Factors Influencing Wound Dehiscence in Abdominal Operation

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Arabic: عوامل مؤثر در بازشدن کامل جدار شکم در عامل جراحی شکمی

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Introduction:
Abdominal wound dehiscence is defined as postoperative wound separation that involves all layers of the abdominal wall. Despite the significant advances in perioperative care over the last 20 years, the incidence of abdominal wound dehiscence and its associated mortality have not improved. The reported incidence continues to be from 0.25 to 6% with associated mortality rates of 9% to 44% [1].
The etiology of abdominal wound dehiscence is believed to be a result of both local and systemic factors. However, the individual clinical significance of these factors has not been well defined. This is due in part to the difficulty in studying each risk factor separately.
The purpose of this study was to review our clinical experience with abdominal wound dehiscence and through statistical comparisons between a patient group with wound dehiscence and a control group, to determine the relative contribution that several risk factors have in the development of fascial disruption. Patients and Methods:
During the 5-year period from 1997-2001 there were 2761 major abdominal operation performed in the Department of Surgery, Imam Reza Hospital, Mashhad, Iran.
These operations included all laparotomies performed by general surgeons.
The reports of all wound dehiscence occurring during this time were reviewed from our monthly morbidity and mortality. Those patients that did not have disruption of all layers of the abdominal wall were excluded from our series. Thirty-one complete fascial disruptions were identified. Thirty-eight patients that had undergone major abdominal operations without dehiscence during the same period were randomly selected as a control group. The primary diagnosis are listed in Table I:
Multivariate analysis was used to determine the individual statistical significance of 21 local and systemic factors (Table II). A result was considered significant when P was value less than 0.05.

Results:
Thirty-one of 2,761 patients developed a fascial wound dehiscence (1%). Serosanguinous drainage was noted from the wound prior to the dehiscence in 21 patients (67%), and disruption occurred on average 11 days postoperatively (range: 1 to 28 days). Wound dehiscences were treated surgically using retention sutures for closure in all but one patient who was treated conservatively by local wound care. Local wound care included frequent saline dressing changes, which has been advocated by some authors for septic dehisced wounds that have not eviscerated [2].
Nine patients died within 80 days of dehiscence for a mortality rate of 29%.
The mortality rate increased dramatically when the number of risk factors for dehiscence increased above 8 (Figures 1 and 2):
Figure 2. Mortality was directly related to the number of risk factor for dehiscence.
Mortality was 33% for patients with 9 risk factors, 50% for patients with 10 risk factors, and 100% for patients with 11 or more risk factors.
it was 33% for 9 risk factors, 50% for 10

Table I. Primary Diagnosis of dehiscence and control groups

<table>
<thead>
<tr>
<th>Control Group (N=38)</th>
<th>Dehiscence Group (N=31)</th>
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<tbody>
<tr>
<td>Malignancy</td>
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<tr>
<td>Colon cancer</td>
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<td>Pancreatic cancer</td>
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<td>Ovarian cyst</td>
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<tr>
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<td>Infarcted bowel</td>
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<tr>
<td>Penetrating small bowel Trauma</td>
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risk factors, and 100% for 11 or more risk factors. The mean time to death was 19
days following reoperation.
Patients who experienced dehiscences spent an average of 42 days in the hospital
compared with 13 days for the control group (P=0.0043).

Age:
The mean age in the dehiscence group was 65 years compared with 56 years for
the non-dehiscence group (P>0.65). Nineteen patients over 65 years of age
developed dehiscences (61%) compared with 13 control patients over 65 years of
age (34%) (P<0.025) (Figure 3).

Sex:
There were 22 males (70%) and 9 females (30%) in the dehiscence group (2.4:1
ratio) compared with 16 males (42%) and 22 females (58%) in the control group (1:
1.4 ratio) (P<0.025) (Figure 4).

Wound infection:
Fourteen patients (45%) developed local wound infection in the dehiscence group
compared with one patient (2%) in the control group. Wound infection was
characterized by erythema and/or purulent drainage requiring early removal
of sutures. The difference in incidence between the two groups was highly
significant (P=0.0001).

Pulmonary disease:
There were 15 (48%) patients in the dehiscence group that had pulmonary
disease but only 8 (21%) in the control group (P=0.007).

