



A prospective evaluation of the risk factors for development of wound dehiscence and incisional hernia

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ABSTRACT

Objective: Post-laparotomy wound dehiscence, evantration and evisceration are important complications leading to an increase in both morbidity and mortality. Incisional hernias are frequently observed following abdominal surgeries and their occurrence is related to various local and systemic factors. This study aims to analyze the factors affecting wound healing by investigating the parameters that may cause wound dehiscence, incisional hernia, sinus formation and chronic incisional pain.

Material and Methods: The records of 265 patients who underwent major abdominal surgery were analyzed. The data on patient characteristics, medication, surgical procedure type, type of suture and surgical instruments used and complications were recorded. The patients were followed up with respect to sinus formation, incisional hernia occurrence and presence of chronic incision pain. Statistical analysis was performed using SPSS 10.00 program. The groups were compared via chi-square tests. Significance was determined as $p < 0.05$. Multi-variate analysis was done by forward logistic regression analysis.

Results: 115 (43.4%) patients were female and 150 (56.6%) were male. Ninety-four (35.5%) patients were under 50 years old and 171 (64.5%) were older than 50 years. The median follow-up period was 28 months (0-48). Factors affecting wound dehiscence were found to be; creation of an ostomy ($p=0.002$), postoperative pulmonary problems ($p=0.001$) and wound infection ($p=0.001$). Factors leading to incisional hernia were; incision type ($p=0.002$), formation of an ostomy ($p=0.002$), postoperative bowel obstruction ($p=0.027$), postoperative pulmonary problems ($p=0.017$) and wound infection ($p=0.011$).

Conclusion: Awareness of the factors causing wound dehiscence and incisional hernia in abdominal surgery, means of intervention to the risk factors and taking relevant measures may prevent complications. Surgical complications that occur in the postoperative period are especially related to wound healing problems.

Key Words: Abdominal surgery, wound dehiscence, incisional hernia, sinus formation, chronic incisional pain

INTRODUCTION

Wound dehiscence after laparotomy can manifest with different presentations varying from simple skin detachment to evisceration and eventration, leading to an increase in surgical mortality and morbidity, as well as increase in length of hospital stay and loss of work force.

Anterior abdominal wall incision hernia that can be seen in the long term is also one of the common surgical complications. Known as postoperative hernia or incisional hernia, it is thought to result from insufficient closure of the fascia and/or poor healing. Factors causing chronic or prolonged postoperative intra-abdominal pressure increase and those affecting wound healing contribute to its development. The incidence of incisional hernias vary from 2% to 20% in different sources, and in addition to pain and impairment in quality of life it may also cause significant complications (1, 2). It has been reported that incarceration may occur in a rate of 15%, and strangulation in 2%, if left untreated (3, 4). Recurrence rates after incisional hernia repair is approximately between 11% to 45%, taking into consideration the cost of treatment, the complications and risk of recurrence, it makes sense to evaluate factors causing its occurrence and trying to take precautions (5-8).

This study aimed to present analysis of the factors affecting surgical wound healing by using parameters that might lead to wound dehiscence in the early postoperative period or the development of incisional hernia in the long term.

MATERIAL AND METHODS

265 patients who underwent major abdominal surgery in Dışkapı Training and Research Hospital, General Surgery Clinic between January 2003 and August 2007, and who were available for regular follow-up were included in the study. The study was designed as an observational study and informed consents were obtained prospectively. Patients who were lost during postoperative follow-up or those with delays in their

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scheduled protocols were excluded from the study. Patient data regarding age, gender, height, body weight, smoking, systemic diseases, drug use, preoperative chemotherapy application, operative records and diagnoses were recorded.

Perioperative albumin, total protein and renal function values were determined. During surgery, data indicating elective versus emergent surgery, the selected incision, incision length, subcutaneous closure type and type of retention sutures used were recorded. The technique used for closure of the fascia and the peritoneum were noted. Pulmonary complications in the postoperative period, abdominal distension, bowel obstruction status, wound infection, whether an ostomy was formed or not during the surgical procedure were also recorded. Patients status of chemotherapy as adjuvant therapy were identified.

