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Review Article

Evaluation of Risk Factors of Wound Dehiscence Following Emergency Laparotomy

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ABSTRACT

Aims and Objectives: Wound dehiscence or acute wound failure may lead to significant postoperative morbidity and mortality. It has an incidence of 0.25%-3.0% and associated mortality of 20%-25%. The aim of the present study to evaluate the risk factors and their management in a patient of wound dehiscence following emergency laparotomy.

Materials and Methods: A prospective observational study evaluated 60 patients who underwent emergency laparotomy were studied for risk factors leading to abdominal wound dehiscence, their clinical presentation and their ultimate outcome from 1st June 2018 to 1st May 2019.

Results: A total of 60 patients evaluated in the study underwent emergency laparotomy, out of which 13.33% patients had wound dehiscence and mortality among patients with burst abdomen was 25%. The risk factors observed among patients with burst abdomen were low body mass index, low hemoglobin and albumin, renal diseases, COPD, presence of wound infection, infection at remote site, postoperative coughing, vomiting, abdominal distension or mechanical ventilation ($p<0.05$). Factors that did not turn out to be significant were age>65, male sex, DM, HTN, preoperative hospitalization >24hours, previous abdominal surgery, jaundice, smoking, duration of surgery >2.5 hours. Two risk factors reported to cause burst abdomen that is emergency surgery and technique of abdomen closure were standardized for all patients. Average postop day at which dehiscence occurred was 8.125 (ranges 5-11 day). 5 (out of 8) patients with burst abdomen who underwent repeat surgery of them 2 (out of 5) expired, 2 had normal abdominal wound healing and 1 had re-dehiscence and underwent incisional hernioplasty and 3 patients were managed conservatively.

Conclusion: Wound dehiscence often reflects an error of judgment on the part of surgeon, a thorough pre-operative assessment, identification and removal if possible is essential to minimize incidence of wound dehiscence and associated mortality.

Keywords: Wound dehiscence; Burst abdomen; Emergency laparotomy

Abbreviations: DM: Diabetes Mellitus; HTN: Hypertension: COPD: Chronic Obstructive Pulmonary Disease

INTRODUCTION

"The elimination of postoperative wound dehiscence is entirely within the jurisdiction of operating surgeon." JD Norris 1939 [1].

Wound dehiscence or acute wound failure is defined as "The postoperative separation of the abdominal musculoaponeurotic layers; which is recognized with in several days and requires some form of intervention; usually during the same hospitalization" [1,2]. It has an incidence of 0.25%-3% and an associated mortality of 20%-25% [3-9]. In children he reported incidence is 0.2%-1.2% with associated mortality of 8%-45%. Disruption of abdominal surgical wound may lead to certain complication like burst abdomen; massive evisceration; sepsis; intra-abdominal abscess and bowel fistulae have been defined in international literature. A thorough preoperative assessment of patient keeping in mind these risk factors is essential so as to identify and remove them if possible; in order to minimize the incidence of wound dehiscence; which has a high death rate.

Wound dehiscence has been shown to be more common after emergency laparotomy. In elective laparotomy the health of the patient has been optimized and all factors under study under are either not present or controlled.

Injured tissues attempt to restore their normal function and

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structural integrity after injury. "Attempts to restore mechanical integrity and to restore barriers to fluid loss and infection and to re-establish normal blood flow and lymphatic flow patterns are termed wound repair" (Figure 1).

Acute fascial dehiscence

Abdominal wound dehiscence is as old as surgery. Predisposing factors are either patient related or surgeon related. Despite several incisions and suture materials; controversy remains; with no consensus on the ideal methods or materials for closure of abdominal wound to prevent dehiscence. A fresh wound has no strength of its own and regains artificial support with sutures. Strength of wound is of two types. Intrinsic strength is that which is due to collagen deposition and extrinsic strength in one which is bestowed on the wound by its sutures. The support of sutures must be maintained for sufficient time so that normal functional and structural continuity is restored [10]. Although suture failure plays an obvious role; the main problem is abnormal connective tissue formation in the scar [8].

Control of bacteria by asepsis; antisepsis and antimicrobials heralded a new era in wound management [11].

Ideal wound healing demands adequate tissue oxygenation; normoglycemia; absence of toxic factors; which reduce collagen synthesis and oxidative killing mechanism of neutrophils [12,13].