Hemodynamic instability:
Thirteen patients (42%) in the dehiscence group had perioperative hypotension (i.e.,
systolic blood pressure of less than 90 mm Hg). This is compared with only one
patient (2%) in the control group. This difference was significant (p=0.018).

Ostomies in the wound:
Two patients (6%) in the dehiscence group had mucous fistulae established in
the inferior end of their midline incisions. However, no patient in the nondehiscence
group had ostomies established in their

wounds. In addition, there were two
patients (6%) in the dehiscence group who
had drain placed in their wound the control
group had one such patient (2%); the
difference was significant for the ostomy
in wound factor (p=0.04).

Emergency surgery:
Sixteen patients (51%) were operated upon
urgently in the dehiscence group. Only
nine patients (24%) in the control group
required emergency surgery. This
difference was not found to be significant
as an independent variable (p=0.10).

Type of closure:
In the dehiscence group, 28 patients
(90%) underwent mass closures of all
layers of the abdominal wall. The other
three patients (10%) were closed in layers.
This was in contrast to the control group in
which 25 patients (66%) had mass
closures and 13 patients (34%) were
closed in a layered fashion. This was not
found to be significant as an independent

<table>
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<th>Significant Factors</th>
<th>P value</th>
<th>Non-significant Factors</th>
<th>P value</th>
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<td>Age over 65 year</td>
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<td>Sex (male)</td>
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<td>Emergency surgery</td>
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<td>Type of incision</td>
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<td>Type of closure</td>
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<td>Anemia</td>
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<td>Systemic infection</td>
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<td>Jaundice</td>
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<td>Obesity</td>
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<td>Diabetes</td>
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<td>Uremia</td>
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<td>Malignancy</td>
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<td>Steroids</td>
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<tr>
<td>Hypocalcemia</td>
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Hypoproteinemia:
We defined hypoproteinemia as a total protein less than 6 g/dl and albumin level less than 3.5 g/dl. The average total protein in the dehiscence group was 4.8 g/dl, and the average albumin was 2.3 g/dl. This compared adversely with the control group who had an average total protein of 6.7 g/dl and average albumin of 3.6 g/dl. There were 26 patients (83%) who were hypoproteinemic in the dehiscence group compared with only 13 patients (34%) in the control group. This difference was highly significant (p=0.001).

Systemic infection:
Those patients with septicemia documented by positive blood cultures, pyrexia and leukocytosis were included in this category. There were 13 such patients (42%) in the dehiscence group but only 4 (10%) in the control group (p=0.0004).

Obesity:
Patients were placed in this category when their body weights exceeded 50% of their ideal body weight. For the purposes of the multivariate analysis, the actual weight of each patient was included in the program. There were three such patients in the dehiscence group (10%) but none in the nondehiscence group (p=0.0001).

Uremia:
Uremia was defined by either persistent elevation in serum creatinine or by poor urinary creatinine clearance determinations. Six patients (9%) from the dehiscence group fell into this category in contrast with only one patient (2%) from the nondehiscence group. The difference was statistically significant (p=0.0001).

Hyperalimentation:
Nineteen patients (61%) required parenteral hyperalimentation at the time of wound disruption in the dehiscence group; only three patients (8%) in the control group required hyperalimentation (p=0.0002).

Malignancy:
The most common malignancy in both groups was colon cancer. Fourteen patients (45%) were noted to have malignancies in the dehiscence group and 4 (26%) in non dehiscence group (Table 1). The factor of malignancy was found to be significant as an independent variable (p=0.0002).

Ascites:
Most patients with ascites in this study had ascites secondary to malignancy. There were six patients (9%) in the dehiscence group and one (2%) in the control group. This was a significant difference (p=0.0004).

Type of incision:
Both study groups were divided based on whether they had undergone laparotomies through a midline or transverse incision. There were no patients explored through paramedian incisions in either group. Twenty nine patients (93%) in the dehiscence group had midline incisions compared with 24 patients (63%) in the non dehiscence group. Only two patients
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(7%) in the dehiscence group had transverse incision compared with 10 patients (26%) in the control group (P=0.34).

**Steroids:**
Perioperative steroid administration was a significant factor in wound disruption. Nine patients (29%) in the dehiscence group were taking corticosteroids. This is in contrast to only three patients (8%) in the control group (p=0.012).