Patients with wound dehiscence, infection, complications such as evisceration and evantrations were recorded as well as these parameters. Following discharge, patients were evaluated in 3 months intervals for the first 2 years and then in every 6 months. In the short-and long-term, sinus formation over the incision line or incisional pain were investigated as complications.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) 10.00 program was used for analysis. Parameters were evaluated as mean±standard deviation. Comparisons between groups were performed with chi-square test. P<0.05 was considered as significant. Parameters that were found to be significant in one-way analysis were included in multi-dimensional analyses. Multivariable logistic regression analysis was used for multivariate analysis.

RESULTS

Patient demographics are summarized in Table 1. Type of surgical procedures and the materials used are reported in Table 2. The mean follow-up was 28 months (1-48 months) and surgical complications in the early postoperative period or during follow-up are shown in Table 3.

Evantration was found in 23 patients (8.7%). Evisceration was observed in 15 patients (5.7%). During follow-up, 69 patients developed incisional hernia (26%). In short-term and long-term follow-up of patients, a sinus formation over the incision was identified in 49 patients (18.5%). In the outpatient clinic, 82 patients (30.9%) complained of chronic incision pain.

225 (84.9%) patients had been operated on due to malignancy. Oncology patient distribution was as follows: 119 (52.9%) colorectal, 63 (28.0%) gastro-oesophageal, 13 (5.8%) hepatobiliary-pancreatic, 14 (6.2%) intra-abdominal mass and 16 (7.1%) other types of cancer (ovarian, lymphoma).

In multivariate analysis, postoperative bowel obstruction (p=0.02), postoperative pulmonary problems (p=0.001) and wound infection (p=0.001) were identified as factors increasing wound dehiscence (Table 4). Factors leading to postoperative hernia were; male gender (p=0.022), incision type (p=0.002), formation of an ostomy (p=0.002), postoperative bowel obstruction (p=0.027), postoperative pulmonary problems (p=0.017) and wound infection (p=0.011) (Table 5).

DISCUSSION

Wound dehiscence and incisional hernia complications that occur in patients undergoing abdominal surgery lead to an increase in morbidity, mortality and length of hospital stay. It is important to be aware of the effect of patient characteristics, used materials and surgical technique on possible complications.

Table 1. Patient demographics

		n (%)
Age	<50	94 (35.5)
	>50	171 (64.5)
Gender	Female	115 (43.4)
	Male	150 (56.6)
BMI (Body mass index)	Thin-normal (<25)	169 (63.8)
	Overweight (>25)	96 (36.2)
Diabetes	No	227 (85.7)
	Yes	38 (14.3)
Hypertension	No	205 (77.4)
	Yes	60 (22.6)
COPD	No	252 (95.1)
	Yes	13 (4.9)
Smoking	Yes	101 (38.1)
	No	164 (61.9)
Steroid use	No	257 (97.0)
	Yes	8 (3.0)
Preoperative chemotherapy	No	246 (92.8)
	Yes	19 (7.2)
Protein	Normal (>6.4 g/dL)	174 (65.7)
	Low (<6.4 g/dL)	91 (34.3)
Albumin	Normal (>3.5 g/dL)	155 (58.5)
	Low (<3.5 g/dL)	110 (41.5)
Hemoglobin	Normal (>12 g/dL)	128 (48.3)
	Low (<12 g/dL)	137 (51.7)
Hematocrit	Normal (>%35)	131 (49.4)
	Low (<%35)	134 (50.6)
Leukocyte	Normal (<11.3x10 ³)	214 (80.8)
	High (>11.3x10 ³)	51 (19.2)
BUN	Normal (=5-20 mg/dL)	237 (89.4)
	High Bun >20 mg/dL)	28 (10.6)
Creatine	Normal (=0.5-1.3 mg/dL)	260 (98.1)
	High (>1.3 mg/dL)	5 (1.9)
Operation history	No	201 (75.8)
	Yes	64 (24.2)
Postoperative chemotherapy	No	117 (44.2)
	Yes	148 (55.8)
Cancer diagnosis	No	40 (15.1)
	Yes	225 (84.9)

		n (%)
Operation	Elective	226 (85.3)
	Emergency	39 (14.7)
Abdominal incision type	Above the umblicus median	23 (8.7)
	Below the umblicus median	3 (1.1)
	Above and below the umblicus median	220 (83)
	Subcostal	14 (5.3)
	Paramedian	1 (0.4)
	Transverse	4 (1.5)
Incision location	Upper abdominal incision	133 (50.2)
	Lower abdominal incision	132 (49.8)
Fascia	Silk	227 (85.7)
	Polydioxanone	32 (12.1)
	Polypropylene	5 (1.9)
	Other	1 (0.4)
Peritoneum	No	252 (95.1)
	Polyglactic acid	13 (4.9)
Subcutaneous tissue	No	252 (95.1)
	Polyglactic acid	13 (4.9)
Retention	No	245 (92.5)
	Yes	20 (7.5)
Fascia closure technique	Seperate	227 (85.7)
	Continuous	38 (14.3)
Ostomy	No	216 (81.5)
	Yes	49 (18.5)