Factors implicated as cause of burst abdomen

Age: Advanced age has been found a risk factor not only after emergency laparotomy but after elective laparotomy as well [8]. Studies of hospitalized surgical patients show a direct correlation between older age and poor wound healing outcome such as dehiscence and incisional hernia [14].

Male gender: most reviews of wound disruption report male gender as a risk factor on the basis of among patients; men outnumber women by at least 2 to 1 [7,15-17].

Diabetes mellitus [2,6]: it causes abdominal wound dehiscence by altering the immune response, thus increasing the susceptibility to wound infection [8]. Along term complication is damaged microcirculation which increases the rate of wound dehiscence [14].

Hypertension: HTN damages microcirculation in long term predisposes to wound infection and dehiscence.

Renal failure [2,6,7,18]**:** Anecdotal experience suggests that acute renal failure predisposes to wound dehiscence. Uremia induced malnutrition has been stated as a possible mechanism.

Jaundice [6,7]: malignant biliary obstruction probably represents a

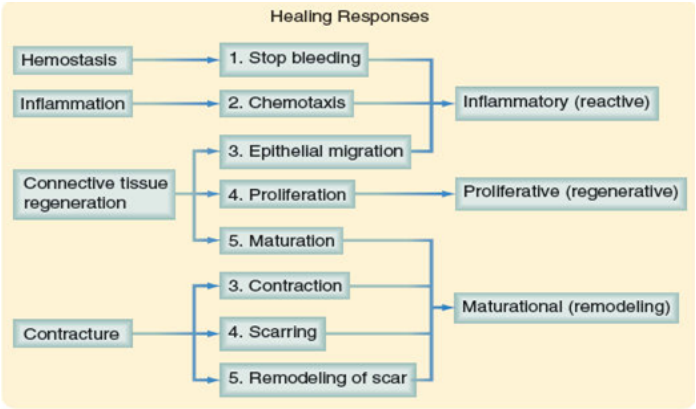

Figure 1: Normal wound healing.

true risk factor for dehiscence [1].

Smoking: It causes clinically significant vasoconstriction. Smoking one cigarette lowers wound and tissue PO_2 in normal volunteers by 30% for the better part of 1 hour [19]. Also due to acquired collagen deficiency, incisional hernias are more common in smokers [20].

COPD: Excessive coughing in the postop period suffering from COPD raises intra-abdominal pressure predisposing to wound dehiscence [5,6].

Use of steroids: Steroid use leads to immunosuppression which further aggravates the intra-abdominal sepsis, which is already playing a major role in acute wound failure [8]. There is reduced cell migration, proliferation and angiogenesis [21]. They also inhibit wound contraction. The stronger anti-inflammatory effects of steroid compound used, greater the effect on wound healing [14].

Drugs: Lower doses of D-penicillamine decreases cutaneous wound strength and increase its collagen solubility by altering the biochemical structure of collagen [22].

Antineoplastic agent [2]**:** All chemotherapeutic antimetabolite drugs adversely affect wound healing by inhibiting early cell proliferation and wound DNA and protein synthesis, all of which are critical for successful repair [14].

Ionizing radiation [2]**:** It cause endothelial cell injury with end arteritis and result in atrophy, fibrosis and delayed tissue repair.

- Malignancy [6,7,18]
- HIV infection

Malnourishment [2,5-7]**:** TNF released during sepsis results in cachexia and loss of appetite resulting in poor food intake, hyper-catabolism, negative nitrogen balance, immunosuppression which further aggravate the sepsis. Thus, the patient enters a vicious cycle of sepsis-protein energy malnutrition-sepsis [8,23].

Obesity: It has been reported a risk factor for burst abdomen [2,6,18,24]. Also incisional hernia occurs most often in obese individuals [20,25].

- Tissue perfusion and oxygenation [14]
- Anemia [5,7]

Hypoalbuminemia: It is probably a true risk factor for fascial dehiscence [5, 7,18,24,26].

Emergency surgery: The risk for dehiscence from emergency operation may be related to more hemodynamic instability than to the unscheduled procedure [24].

Duration of surgery: Duration of surgery >2.5 hours has been reported as a cause of burst abdomen [25].

Incision: Rate of infection is higher in midline incision than transverse incision [7,15,16,18,27,28].

Technique of abdominal closure: The tension free mass closure is recommended and a continuous closure is preferable [1,4,8,18]. Use of non-absorbable suture material with 1cm interval and 1cm tissue bite, keeping suture length to wound length ratio as 4:1 is also recommended [7,18].