**Anemia:**
In this study, we defined anemia as hemoglobin less than 10 g/100 dl at the time of wound disruption in the dehiscence group or early in the postoperative period in the nondehiscence group. There were 28 anemic patients (90%) in the dehiscence group but only 6 (16%) in the control group. This difference, however, was not found to be significant as an independent variable (p<0.06).

**Diabetes:**
There were six diabetic patients in the wound dehiscence group (19%) compared with only three in the control group (8%). Diabetes was not found to be significant as an independent variable (p=0.39).

**Jaundice:**
This factor was assessed based on the absolute bilirubin levels. In our series, there were seven patients (22%) with hyperbilirubinemia in the dehiscence group but only two (5%) in the nondehiscence group. However, the difference was not significant (p=0.43).

In summary, based on this multivariate analysis, 14 of 21 risk factors studied were found to be statistically significant independent variables in the development of fascial disruption (Table II). When the dehiscence and the control groups were pooled together (n=69) and the patients analyzed for the number of risk factors that each possessed, it was found that wound dehiscence is directly correlated with the number of significant risk factors (Figure 1). None of the patients with less than four significant risk factors developed dehiscence whereas 60% of the patients with six risk factors and all of those with more than eight did. In addition, the number of risk factors could predict the outcome of the patient. None of the patients with fewer than eight factors died. The mortality rate sharply increased in patients with 8 to 10 factors, and all the patients with more 10 factors died (Figure 2).

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**Figure 3**

![Histogram showing number of patients by age group for control and dehiscence groups.](chart.png)
Discussion:
Wound dehiscence carries a very high mortality rate (29%) and major morbidity. It is a dreaded complication that increases hospital stay and cost. The data from this study indicates that wound disruption is more likely to occur in patients over 65 years of age undergoing major abdominal surgery (Figure 3). This has been a consistent finding in the literature. Some authors have suggested an increased risk in patients over 70 years of age [3], in patients over 64 years of age [4], or in patients over 50 years of age [5].

Patients with wound disruption were nearly two and a half times more likely to be males than females (Figure 4). Female-to-male ratios have previously been reported to be 1:1.6 in a series of 70 patients [6], 1:2.4 in a series of 47 patients [7], and 1:3 in a series of 117 patients [4]. Male predominance seems to be a consistent finding, but its exact cause has yet to be elucidated. Nonetheless, the sex of the patient as an independent risk factor cannot be controlled by the surgeon. Local wound infection was found to be one of the most important independent variables for wound disruption in our series. This factor occurred 20 times more frequently in the dehiscence group than in the control group (p=0.001).

The most common organism responsible for wound infection was Staphylococcus aureus. In a smaller number of patients, polymicrobial infections were noted including isolated of enteric organisms. Several authors [8] have noted impaired healing of infected wounds, particularly incisions inoculated with S. aureus. On the other hand, others [9] have noted increased strengths of wounds and accelerated healing with milder infections caused by gram-negative organisms such as Escherichia coli and proteus. However, this is not true for suppurative wounds, particularly those caused by S. aureus and pseudomonas aeruginosa where violent local inflammation and tissue destruction occur [9], causing a decrease in tensile strength and fibroblast concentration [10]. Therefore, it is important to prevent the development of local wound infection as it will reduce the incidence of dehiscences [5].

Indeed, it has been shown that the rate of wound infection can be decreased by minimizing contamination and by leaving the skin and subcutaneous tissues open to heal by secondary intention or delayed primary closure when contamination is unavoidable [6,11,12].

