Smoking Is a Risk Factor for Incisional Hernia

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Hypothesis: A number of risk factors for incisional hernia have been identified, but the pathogenesis remains unclear. Based on previous findings of smoking as a risk factor for wound complications and recurrence of groin hernia, we studied whether smoking is associated with incisional hernia.

Design: Cohort study. Clinical follow-up study for incisional hernia 33 to 57 months following laparotomy for gastrointestinal disease. Variables predictive for incisional hernia were assessed by multiple regression analysis.

Setting: Department of Surgery, Bispebjerg Hospital, University of Copenhagen, Copenhagen, Denmark.

Patients: All 916 patients undergoing laparotomy from 1997 through 1998. Surgeons performed clinical examination in 310 patients; patients who failed to meet for examination, died, or were lost to follow-up were excluded.

Main Outcome Measures: Thirty-four variables related to patient history, preoperative clinical condition, operative severity and findings, and the surgeon’s training.

Results: The incidence of incisional hernia was 26% (81/310). Smokers had a 4-fold higher risk of incisional hernia (odds ratio [OR], 3.93 [95% confidence interval (CI), 1.82-8.49]) independent of other risk factors and confounders. Relaparotomy was the strongest factor associated with hernia (OR, 5.89 [95% CI, 1.78-19.48]). Other risk factors were postoperative wound complications (OR, 3.91 [95% CI, 1.99-7.66]), age (OR, 1.04 [95% CI, 1.02-1.06]), and male sex (OR, 2.17 [95% CI, 1.21-3.91]).

Conclusion: Smoking is a significant risk factor for incisional hernia in line with relaparotomy, postoperative wound complications, older age, and male sex.

Arch Surg. 2005;140:119-123

INCISIONAL HERNIA IS A LATE COMPLICATION FOLLOWING ABDOMINAL SURGERY, OCCURRING AS A RESULT OF BREAKDOWN OR LOSS OF FASCIAL CLOSURE AND, AS SUCH, A IATROGENIC DISEASE.1 The incidence after laparotomy has been reported as ranging between 4% and 12% in large series,2,6 but the true incidence is probably underestimated.7 Many incisional hernias are asymptomatic, but if symptoms are present, an incisional hernia may be associated with major morbidity, loss of time from productive employment, and diminished quality of life.1 Given the financial cost of incisional hernia repair and the disappointing recurrence rates up to 45%, incisional hernia remains a significant challenge for most surgeons.

A number of factors associated with incisional hernia have been identified, some of which are local, such as wound infection and surgical technique,2,9 and some systemic, such as older age, male sex, and altered collagen metabolism.3,10 In addition, a lifestyle factor like obesity has been found to be associated with incisional hernia.5,11 Based on a previous study where we identified smoking as an independent predictor of inguinal hernia recurrence,13 we hypothesized that smoking is associated with incisional hernia following laparotomy. Thus, the aim of this study was to identify and assess factors predictive of incisional hernia when adjusting for potential confounders through multiple logistic regression analysis.

METHODS

From January 1997 through December 1998, a total of 1066 elective and emergency laparotomies and relaparotomies were performed in 916 patients. The operations were performed at the Department of Surgery, Bispebjerg Hospital, Copenhagen, Denmark, and included open gastrointestinal, biliary, and pancreatic surgery as well as operations on the small bowel, colon, and rectum. In October 2001 (ie, 33-37 months following laparotomy), a clinical examination for incisional hernia was conducted. All patients alive at the time of follow-up were eligible for clinical examination except those who were lost to follow-up.

Data on variables related to the patient history, characteristics of the disease, preoperative clinical condition, operative severity and
findings, and the surgeon’s training were recorded prospectively in a clinical database. Data regarding patient history (family, employment and functional dependent status, smoking and drinking habits, and comorbidity [defined as a medical disease in current treatment]) were collected from questionnaires completed prior to surgery by the patient or surgeon at hospital admission or at referral to the outpatient clinic. These data and data from the operation and clinical record were recorded in a clinical database. Subsequently, the database was validated manually by matching the data with the clinical record of each patient.

Postoperative complications occurring within 30 days after surgery were recorded by the surgeon at hospital discharge or at readmission. In case of admission to other departments of the hospital within 30 days, relevant data were extracted from retrieved clinical records and hospital discharge letters. Thus, only complications requiring hospitalization were recorded.

The data were entered in the database using EPI-INF0 6.0 software (Centers for Disease Control and Prevention, Atlanta, Ga). Data entry for all patients was ensured by continual control procedures. Subsequently, the database was validated manually by matching the data with the clinical record of each patient.

At follow-up, additional supplementary data not recorded in the database were obtained from the clinical record such as height and weight, fascial closure, and localization of incision. We obtained a detailed smoking history from the patient to validate the smoking data recorded at the time of surgery, as well as indications of increased intra-abdominal pressure (hard la-
Three hundred ten patients were examined; 491 patients (53.3%) died before examination, 22 patients (2.4%) were lost to follow-up, and 93 patients (10.1%) failed to meet for examination. The incidence of incisional hernia was 26% (81/310). In 85% (66/81), the hernia was located in a midline incision (P<.05). An existing ostomy or sutured ostomy wound was present in 6% (18/310), in which 6 patients had a parastomal or incisional hernia. All fascial closures were made with absorbable suture (Vicryl 0-0; Ethicon, Johnson & Johnson Intl, St Stevens-Woluwe, Belgium) using a continuous or interrupted suture technique.