		n (%)
Postoperative bowel obstruction	No	238 (89.8)
	Yes	27 (10.2)
Postoperative respiratory problems	No	199 (75.1)
	Yes	66 (24.9)
Wound infection	No	196 (74)
	Yes	69 (26)

In our study, male gender was associated with hernia formation ($p=0.022$). Age (>50) did not have an effect. Sorensen et al. (9) found an association with older age and male gender and the formation of a hernia in a series of 916 patients. However, other studies did not find a significant relation with gender and hernia formation (8). It is thought that accompanying disease in advanced age may affect wound healing and thus it is accepted as a risk factor for wound separation (10). However, since age and gender are risk factors that the clinician cannot influence, in the literature emphasis is made on modifiable factors.

Local factors are more effective and important than systemic factors in wound healing and separation (11). The consensus

is that well controlled diabetes is not a risk factor for fascia dehiscence (10). In our patients with systemic diseases, diabetes and hypertension were not found to relate to wound healing or hernia formation. Obesity ($BMI>25$) and COPD seem to cause an increase in wound dehiscence, but it did not reach statistical significance. This finding is similar to series that report increase in complications with COPD not reaching significance (12-15). There are studies stating that the presence of systemic disease is an important factor in wound dehiscence and that diabetes leads to an increase in wound dehiscence especially by increasing wound infection rates (12).

Postoperative wound dehiscence rates range between 0.024% to 11% and different factors are defined in etiology (16-20). One of the important reasons for these differences is inclusion of patients with appendectomy and inguinal hernia repair in large series resulting in a heterogenous group of patients. Our study group included a significant number of patients who have received preoperative chemotherapy and major oncological surgery (84.9%). The high rate of evisceration, 5.7% (15 patients), in our series may be explained by high number of co-morbid diseases, advanced age, major surgical procedures, high incision length and a group consisting of oncology patients.

	p	Risk	95% Confidence Interval	
			Minimum	Maximum
Ostomy formation	0.002	5.2	1.9	14.7
Postoperative pulmonary infection	0.001	7.2	2.6	19.5
Wound infection	0.001	6.5	2.3	19.0

	p	Risk	95% Confidence Interval	
			Minimum	Maximum
Male gender	0.022	2.763	1.159	6.588
Lower abdominal incision	0.002	4.074	1.692	9.811
Postoperative bowel obstruction	0.027	3.539	1.154	10.859
Postoperative pulmonary problems	0.017	2.877	1.204	6.875
Wound infection	0.011	3.055	1.296	7.202
Ostomy formation	0.002	5.2	1.9	14.7

Cytotoxic drugs, smoking and steroid use is known to adversely affect wound healing. It is recommended that postoperative chemotherapy should be given 2-3 weeks after completion of acute wound healing and that steroids should be cut after dose reduction in the preoperative period. Steroid use was reported as a factor for wound breakdown by affecting wound healing (8, 12, 21-23). We did not find a relationship between use of preoperative/adjuvant chemotherapy and steroid use with wound separation.

Local factors affecting wound healing, which are also part of surgical technique, can be listed as foreign bodies, surgical drains, the extent of contamination with infection, necrotic tissue at the surgical site and creation of a stoma. These are also mechanic factors affecting wound healing. Wound infections of varying degrees affect the abdominal wall at different rates and they are major causes of development of incisional hernia or wound dehiscence (14, 24, 25). In our series, wound infection that was present in 69 patients (26%), had a significant relationship with incisional hernia (p=0.011) and wound dehiscence (p=0.001). The use of prophylactic antibiotics, complying with the rules of asepsis and antisepsis are important for infection control.

During surgery, 49 patients (18.5%) had a creation of colostomy or ileostomy. It is well known that creation of a stoma on the incision line or near the incision has an adverse affect on wound healing. Riou suggests that every drain placed or every ostomy formed causes wound healing problems (8). Wound dehiscence was observed in 24 (49%) of patients with colostomy or ileostomy. Formation of an ostomy was statistically significant in multivariate analysis, in terms of affecting wound healing (p=0.002).