Pulmonary disease and postoperative...
pulmonary complications (atelectasis, bronchitis, and pneumonia) are important systemic risk factors [1]. The propensity for fascial disruption is due to an increased intra-abdominal pressure experienced by the coughing patient during early wound healing. Nearly half of the patients that dehisced in our series had serious pulmonary disease and were reported to cough significantly during the early postoperative period. Although this factor is important as an independent variable in the development of dehiscence (p=0.007), it may be more difficult to control than the other local factors. Tobacco abstinence for several weeks prior to surgery, optimization with bronchodilators perioperatively when appropriate, and close attention to pulmonary toilet postoperatively are some of the measures that can be undertaken to minimize this risk factor. The type of incision and the method of wound closure are the factors that can most easily be influenced by the surgeon. Midline incision and mass closure were both more common in the dehiscence group, but these are also more frequently used at our institution for major abdominal procedures. Neither was found to be a significant independent variable in our analysis. Some authors have noted that upper abdominal midline incisions are more prone to disruption than lower ones because of the relative fixation of upper abdominal muscle aponeurotic layers to the narrow angle between the ribs [13,14]. Others have noted a lower incidence of dehiscence in transverse incisions as compared with those found in midline or paramedian incisions [7]. However, several controlled clinical studies [15,16] have noted, as we have p=0.34, that there is no difference in disruption between transverse and midline incisions. In addition, similar bursting strengths have been noted experimentally between the two incisions [12]. Wound dehiscence classically occurs 1 to 2 weeks postoperatively, often following serosanguinous discharge from the wound (67%). At this time, most of the wound strength is provided by the sutures and not by wound healing [16,17]. Therefore, it would seem logical that the type of closure has an important influence on fascial disruption. However, we found no significant difference in dehiscence between layered and mass closure, continuous and interrupted closure, or in the type of suture material used (p=0.44). Irvin et al [5] as well as Syone et al [18] noted no difference in disruption between layered and mass closures. In addition, closing the peritoneum does not appear to provide any additional strength to the wound closure [12]. Some authors claim that there may be a decreased incidence of adhesion formation when the peritoneum is not reapproximated [19]. Similarly, several large prospective randomized series have shown equivalent dehiscence rate between continuous and interrupted closures [1,18,20,21]. No difference in dehiscence was noted between the various absorbable sutures [22] or the various monofilament sutures [23,24]. However, some authors have noted greater sinus formation with nylon [25], and others have noted significantly more wound failures with polyglycolic sutures compared with monofilament ones [10]. Several authors prefer a continuous running polypropylene closure because of its simplicity and speed [27] as well as its superiority in an infected setting [10] and greater wound bursting pressures [28]. When dehiscence has occurred, we recommend reinforcing the closure with retention sutures. In a prospective series of 500 patients closed with retention sutures, not a single dehiscence was encountered [15]. Perhaps more important than the choice of suture material or the type of closure is the technique used in placing the sutures. Jenkins [29] has stressed the mechanical cause of the burst abdomen and has noted a significantly lower rate of dehiscence when sutures are placed wide enough so that the length of the suture is greater than four times that of the wound. In addition animal experiments have shown that the strongest closures are those in which large bites are taken with loose ties [16]. Indeed, sutures tied too tightly cause tissue necrosis and marked decrease in tensile strength [30]. In an experimental model [28], the highest
bursting pressures could be achieved with the running sutures where tension was evenly distributed or with loosely tied figure of eight closures. The risks for dehiscence are further increased when surgery is performed on hemodynamically unstable patients (p=0.018). Although the urgency for an operation may not be predictable and was not found to be a statistically significant independent variable (p=0.10), time spent preoperatively resuscitating hemodynamically unstable patients could affect the subsequent development of dehiscence. We believe that the placement of colostomies within the wound introduces an inherent risk for infection and fascial weakening and may predispose to wound disruption (P=0.04).

Some authors have emphasized the importance of this risk factor [1] and noted increased dehiscence rates. In our series, the number of dehiscence patients with a colostomy in the wound were too small to make firm statistical conclusions. Nonetheless, it seems intuitively obvious to avoid this added risk factor.

Several systemic risk factors were found to be statistically significant independent variables in this study. Hypoalbuminemia was a consistent predictor of wound disruption (P=0.001) and has been shown in the literature to decrease tensile strength of wounds. Alexander and Prudden [31] noted in their series that 53% of patients with dehiscences had albumin levels less than 3 g per 100 ml compared with only 9% in the control group. This difference between the two groups is comparable to our series. Systemic infections and obesity were also poor predictors for fascial disruption. Goodson and Hunt [32] and others have noted deficient collagen formation and consequent poor tensile strength in both experimental and clinical models of obesity. Other factors such as uremia, malignancy, and ascites were also found to be significant (see Table II).

Unfortunately, unlike most local risk factors, they are difficult to control by the surgeon.