Surgeon in training: Data regarding the influence of trainee status on wound dehiscence is inconclusive and not extensive [15].

Postoperative elevation of intra-abdominal pressure: Increased intra-abdominal pressure secondary to coughing, vomiting,

abdominal distention and mechanical ventilation is cited as instigator of dehiscence [5-7,15,26]. They are also precursor of development of incisional hernia.

- Wound infection [2,6,7,15,24,26,29,30]

Complications of acute fascial dehiscence

- Wound sepsis
- Intra-abdominal abscess
- Bowel fistulae
- Death
- Incisional hernia [20]

Madsen et al. [31] reviewed 198 burst abdomens from 1972 to 1987 and found that cardiorespiratory failure was the most common cause of death, peritonitis was the second most common cause. Advanced age, female sex and post disruption mechanical ventilation were risk factors for death after dehiscence occurred.

Spiliotis, Tsiveriotis, Datsis, Vaxevaniou, Zacharis, Giafis et al. [4] retrospectively analyzed 3500 laparotomies performed in 2001-2007. 15 patients developed wound dehiscence. In 9 of these 15 patients, emergency laparotomy was performed. Wound dehiscence was more often observed on the 9.2 postoperative days. Age above 65 years, diagnosis of cancer, COPD, malnutrition, sepsis, obesity, anemia, DM, use of steroids, chemotherapy or radiotherapy were identified as risk factors.

Afzal and Bashir [4] in 2002-03 showed that the incidence of wound dehiscence was higher in emergency laparotomies than in elective laparotomy. 35 of 430 patients studied by them had acute wound failure. Statistically significant in their study were intra-abdominal sepsis, age>65 years, local sepsis, malnutrition, emergency surgery, use of steroids and DM.

AIMS AND OBJECTIVES

To study the prevalence, etiological factors, investigations required, treatment is given and outcomes of various gynecological problems in adolescent girls 10-19 years of age, attending the Outpatient Department (OPD) of a tertiary care center in North India.

METHODS AND METHODOLOGY

Study design

Cross sectional study.

Study setting

Tertiary care center based from 1st June 2018 to 1st May 2019.

Study subject

Inclusion criteria: Patients undergoing emergency laparotomy.

Exclusion criteria:

- Patients not giving consent
- Patients who leave against medical advice or abscond
- Patients undergoing emergency appendectomy
- Sample Size- 60

Risk factors under study

- Age
- Sex
- Preoperative hospitalization >24 hours
- Previous abdominal surgery
- Medical disease-DM, HTN, uremia, jaundice, COPD
- Smoking
- Immunocompromised state-corticosteroids, cancer chemotherapy, malignancy, HIV
- History of exposure to ionizing radiation
- Nutrition-anemia, hypoproteinemia, BMI<25 Kg/m^2
- Duration of surgery
- Incision type and location
- Type of operation (classification of surgical wound)
- Postoperative coughing, vomiting, abdominal distention, mechanical ventilation
- Wound infection or infection at remote site

Plan of study

After a decision for emergency laparotomy had been taken for a patient on the basis of clinical presentation and imaging studies, an informed consent, detailed history was taken and clinical examination done with special emphasis on the risk factors under study. Routine emergency investigations were sent. Emergency laparotomy was done under GA in standard manner under all aseptic precautions. Non-suction drain left *in situ* (if required) and ostomies (if any) were brought through separate incision. Abdominal closure was also done in standard manner. Postoperative the type and duration of surgery, type of incision, location and intraoperative findings were noted. Patient was given routine postop care. On postop day 2 dressing was removed and wound assessed. Any wound discharge was sent for culture and sensitivity and antibiotics was given accordingly. Wound was assessed for any wound dehiscence during postop day 5-8. In patients who developed wound dehiscence, if the size of defect was small or the patients was critically ill or overwhelming wound sepsis then the dehiscence was managed conservatively. Large size wound dehiscence was packed with moist sterile dressing and generous strip of adhesive tape placed transversely across the abdomen. An abdominal binder was used for support and patients advised against excessive physical activity. Patients were asked to follow up for detection and repair of incisional hernia later.

The data compiled was analyzed by Wilcoxon Rank Sum test for continuous data and by Chi Square test and Fischer's Exact test for categorical data. p value <0.05 was considered significant.