Incisional hernia and wound problems are more frequently observed in longitudinal incisions than transverse incisions (14, 26). The choice of incision is made after considering factors like requirement of the surgical procedure, it the incision

can be extended and appropriateness for closure. It has been reported that herniation risk is low in paramedian and lateral paramedian incisions (27). Our mean incision length was 20.2 cm (6-31 cm). The shape or length of incision in the present study was not found to be statistically significant.

Re-laparotomies and old incision length cause problems in wound healing and abdominal closure (26-30). In seven patients (10.9%) with a past surgery history and old abdominal incision scar, wound dehiscence and evisceration was observed in the early period. In 22 patients (34.4%) a long-term postoperative hernia was detected. Lower abdominal incisions (p=0.002) were found to be associated with postoperative hernia.

The discussion on fascia closing technique, surgical instruments and suture materials has been going on for many years. It is obvious that a single reason cannot be held responsible for wound dehiscence. Surgical sutures are one of the risk factors that can be controlled by choice and technique and they are important. Currently, the use of nonabsorbable or slowly absorbed suture materials is recommended and the incision length/stitch length ratio should be set as 4/1 to reduce the occurrence of incisional hernias (1, 14, 31). In this study, an association between suture materials, fascia closing technique or surgical instruments (cautery, scalpel) was not determined. In 11 of our patients with retention sutures (55%) wound dehiscence was seen. Although found to be statistically significant, this result is not important since retention sutures were only used in high-risk patients. In our clinic, this suture technique was applied to patients with a high risk of wound separation, who have undergone repeated laparotomies and had surgical complications like gastrointestinal fistulas. In the literature, there are studies indicating that prophylactic use of retention sutures significantly prevents wound dehiscence (32).

Postoperative surgical complications leading to increased intra-abdominal pressure also effect wound breakdown.

Vomiting, paralytic bowel obstruction, lung problems such as atelectasis and pneumonia also play a role in increased pressure. Pulmonary infections ($p=0.017$) and postoperative bowel obstruction ($p=0.027$) were associated with abdominal wound dehiscence.

Sinus formation is a complication that may cause wound infection, prevent cosmetic improvement of the incision, and may result in wound dehiscence by creating foci of abscess in the region. They usually occur in the long term. They are treated with extraction of suture materials from the sinus abscess and abscess drainage. Patients can complain of pain over the incision line in the postoperative follow-up, in the absence of any problem. This is the definition of chronic pain after surgery, it continues for at least 3 months, and its incidence and mechanism of formation is controversial (33). We have found the rate of pain as 30.9%, in the literature it is reported as 28% after colectomy, 32% following hysterectomy and 85% after thoracotomy or amputation. Incisional pain is important for its impact on patient comfort and resulting an increase in long-term pulmonary complications after surgery. It has been shown that the use of absorbable suture materials for abdominal incision closure reduce incisional pain by 50% and sinus formation by 48%. Factors affecting sinus formation and chronic incision pain are discussed as contamination and infection of the surgical site, obesity and subcutaneous fat amount, the amount and type of suture material (15, 34). In a meta-analysis, the most important difference between absorbable and non-absorbable suture materials was regarding sinus formation and incisional pain. Non-absorbable suture materials showed statistically significant sinus formation ($p=0.02$) and prolonged incision pain ($p<0.005$) (15, 34).

CONCLUSION

There is no ideal method for abdominal closure. Abdominal closure technique should be easy, fast, inexpensive and safe. In parallel to the developments in surgical practice one of the key issues discussed in the literature, is closing methods. Interference with changeable and manageable risk factors by clinicians in the preoperative and postoperative period is very important. Cessation of smoking and steroid-containing drugs in the pre-operative period, early mobilization, tight glucose control in diabetic patients and pulmonary rehabilitation after surgery are also significant. Infections, postoperative pulmonary problems, and postoperative bowel obstruction in patients undergoing major surgery are related to the development of wound dehiscence and incisional hernia, therefore measures should be taken to prevent such complications during follow-up. It should be remembered that an ostomy formation as a surgical technique will impair the healing of the abdominal wall, and these patients will be at a higher risk. Absorbable suture materials should be preferred to prevent sinus formation and chronic incision pain. With the increasing number of laparoscopic procedures in surgical practice, issues regarding abdominal closure and incisional hernia could be reduced.

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