The adverse effects of corticosteroids on wound healing are well established. An early reduction in initial inflammatory response to wounding and a delay in fibroplasia have been noted. However, the effect of steroids on the incidence of disruption and wound infection is still disputed in the literature. We have found this factor to be a significant independent variable in dehiscence (P=0.012).

Some authors have found only a minimal decrease in tensile strength in patients taking long-term moderate dose steroids [33]. Others have noted similar rates of dehiscence but significantly increased rates of infection in steroid patients as compared with control patients [34]. Yet others have noted a marked decrease in tensile strengths of resutured wounds when cortisone was administered in experimental models [35].

Although several experimental studies have noted impaired wound healing associated with jaundice [36,37], clinical studies [38] have noted, as we have, that there is no difference in dehiscence rate between control and jaundiced patients (P=0.43). Anemia and diabetes are also risk factors that were not significant independent variables in our study (P=0.06 and 0.39, respectively). The literature provides conflicting data in this regard [6, 7, 39].

Surprisingly, 61% of the patients with dehiscence required total parenteral nutrition at the time of dehiscence, but most were hypoproteinemic despite the total parenteral nutrition. This supports the observations in animal studies that normal albumin levels need to be maintained with total parenteral nutrition to promote normal wound healing and prevent dehiscence in malnourished rats [40].

In summary, older male patients undergoing major abdominal surgery with specific medical problems, such as severe pulmonary disease, low albumin, obesity, uremia, and ascites, are at a very high risk for developing postoperative wound dehiscence.

Operative decisions such as the type of incision to use and the closure technique do not seem to influence wound dehiscence. Local and systemic infections may be precursors to wound disruption, and total parenteral nutrition may not protect against complete wound disruption.
especially if the patient remains hypoproteinemic. Patients with five or more risk factors for dehiscence have a very high incidence of wound disruption. We believe that serious consideration should be given to placing retention sutures in these high-risk patients to try to prevent evisceration and dehiscence. Patients with no more than three risk factors had a very low incidence of wound disruption. Serous drainage from a wound, 1 to 2 weeks after surgery, should alert the physician to possible wound dehiscence. Factors often feared to be significant predictors of dehiscence, such as anemia, jaundice, and diabetes, were not associated with wound disruption in this study. Although this manuscript does not present any new information, it does provide information that assigns relative importance to various factors that favor abdominal wound dehiscence and are associated with up to a 29% death rate.

CONCLUSION: Abdominal wound dehiscence is defined as postoperative wound separation that involves all layers of the abdominal wall. Despite the significant advances in perioperative care the incidence of wound dehiscence and its mortality have not improved. Wound dehiscence classically occurs one to two weeks postoperatively often following serosanguinous discharge from the wound. We believe that serious consideration should be given to placing retention sutures in high risk patient to prevent evisceration and dehiscence. Although this manuscript does not present any new information, it does provide information that assigns relative importance to various factors that favor abdominal wound dehiscence.

Abstract:

Objective: The purpose of this study was to review our clinical experience with abdominal wound dehiscence.

Materials & Methods: During the 5-year period from (1997-2001), there were 2,761 major abdominal operations performed at the Department of Surgery Imam Reza Hospital, Mashhad, Iran. Twenty-one specific local and systemic risk factors were analyzed and compared with the control group.

Results: 31 (1%) abdominal wound dehiscences occurred in 2,761 patients undergoing major abdominal surgery. Significant risk factors were found to include age over 65 year, wound infection, pulmonary disease, hemodynamic instability, and ostomies through incision. Risk factors not found to be important included, sex, type of incision, type of closure, anemia-jaundice and diabetes. When dehiscence and control groups were combined 30% of patients with at least five significant risk factor developed dehiscence, and all the patients with more than eight risk factors developed a wound dehiscence. There was an overall mortality of 29% which was directly related to the number of significant risk factors. The coexistence of 9 risk factors portended death in one third of the patients, and all the patients with more than 10 risk factor died.

Conclusion: Wound dehiscence carries a very high mortality rate and major morbidity. It is a dreaded complication that increases hospital stay and cost. We believe that serious consideration should be given to placing retention sutures in high risk patients to try to prevent evisceration and dehiscence. Serous drainage from a wound after surgery should alert the physician to possible wound dehiscence.

Key Words: Wound's Dehiscence- Evisceration- Abdominal Operation.
References: