

## Can Postoperative Abdominal Wound Dehiscence be Predicted?

Cavit ÇÖL, Atilla SORAN and Meltem ÇÖL

*Department of General Surgery, Ankara Numune Teaching Hospital, Turkey*

(Received April 1, 1998; Accepted April 4, 1998)

The purpose of this study was to identify risk factors in wound dehiscence and to determine which factors might be predictable. Forty patients with abdominal wound dehiscence were compared with 40 control patients standardized by sex and age. Hypoproteinemia, nausea/vomiting, fever, wound infection, abdominal distension, type of suture material, 2 or more abdominal drains, and the surgeon's experience were factors significantly associated with wound dehiscence. Emergency surgery, jaundice, ostomy, total parenteral nutrition, ascites, pulmonary morbidity, co-existence of disease, anemia, leucocytosis, and type of incision were nonsignificant variables. The number of patients with wound dehiscence increased with an increase in the number of risk factors, reaching 100% for patients with 8 risk factors. The risk factors of wound dehiscence can be predicted early and their number can be decreased before and after surgery by an experienced surgeon, leading to a lowered incidence of wound failure.

(Key Words: Abdomen, wound dehiscence, risk factors)

### INTRODUCTION

Surgical abdominal wound dehiscence (WD) is a serious complication. At best, the patient is subjected to the inconvenience of a discharging wound and the later appearance of an incisional hernia; at worst, immediate reoperation is required, with a fatal outcome in approximately 20% of cases (7). Despite increased knowledge concerning wound healing and progress in perioperative and postoperative care over the past few decades, WD after abdominal injury continues to be a problem which considerably prolongs hospital stay and is associated with mortality rates of 10-44% (5, 10, 13, 14, 20).

Factors related to WD are surgeon-experience, type of incision, suture material, drain, ostomy, and to patient-related factors such as age, nutritional state, and a co-existing disease (5). To identify factors contributing to the development of WD, we reviewed 11,329 major abdominal operations at the biggest teaching hospital in Turkey, and compared WD patients with randomly selected controls standardized by age and sex and operated on during the same period. The aim of this

study was to evaluate the risk factors of WD and determine which factors could be predictable.

### PATIENTS and METHODS

Between 1992 and 1996, 11,329 major abdominal laparotomies were performed in the Department of General Surgery, Ankara Numune Teaching Hospital. Forty patients were reported with complete wound dehiscence (group 1). During the same time period, 40 non-wound dehiscence (Non-WD) patients (group 2) were selected to serve as controls. The medical records of all patients were reviewed and local and systemic factors, surgeons' experience, operative procedure, suture materials, drain, and postoperative morbidity were considered and compared separately.

Clinically jaundiced patients had a serum total bilirubin level  $>50$   $\mu\text{mol/L}$  (normal 2 to 20). Anemia was defined as a hemoglobin value of less than 10 g/100d $\ell$  (normal 10-14 g/d $\ell$ ), and leucocytosis as a white blood cell count greater than 10,000 cells/ $\mu\ell$ . Hypertension was defined as blood pressure exceeding 160/100 mmHg or a history of

hypertension controlled either by diet or drug.

Data are reported as mean  $\pm$  standard deviation (SD). Statistical analyses were done by the  $\chi^2$  and Fisher exact tests, and significance was set at  $p < .05$ .

## RESULTS

Forty of 11,329 patients developed WD, an incidence of 0.35%. The primary diagnoses and operative procedures are listed in Tables 1 and 2. Ten of the 40 patients (25%) in group 1 had duodenal ulcers, and 9 of the 40 patients (22%) in group 2 had gastric cancer. The mean age of the group 1 patients was  $53 \pm 15$  years, compared with  $53 \pm 13$  years for group 2 ( $p > .05$ ). There

were 26 males and 14 females in both groups. None of the patients abused alcohol or steroids. All patients were in a normal weight range.

The most common malignancy was colon cancer in group 1; gastric cancer in group 2. Malignancy was not found to be a significant factor between the groups ( $p > .05$ ) (Table 3).

Jaundice, ascites, hypertension, intercurrent illness, anemia, and leucocytosis were the systemic factors assessed, and were not found to be significant ( $p > .05$ ) (Tables 3 and 4).