RESULTS

Total number of patient studied: 60

Number of patients developed wound dehiscence: 8 (13.33%)

Demographic profile of patients:

- Age ranged between 9 months-84 years
- Total 48 men and 12 women studied
- Burst abdomen developed only in men

Statistical analysis

For categorical analysis, p value was calculated using both the Pearson's Chi Square Test and the Fisher's Exact Test. p value <0.005 was considered significant (Table 1).

Table 1: Risk factors in dehiscence and non-dehiscence cases (categorical data).

S.No.	Risk Factor	Non Dehiscence Cases (n-52)	Dehiscence Cases (n-08)	p-value (Chi Square/Fisher Exact Test)	
1	Age>65 years	2	0	0.5726	1
2	Male sex	40	8	0.1287	0.3381
3	Preoperative hospitalization>24 hours	8	2	0.4969	0.6096
4	Previous abdominal surgery	7	0	0.2695	0.5783
5	Diabetes mellitus	5	0	0.3596	1
6	Hypertension	4	0	0.4168	1
7	Renal disease	7	5	0.0012	0.0058
8	Jaundice	6	1	0.9371	1
9	Smoking	23	4	0.7601	1
10	COPD	4	4	0.001	0.0079
11	Low BMI	5	4	0.00637	0.01224
12	Corticosteroids therapy	0	1	-	-
13	Cancer chemotherapy	0	0	-	-
14	Radiation exposure	0	0	-	-
15	Malignancy	2	0	-	-
16	HIV infection	0	0	-	-
17	Duration of surgery>2.5 hours	11	0	0.15	0.3301
18	Incision type and location*	-	-	-	-
19	Classification of surgical wound Class 1 Class 2 Class 3 Class 4	 4 5 2 41	 0 0 0 8	0.5576	1
20	Postoperative coughing, vomiting, abdominal distention, mechanical ventilation			0.0138	0.0258
21	Wound infection	19	8	0.0008	0.000867
22	Infection at remote site	3	3	0.0054	0.0266

Hemoglobin levels: Low hemoglobin levels is a risk factor for burst abdomen (Tables 2-4).

Albumin levels: Low serum albumin is a risk factor for burst abdomen (Tables 5-7).

For continuous data, the Wilcoxon Rank Test was used in statistical analysis. This test checks whether the median of two different populations is similar or not. p value <0.005 was considered significant (Table 8).

Average postoperative day at which dehiscence occurred was 8.125 days (ranges 5-11 days). The day of presentation for patients who had leaked bowel contents was earlier average (6.25 days) than for patients' who didn't (average 10 days). Four patients had leak of bowel contents resulting in fecal discharge from their laparotomy wound along with gaping of wound. Pf the remaining four patients, serosanguinous and later purulent discharge were noted prior to development of wound dehiscence in three patients. Tearing of propylene sutures through the rectus sheath was also seen.in one patient, dehiscence occurred after a bout of cough, the propylene suture was seen to be broken (COPD).

Management of patients with burst abdomen: The four patients who had fecal discharge from their laparotomy wound along with wound dehiscence were taken for emergency re-exploration. Three of them had ileal perforations with fecal contamination of peritoneal cavity. A thorough peritoneal lavage was done and part of ileum resected. The bowel was exteriorized as double barrel ileostomy and abdominal closure done in standard manner. One of these patients expired on 3rd day after repeat surgery. Another one developed re-dehiscence which was managed conservatively and subsequently underwent elective mesh repair. The third patient had normal wound healing with no subsequent dehiscence or incisional hernia. One patient had caecal perforation, but due to intraoperative hemodynamic instability, a tube caecostomy

Table 2: Hemoglobin levels of all patients.

Hemoglobin (g/dl)	Frequenncy
8	3
10	11
12	14
14	17
16	13
More	2

Table 3: Hemoglobin levels of patients without burst abdomen.

Hemoglobin (g/dl)	Frequency
8	3
10	9
12	8
14	17
16	13
More	2

Table 4: Hemoglobin levels of patients without burst abdomen.

Hemoglobin(g/dl)	Frequency
8	0
10	2
12	6
14	0
16	0
More	0

Table 5: Serum albumin level of all patients.

S. Albumin (g/dl)	Frequency
1.5	0
2	18
2.5	12
3	13
3.5	8
4	7
More	2

Table 6: Serum albumin level of patients without burst abdomen.

S. Albumin (g/dl)	Frequency
1.5	0
2	11
2.5	11
3	13
3.5	8
4	7
More	2

Table 7: Serum albumin level of patients with burst abdomen.

