infection, wound abscess, or intra abdominal abscess) or disruption of sutured tissue (wound, fascia, or anastomosis). At discharge, the surgical staff recorded complications and reoperations.

In case of admission to other departments of the hospital within 30 days, relevant data were extracted from retrieved clinical records and discharge letters. Thus, only complications needing hospitalization were recorded.

Statistical analysis was performed using the SPSS 15 software. Results were expressed as mean ± standard deviation. Categorical variables were compared using Chi-square test with Yates correction Normality was analyzed with Shapiro-Wilk normality test. Logistic

Table 2: Postoperative tissue and wound complications: infections and dehiscence.

	Elective surgery n=461	Emergency surgery n=169	P Values [†]
Surgical site infections			
Superficial wound infection	19 (4.1)	18 (10.6)	
Deep wound infection	12 (2.6)	9 (5.3)	
Intraabdominal abscess	2 (0.4)	4 (2.4)	
Total	33 (7.1)	31 (18.3)	
One or more surgical site infections	20 (4.3)	19 (11.2)	< 0.001
Wound or tissue disruptions			
Wound or fascial rupture	6 (1.3)	9 (5.3)	
Anastomotic leakage	8 (1.7)	11 (6.5)	
Total	14 (3.0)	20 (11.8)	
One or more wound or tissue disruptions	14 (3.8)	17 (10.1)	< 0.001
Tissue and wound complications			
Total	39 (8.5)	56 (33.1)	
One of more tissue and wound complications	15 (3.3)	16 (9.5)	< 0.001

[†]Values are absolute with percentages in brackets

[†]P Values for Hi square test

regression was used for calculating Odds Ratio like crude and adjusted. Statistical analysis was performed using the SPSS 15 software. Significance was set at $p < 0.05$.

Results

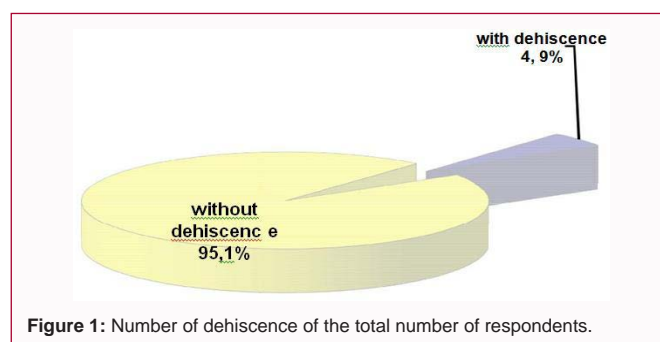
Dehiscence of laparotomy occurred in 4.9% of patients and 31 patients of the total 630 respondents (Figure 1). A total of 630 operations entered the database, of which 461 or 73.2% were elective and 169 or 26.8% emergency operations. Variables as listed in Table 1, with possible relation to postoperative complications were assessed.

The overall incidence of wound postoperative complications (wound dehiscence) was 3.3% following elective operation, and 40.0% of these patients (6/15) were admitted for more than 15 days after surgery (Table 2). Following emergency operation, 9.5% patients had dehiscence of laparotomy, and 62.5% (10/16) were admitted for more than 15 days following surgery (Table 2). The analysis of factors associated with tissue and wound complications following elective surgery disclosed that smoking, comorbidity, perioperative blood loss, and type of operation were independent risk factors (Table 3).

Multivariate subgroup analysis of the association between smoking and complications disclosed that smoking was independently associated with surgical site infections (OR 1.58; 1.09-2.22), as well as tissue and wound dehiscence (OR 1.65; 1.07-2.73).

Variables which were significantly associated with tissue and wound complications in the univariate analysis, but failed to be significant in the final multivariate model were family status, multiple operations, malignancy, reoperation, and surgeon's training. In emergency surgery, male gender, peritonitis, operation, and multiple operations were independent predictors of tissue and wound complications (Table 4). Postoperative blood loss is proved in all cases to be significant risk factor.

Variables which were significantly associated with tissue and wound complications in the univariate analysis but failed to be significant in the final multivariate model were pulse, impaired sensorium, blood loss, malignancy, reoperation, and surgeon's training.



Discussion

Our results show that dehiscence of laparotomy was present in 4.9% of patients or 31 patients of the total 630 respondents. The Cracow study Konig J, Richter P, Zurawska S and associates with dehiscence of laparotomy occurred in 56 patients or 2.9% of their patients [7]. In an Indian study from Rajindra Hospital in Patiala wound dehiscence was found on 2.84% of patients [8]. Comparing the occurrence of the dehiscence of laparotomy in our study with the dehiscence of the wound in the previous two studies, we can conclude that our results are not worse. Our study demonstrates a significantly higher incidence of postoperative tissue and wound complications in emergency than elective surgery, thus confirming previous reports [9,10]. In the German study by the Fleischer G.M., Rennert A. and Ruchmer M. dehiscence laparotomy occurs in 5% to 10% of patients with infection [3]. When present, infection and disruption of wounds and tissues were associated with a higher risk of reoperation, and a prolonged postoperative admission [11]. Unlike other reports, no association between wound complications and mortality was found [11].

Common for all tissues subject to surgery is a disruption of the local vascular supply, thrombosis of the vessels, and tissue hypoxia [12]. Once the blood supply is restored, several factors may complicate healing. The most important seems to be the proliferation of bacteria in the wound and tissue, which affects each process involved in healing and increases the risk of wound infection, delayed healing,

Table 3: Variables associated with tissue and wound complications following elective operation analyzed by logistic regression: the final model.

	Univariate		Multivariate	
	OR	95% CI	OR	95% CI
Smoking Status				
Nonsmoker	1	-	1	-
Smoker	1.58	1.09-2.22	1.65	1.07-2.73
Comorbidity				
No	1	-	1	-
Yes	1.29	1.17-1.69	1.36	1.27-2.01
Blood Loss				
<100 ml	1	-	1	-
100 ml to 500 ml	3.27	2.08-4.93	1.63	0.96-2.46
>500 ml	7.83	4.92-12.16	4.08	1.82-5.92
Operation				
Hernia surgery	1	-	1	-
Biliary surgery	0.73	0.39-1.43	0.62	0.35-1.47
Gastroduodenal surgery	4.33	2.27-10.82	1.98	0.66-6.54
Small-bowel surgery	3.84	1.96-7.32	1.92	1.63-4.98
Colorectal surgery	6.83	5.11-9.84	2.87	2.10-4.69

and dehiscence [13]. In both elective and emergency surgery, large operations like colorectal and small-bowel operations were more strongly associated with complications when compared to smaller operations.

Wound infections, intrabdominal abscesses, and anastomotic leakage are known to occur more frequent following surgery on the lower than upper digestive tract [14]. This observation is presumably due to a higher incidence of anastomotic dehiscence of colon and especially rectal anastomosis, where the intraluminal bacterial load is high [9]. The presence of bacteria in the healing tissue affects all processes of healing and promotes impairment of collagen synthesis and release of proteolytic enzymes, which promotes dehiscence by decreasing the suture-holding capacity of the tissue [15].

Following elective operations, perioperative blood loss was a pre-risk of postoperative tissue and wound complications in a dose-dependent manner, when adjusting for other risk factors and confounders. This finding confirms previous reports, and suggests that hypovolemia and reduction of tissue oxygenation by loss of red blood cells is detrimental to healing and increases the risk of infection and tissue dehiscence [16,17]. An immune modulator effect of allogenic blood transfusions to compensate for perioperative blood loss has been suggested as causative for postoperative wound infections [18].

Smoking and comorbidity such as diabetes, cardiovascular disease, and lung disease were associated with surgical site infections and dehiscence of tissue and wounds, thus confirming previous reports [19,20]. Several pathogenetic mechanisms may be involved. Smoking, micro vascular disease, and severe lung disease are known to cause peripheral tissue hypoxia which increases the risk of wound infection and dehiscence.

In addition, some studies suggest that hypoxia, smoking, and diabetes reduce collagen synthesis and oxidative killing mechanisms of neutrophils [21,22].

Table 4: Variables associated with tissue and wound complications following emergency operation analyzed by logistic regression the final model.

	Univariate		Multivariate	
	OR	95% CI	OR	95% CI
Gender				
Female	1	-	1	-
Male	1.54	1.18-2.06	1.7	1.38-2.08
Peritonitis				
None	1	-	1	-
Serous fluid	1.25	0.89-1.75	0.91	0.53-1.34
Localized pus	2.62	1.87-3.69	1.98	1.42-2.99
Diffuse	3.08	2.26-5.10	2.15	1.34-3.16
Operation				
Hernia surgery	1	-	1	-
Appendix surgery	1.87	5.92-6.32	2.22	0.80-4.27
Biliary surgery	1.79	1.12-6.06	2.34	1.26-8.42
Gastroduodenal surgery	4.25	2.23-8.47	3.29	2.14-6.73
Small-bowel surgery	3.72	1.64-7.68	1.83	1.05-5.72
Colorectalni surgery	7.34	4.29-15.72	5.21	3.19-10.91
Multiple Operations				
1 operation	1	-	1	-
>1 operation	3.04	2.60-4.30	2.56	1.87-3.45

The presence of neoplastic disease were followed by the intense tumor metabolism, malnutrition and disorders of absorption, all of which can disrupt the normal process of wound healing and therefore is more frequent occurrence of dehiscence [23]. In study by Oh SJ et al., [24] in South Korea since 1987 to 2004 were included 8033 patients. Dehiscence laparotomy occurred in 9.3% patients with cancer.

In emergency surgery, peritonitis in terms of localized pus or diffuse peritonitis was a strong risk factor of wound and tissue complications. As shown by others, wound infection is likely to occur when peritonitis with a large intrabdominal bacterial load and bacteriemia is present, despite intravenous antibiotics administered perioperatively [5,9,14]. Male gender was a significant risk factor for postoperative complications following emergency operations, too. Especially wound disruption and anastomotic leakage has been reported as being more frequent [25]. The reason is dubious but may be associated with a lesser collagen production and reduced wound-healing capacity in men [26]. Multiple operations predict wound and tissue complications as well presumably due to bacterial contamination of the wound and tissue and resuture of relatively a vascular scar tissue of the fascia [27,28].

Prospective study in Greece, through the period of 15 years, proved that (besides the pre-risks shown in our study) the significant risk factors (p<0.05) are ascites, hypoalbuminemia and the use of steroids [29].

Conclusion

Patients with a great many of risk factors like smoking, diabetes, cardiovascular disease, lung disease, male gender, contamination of the surgical site, blood loss, and the operation itself are predisposed for development of postoperative wound complications (infections and wound dehiscence) with the morbidity and mortality still very

high. Therefore it is important to identify them early and treat those patients with care. Good preoperative preparation reduces postoperative wound complications.

Further, development of clinical pathways would prove valuable if the absolute risk of each patient could be estimated when planning surgery to specifically optimize the patient's preoperative condition to reduce the risk of complications.

Healthy life and good preoperative preparation reduce postoperative wound complications.

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