Emergency surgery, type of incision, ostomy, total parenteral nutrition, postoperative bowel movement (within first 72h), postop-

**Table 1** Patient diagnoses

Diagnosis	WD (%) (n = 40)	Non-WD (%) (n = 40)	Total (%) (n = 80)
Acute abdomen	6(15)	3(7)	9(11)
Colorectal tumor	4(10)	6(15)	10(12.5)
Duodenal ulcer	10(25)	2(5)	12(15)
Ileus	4(10)	4(10)	8(10)
Liver hydatid cyst	-	1(2.5)	1(1.2)
Obstructed jaundice	4(10)	2(5)	6(7.5)
Mesenteric ischemia	5(12.5)	1(2.5)	6(7.5)
Rectal prolapse	-	3(7.5)	3(3.7)
Cholelithiasis	1(2.5)	6(15)	7(8.7)
Trauma	4(10)	3(7.5)	7(8.7)
Gastric Cancer	2(5)	9(22.5)	11(13.7)
Total	40(100)	40(100)	80(100)

**Table 2** Surgical procedures

Operation	WD (n = 40)	Non-WD (n = 40)
Appendectomy	4	-
Abdominal rectopexy	-	3
BTY + Billroth II	5	7
BTY + PP *	6	-
Colon resection	6	8
Colectomy	3	1
Small bowel resection	5	1
Cholecystectomy	2	6
Cholecystectomy + BDA **	3	1
Whipple	1	2
Total gastrectomy	-	2
Other laparotomies	5	9
Total	40	40

\* BTY: Bilateral truncal vagotomy; PP: pyloroplasty

\*\* BDA: Bilio-digestive anastomosis

**Table 3** Group comparison according to risk factors

Factor	WD (n = 40)	Non-WD (n = 40)	$\chi^2$	P
Emergency surgery	18	11	2.65	NS
Malignant	9	15	3.81	NS
Jaundice	6	2	2.22	NS
Ostomies performed	3	1	1.05	NS
Hypoalbuminemia	30	19	6.87	< .01
TPN*	19	16	0.46	NS
Ascites	1	2	0.35	NS
Nausea/vomiting	13	4	6.05	< .05
Distension	16	2	14.05	< .0001
Pulmonary morbidity	20	18	0.20	NS
Co-existence disease	28	21	2.58	NS
Wound infection	20	2	23.31	< .00001
2 or more drains	20	9	6.66	< .05
Postoperative fever	18	5	10.31	< .001
Hemoglobin (gr/dl)	11 ± 2.8	11.6 ± 3.2	13.2	NS
WBC (cell/ $\mu^3$ )**	14,595 ± 6,746	9,890 ± 5,296	70.62	NS

\* TPN: Total parenteral nutrition.

\*\* WBC: White blood cells.

**Table 4** Co-existence of Disease

	WD (%) (n = 40)	Non-WD (%) (n = 40)	Total (%) (n = 80)
Atherosclerosis	13 (32.5)	4 (10)	17 (21.2)
DM <sup>a</sup>	5 (12.5)	6 (15)	11 (13.7)
Hypertension	6 (15)	8 (20)	14 (17.5)
Chronic renal disease	6 (15)	1 (2.5)	7 (8.7)
COFD <sup>b</sup>	9 (22.5)	7 (17.5)	16 (20)
CHF <sup>c</sup>	1 (2.5)	-	1 (1.2)
Others	5 (12.5)	-	5 (6.2)
None	12 (30)	19 (47.5)	31 (38.7)

<sup>a</sup> DM: Diabetes mellitus.<sup>b</sup> COFD: Chronic obstructive pulmonary disease.<sup>c</sup> CHF: Congestive heart disease.**Table 5** Type of incision

Incision	WD (%) (n = 40)	Non-WD (%) (n = 40)
Upper median	12 (30)	9 (22.5)
Lower median	4 (10)	8 (20)
Upper + lower median	15 (37.5)	14 (35)
Paramedian	4 (10)	2 (5)
Subcostal	5 (12.5)	7 (17.5)

Differences not significant,  $p > .05$ .**Table 6** Suture material for laparotomy

Suture	WD (%)	Non-WD (%)	Total (%)
Silk	12 (30)	1 (2.5)	13 (16)
Polidioxanone (PDS)	22 (55)	38 (95)	60 (75)
Polypropylene (prolen)	6 (15)	1 (2.5)	7 (9)

The difference in efficacy of suture materials between any two groups was highly significant ( $\chi^2 = 17.17$ ,  $p < 0.001$ ).

erative oral intake (within 72h), postoperative pulmonary morbidity and surgery-related factors were compared, but nothing of significance was found ( $p > .05$ ) (Tables 3 and 5).