S. Albumin (g/dl)	Frequency
1.5	**0**
2	**7**
2.5	**1**
3	**0**
3.5	**0**
4	**0**
More	**0**

Table 8: Comparison of Median of risk factors in dehiscence and non-dehiscence cases.

S.No.	Risk Factor	p-value
1	Age	0.4144
2	Hemoglobin (g/dl)	0.0349
3	S. Albumin	0.000050747
4	Duration of surgery	0.2153

was done but unfortunately patient expired on day 3 after repeat surgery.

Of the remaining four patients, two were managed conservatively in view of overwhelming wound infection. One patient underwent elective mesh repair of the abdominal wall defect 1 year after previous surgery, the other was lost to follow up.

In view of concomitant of acute exacerbation of COPD, ARF, anemia, hypoproteinemia another patient was also managed conservatively and subsequently discharged after the wound had healed with secondary intention.

The fourth patient (who developed burst abdomen due to break in propylene suture) underwent emergency closure of rectus sheath and he subsequently didn't develop wound dehiscence.

Outcome of patients with burst abdomen: The average duration of hospital stay of patients who developed abdominal wound dehiscence was 59 days compared to 16.34 days for patients who didn't (p value 0.0014, statistically significant).

Four patients who had postoperative leak of bowel contents and wound dehiscence underwent repeat surgery. One patient underwent emergency re-suturing resulting of the rectus sheath after it dehisced. Only one patient who didn't develop burst abdomen underwent repeat surgery in view of traumatic main pancreatic duct disruption.

Two patients who developed abdominal wound dehiscence expired (mortality-25%) compared to overall mortality of 6.67%.

DISCUSSION

This prospective observational study evaluated 60 patients who underwent emergency laparotomy between 1st June 2018 and 31st May 2019.

Occurrence and mortality: In our study 8 out of 60 patients had abdominal wound dehiscence (13.33%) and 2 out of 8 expired (mortality 25%). Emergency laparotomy is the main reason for occurrence of burst abdomen in our study. Our study included 10 children below 18 years, none of them developed wound dehiscence. 25% mortality in patient with burst abdomen is comparable to reported literature.

Risk factors: Two risk factors reported to cause burst abdomen, namely emergency surgery and technique of abdominal closure were standardized for all patients. The risk factors which differed significantly among patients with burst abdomen and those without were low BMI, low levels of hemoglobin and serum albumin, renal disease, COPD, presence of wound infection, infection at a remote site, postop coughing, vomiting, abdominal distention or mechanical ventilation ($p<0.05$).

Factors that didn't turn out to be significant were age>65 years, male sex, preoperative hospitalization>24 hours, previous abdominal surgery, DM, HTN, COPD, jaundice, smoking, duration of surgery>2.5hours and classification of surgical wound.

Factors which could not be evaluated were corticosteroid therapy, cancer chemotherapy, exposure to ionizing radiation, presence of malignancy, HIV, obesity and incision type and location due to their inadequate representation.

Management and outcome: Average postoperative day at which dehiscence occurred was 8.125 days. This is similar to the reported mean time to dehiscence. However the day of presentation for patients who had leaked bowel contents was earlier (avg 6.25 days) than for patients who didn't (avg 10 days). 4 patients had leak of bowel content resulting in fecal discharge from laparotomy wound, were subsequently taken for emergency re-exploration. Two of these patients expired on 3rd day after repeat surgery. Another one developed re-dehiscence of the anterior abdominal wall was managed conservatively and followed by elective mesh repair. Fourth patient had normal wound healing with no subsequent dehiscence. Of the remaining 4 patients, serosanguinous and later purulent discharge was noted prior to development of wound dehiscence. Tearing of prolene sutures through rectus sheath was

also seen. 2 were managed conservatively in view of overwhelming wound infection. 1 patient underwent elective mesh repair and the other one was lost to follow up. In one patient, dehiscence occurred after a bout of cough (COPD) underwent emergency closure of rectus sheath and didn't develop wound dehiscence and incisional hernia. The average duration of hospital stay in patients who developed wound dehiscence was 59 days compared to 16.34 days for patients who didn't develop.

CONCLUSION

Wound dehiscence often reflects an error of judgment on the part of surgeon, a thorough pre-operative assessment, identification and removal of risk factors if possible is essential to minimize incidence of wound dehiscence and associated mortality.

CONFLICTS OF INTEREST

None.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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