The median span from operation to an incisional hernia becoming symptomatic was 3 months (interquartile range, 2-6), and in 74% (60/81), the hernia occurred within the first year after laparotomy. Forty-nine percent (40/81) had discomfort or pain, and 25% (19/81) used a corset or an abdominal binder. Incisional hernia repair was performed in 23% (71/81).

Data recorded in the database related to patient history, preoperative clinical condition, operative severity and findings, and postoperative complications with a possible relation to incisional hernia are listed in Table 1. Overall, the results showed that patients who had been operated on electively were largely operated on by specialist surgeons, had malignant colorectal disease, experienced a larger blood loss, and had fewer postoperative wound complications (Table 1). In contrast, the patients operated on emergently mainly underwent gastroduodenal or small-bowel surgery, were in poor preoperative clinical condition with abnormal blood values and peritonitis, and had a high incidence of postoperative wound complications (Table 1).

The multiple regression analysis disclosed that older age, male sex, daily smoking, postoperative wound complications, and relaparotomy were independently associated with incisional hernia (Table 2). No significant interaction between postoperative wound complications and smoking or wound complications and relaparotomy were found. Neither emergency surgery nor conditions associated with increased intra-abdominal pressure were independent predictors of incisional hernia.

A dropout analysis of patients eligible for follow-up disclosed that the examined patients had a higher prevalence of risk factors associated with incisional hernia (Table 3). No significant changes in the estimates of the multivariate analysis were found when performing a best case/worst case analysis, testing for selection bias owing to a hypothetical difference in the incidence of incisional hernia between patients who were examined and those who were not.

In conclusion, smokers have a 4-fold higher risk of incisional hernia than nonsmokers, independent of confounders and risk factors previously recognized to be associated with incisional hernia.2,5,11
The majority of incisional hernia was in midline incisions and occurred during the first year after laparotomy, which confirms previous studies. The incidence of incisional hernia in this study was higher than reported by others. However, as a considerable number of incisional hernias are known to be asymptomatic, the incidence found in this study may be owing to the long follow-up and the fact that all patients were physically examined by surgeons. In addition, parastomal hernias were included in our definition of incisional hernia, which may explain the high hernia rate because ostomies have been reported as being associated with the formation of incisional hernia.

Postoperative wound infection is a well-documented risk factor for early dehiscence of incisional wounds and fascia and for later development of incisional hernia. The pathogenesis is related to proliferation of bacteria in a wound, which affects each process involved in healing leading to decreased collagen synthesis, decreased bursting strength of the abdominal wall, and an increased risk of dehiscence.

Smokers have a higher risk of surgical site infections, dehiscence of tissue and wounds, and recurrence of groin hernia. Following this study, incisional hernia may be added to the list.

The proportion of smokers with incisional hernia was high as reported by other studies of patients with abdominal-wall hernia. Several pathogenic mechanisms seem to be involved. Smoking and peripheral tissue hypoxia, which may be caused by smoking, increase the risk of wound infection and dehiscence presumably through reduction of the oxidative killing mechanism of neutrophils, which constitute a critical defense against surgical pathogens. In addition, decreased collagen deposition in surgical test wounds has been found in smokers, a mechanism that may further attenuate the fascia in addition to the reduced collagen I–collagen III ratio present in incisional hernia. Degradation of connective tissue caused by an imbalance between proteases and their inhibitors may also be responsible. The latter mechanism, which is enhanced by smoking, is believed to cause tissue-destructive disorders like abdominal aorta aneurysm and pulmonary emphysema. Both diseases are associated with abdominal-wall herniation. In fact, the incisional hernia rate has been reported as high as 31% following midline laparotomy for abdominal aorta–aneurysm repair.

In this study, a relaparotomy was the strongest predictor for incisional hernia. Reoperations have previously been found to increase the rate of abdominal wound dehiscence and may also be responsible for the development of incisional hernia. Insufficient healing due to resuture of relatively nonvascular scar tissue of the fascia has been suggested. In addition, patients undergoing relaparotomy are likely to have bacterial contamination of the wound and may in addition have peritonitis, which increase the risk of wound infection and delayed healing.

Older age and male sex were independently associated with the development of incisional wall hernia, confirming other reports. In both, delayed wound healing and decreased collagen synthesis may be involved. Contrary to others, we did not find obesity to be associated with incisional hernia.

The majority of the patients undergoing laparotomy died before follow-up. This relatively high mortality rate may be because the patient population was unselected and the hospital covers a central urban area with considerable social problems and drug and alcohol abuse. One may therefore question whether the examined patients are representative of a population undergoing laparotomy for gastrointestinal disease. Yet, in patients who survive their laparotomy by 2.5 years, we believe that our findings are representative supported on the fact that no selection bias was present.

In conclusion, smokers have a high risk of incisional hernia formation independent of other recognized risk factors, presumably owing to the detrimental effect of smoking on wound healing. This finding may encourage surgeons to advise patients to quit smoking prior to surgery. However, as the evidence of the effect of smoking cessation prior to surgery is conflicting, long-term smoking-cessation intervention studies are needed to determine whether smoking cessation may reduce incisional herniation.

Accepted for Publication: July 27, 2004.

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Funding/Support: This study was supported by grant 9801273 from The Danish Research Council, Copenhagen.

Acknowledgment: We thank Peer Wille-Jørgensen, MD, DMSci, Johan Kjaergaard, MD, DMSci, and Torben Jørgensen, MD, DMSci, for preceding work in the database steering group; Rikke Roel and Mathilde Winckler for assistance at follow-up; and Edzard Domela for retrieving data from the blood bank.
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