In group 1, the average albumin level was  $31 \pm 7$  gr/L (range 16-44 gr/L), the average globulin level was  $29 \pm 6$  gr/L (range 13-48 gr/L). These values differed significantly from the group 2 values, where the average albumin level was  $37 \pm 5$  gr/L (range 26-48 gr/L) and the globulin level was  $30 \pm 5$  gr/L (range 24-48 gr/L) ( $p < .01$ ).

Twelve patients (30%) in the WD group underwent wound closure of all layers with interrupted silk sutures; 22 patients (55%) with continuous polydioxanone and 6 patients (15%) with continuous polypropylene. In the control group, continuous polydioxanone was preferred for all patients ( $\chi^2 = 17.17$ ,  $p < .001$ ) (Table 6).

Senior surgeons performed only 7.5% of the operations in group 1, but 30% of the operations in group 2 ( $p < .05$ ).

Postoperative factors such as; vomiting/nausea (more than 2 times per day, or controlled with treatment), abdominal distension, fever (more than  $38^\circ\text{C}$  in two consecutive readings), and infection of the wound were also found to be significant factors between the 2 groups ( $p < .05$ ).

WD was more often observed on the 7th postoperative day (range 1-18 days). In the 40 patients with WD, 30 were treated surgically with the remaining 10 being treated conservatively. Re-dehiscence was not observed in any patient. Retention sutures were not performed either for primary wound closure or re-operation in the WD patients.

There were no deaths in the control group, but 12 patients (30%) died in the WD group. As the number of risk factors for dehiscence increased, so did the mortality rate. Mortality was 30% for patients with 7 risk factors, 58% for patients with 8 risk factors, and 100% for patients with 10 or more risk factors.

## DISCUSSION

Wound dehiscence is affected by multiple factors. The question is which factors can the surgeon control in order to prevent complication with its high rates of morbidity and mortality. WD has been shown to be more

frequent in patients over 65 years of age than in younger ones (11, 12, 14) and predominantly affects females. Hence we standardized the subjects by age and sex before comparing the other predictable and possibly preventable risk factors. The surgeon of course cannot change either the age or sex of the patients, but what about other conditions? It has been shown, in comparable studies, that hypoproteinemia decreased the tensile strength (TS) of wounds (1, 9, 10, 11, 12, 14). If the operation is not urgent the surgeon can change this risk factor before surgery.

Local infection is one of the most important risk factors for WD (7, 10, 14), and in many cases can be prevented. Pathogenic organisms cause a decrease in TS and fibroblast concentration, so that tissue destruction occurs (3). In our study, the number of patients with WD could have been reduced if we could have prevented wound infections.

Conflicting data is available concerning jaundice, ascites, malignancy, pulmonary disease, bowel movement, and the co-existence of disease, factors which can be difficult to control by the surgeon (4, 5, 10, 18, 20). In addition, anemia, hypertension, emergency surgery, ostomy drains, type of incision, oral intake and total parenteral nutrition are some of the factors which can be controlled (6, 9, 13, 20). All of these factors were not significant, independent variables in our study; nevertheless, the incidence of WD and associated mortality increased in patients with 8 or more risk factors.

It is obvious that the surgeon's experience plays a major role in affecting the outcome of surgery. This holds for wound care and disruption, as well. Even if we did not find significant differences between the groups in our study, the level of experience was also important with regard to timing of surgery, the choice of suture material, type of incision, drains, and ostomy. A significant difference in the dehiscence group was found concerning the type of suture material used. No suture material can reach the ideal of being non-irritating, does not cause infection, is absorbable, and has strength. Previously, polyglycolic and silk sutures were commonly used, although they caused more wound failure and infections compared with

alternative sutures (14). Our literature survey indicates wide support for the use of monofilament polydioxanone and polypropylene sutures to continuous closure (2, 10, 15, 16, 19, 21).

Abdominal distension, vomiting, and nausea are risk factors caused by increasing intra-abdominal pressure (2, 8, 10, 17), and were found to be significant in our study. Could we have prevented high intra-abdominal pressure and thereby decreased the incidence of WD? Like postoperative high fever, these were found to be significant independent variables in our study, and the surgeon can control these factors.

In conclusion, we observed that WD increased if the patient had five or more risk factors. Although some factors could not be changed either before or after surgery, some local and systemic factors were adversely influenced by surgeons. Patient-related risk factors should be assessed before surgery, and should be rectified immediately. High-risk patients should be operated on by an experienced surgeon, and with proper timing. Postoperative patient care is extremely important. If the risk factors can be predicted early, their number can be decreased, and obviously, the incidence of wound failure would be lowered.

#### REFERENCES

- 1) Alexander HC, Prudden JF: The causes of abdominal wound disruption. *Surg Gynecol Obstet* 122: 1223-1229, 1966.
- 2) Brodin RE: Prospective randomized evaluation of midline fascial closure in gastric bariatric operations. *Am J Surg* 172: 328-331, 1996.
- 3) Bucknall TE: Factors influencing wound complications: a clinical and experimental study. *Ann R Coll Surg Engl* 21: 71-78, 1981.
- 4) Grande L, Garcia-Valdecasas JC, Fuster J, Visa J, Pera C: Obstructive jaundice and wound healing. *Br J Surg* 77: 440-442, 1990.
- 5) Gislason H, Gronbech JE, Soreide O: Burst abdomen and incisional hernia after major gastrointestinal operations-comparison of three closure techniques. *Eur J Surg* 161: 349-354, 1995.
- 6) Grimes CJC, Younathan MT, Lee WC: The effect of preoperative total parenteral nutrition on surgery outcomes. *J Am Diet Assoc* 87: 1202-1206, 1987.
- 7) Hugh TB: Abdominal wound dehiscence-editorial comment. *Aust N Z J Surg* 60: 153-155, 1990.
- 8) Israelsson LA, Jonsson T: Closure of midline laparotomy incisions with polydioxanone and nylon: The importance of suture technique. *Br J Surg* 81: 1606-1608, 1994.
- 9) Kudsk KA, Croce MA, Fabian TC, Minard G, Tolley EA, Poret A, Kuhl MR, Brown RO: Enteral versus parenteral feeding. Effects on septic morbidity after blunt and penetrating abdominal trauma. *Ann Surg* 215: 503-511, 1992.
- 10) Makela JT, Kiviniemi H, Juvonen T, Laitinen S: Factors influencing wound dehiscence after midline laparotomy. *Am J Surg* 170: 387-390, 1995.
- 11) Mendoza CB, Postlewaith RW, Johnson WD: Incidence of wound disruption following operation. *Arch Surg* 101: 396-398, 1970.
- 12) Penninckx FM, Poelmans SV, Kerremans RP, Beckers JP: Abdominal wound dehiscence in gastroenterological surgery. *Ann Surg* 189: 345-352, 1979.
- 13) Poole GV: Mechanical factors in abdominal wound closure. The prevention of fascial dehiscence. *Surgery* 97: 631-639, 1985.
- 14) Riou J-PA, Cohen JR, Johnson H: Factors influencing wound dehiscence. *Am J Surg* 163: 324-330, 1992.
- 15) Rubio PA: Closure of abdominal wounds with continuous nonabsorbable sutures: experience in 1,697 cases. *Int Surg* 76: 159-160, 1991.
- 16) Sahlin S, Ahlberg J, Granstrom L, Ljungstrom KG: Monofilament versus multifilament absorbable sutures for abdominal closure. *Br J Surg* 80: 322-324, 1993.
- 17) Saxe JM, Ledgerwood AM, Lucas CE: Management of the difficult abdominal closure. *Surg Clin North Am* 73: 243-251, 1993.
- 18) Taube M, Ellis H: Mass closure in an abdominal wound following major laparotomy in jaundice patients. *Ann R Coll Surg Engl* 29: 276-278, 1987.
- 19) Trimbos JB, Smith IB, Holm JP, Hermans J: A randomized clinical trial comparing two methods of fascia closure following midline laparotomy. *Arch Surg* 127: 1232-1234, 1992.
- 20) Wain MO, Sykes PA: Emergency abdominal re-exploration in a district general hospital. *Ann Roy Coll Surg Engl* 69: 69-74, 1987.
- 21) Wandsrom JC, Gerdin B: Closure of abdominal wall: how and why? *Acta Chir Scand* 156: 75-82, 1990.