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Original Article

A Study for Identifying the Prevalence of Various Risk Factors for Wound Healing in Patients Undergoing Midline Laparotomy

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Abstract

Background: Laparotomy is associated with significant morbidity, including adhesions, intestinal obstruction, burst abdomen and incisional hernia. The patient's physiologic status before laparotomy is important for a successful outcome. Efforts should be made to optimize the patient's general condition. There are various modifiable and non-modifiable risk factors affecting wound healing. Identification of these risk factors is of utmost importance in anticipating the need for interventions and preventing wound morbidity. This has huge financial implications for the patients and hospital as well. Correction of fluid and electrolyte imbalances, blood transfusions, and antibiotics and nebulizations for respiratory improvement helps in improving the successful outcome after laparotomy. Achieving wound repair is considered as the foundation of surgery. Optimal restoration of form and function is the main goal of all those who perform surgery, regardless of the tissue on which one works. Wound heals in various phases which consists of multiple events, such as immediate coagulation by platelets, inflammation by neutrophils and macrophages, matrix synthesis and deposition by fibroblasts, angiogenesis, fibroplasia, epithelialization, contraction, and finally remodeling. An exploratory laparotomy is associated with the same complications that are associated with any laparotomy. Immediate complications include the following: (1) Paralytic ileus: After surgery intestinal function returns to normal within 5 days. If it takes more than 5 days patient is considered to have paralytic ileus. Post-operative paralytic ileus refers to obstipation and intolerance of oral intake due to non-mechanical factors following abdominal or non-abdominal surgeries, (2) Intra-abdominal collection or abscess: They mainly occur after surgery for trauma, infectious conditions, such as appendicitis and gastric perforations. It is treated with antibiotics and drainage either percutaneous or open, (3) Wound infections: Surgical site infections are the most common infections comprising 14–16% of inpatient infections. Potential sources of infections are the patient (especially contamination by alimentary tract bacteria), hospital environment, food, other patients staff, infected surgical instruments, dressings, even drugs and injections, (4) Abdominal wall dehiscence: Wound dehiscence occurs significantly more frequently after emergency operations and in patients with comorbidities, such as complicated neoplastic disease and complicated inflammatory diseases. Burst abdomen is considered when intestine or other viscera are seen through the abdominal wound after surgery, (5) Pulmonary atelectasis, (6) Enterocutaneous fistula. Delayed complications include the following: (1) Adhesive intestinal obstruction, (2) Incisional hernia.

Aims and Objectives: A prospective study to evaluate the prevalence of various risk factors for wound infections in patients undergoing midline laparotomy in Department of Surgery in GMC Amritsar.

Materials and Methods: Settings and Design- this prospective study was conducted in patients admitted to department of surgery in GMC Amritsar during July 2017 to August 2018. 40 patients who underwent midline laparotomy were studied. Sample size was taken for convenience. The data from the present study were systematically collected, compiled and statistically analyzed using software IBM SPSS 23.0 (Armonk, NY: IBM Corp.) to draw relevant conclusions. Data were expressed as mean, standard deviation, number and percentages. The patient characteristics (non-parametric data) were analyzed using the "Chi-square tests" and the inter-group comparison of the parametric data was done using the "Unpaired "*t*" test." The "*P*"-value was determined to finally evaluate the levels of significance. The $P < 0.05$ was considered as significant at 5% significance level; $P < 0.01$ was considered significant at 1% significance level and a $P < 0.001$ was considered as highly significant.

Keywords: Laparotomy, Patient, Prevalence

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BACKGROUND

The risk factors known for impeding wound healing are many. There are many modifiable and non-modifiable risk factors. Age is a non-modifiable risk factor, with the older and very young showing poor tendencies for wound healing. The etiology that leads to midline laparotomy in

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the Indian settings are mainly infectious in etiology. There are several modifiable risk factors, such as anemia, renal failure, jaundice, diabetic control, and hypoprotenemia, which we can, by therapeutic interventions, make favorable for wound healing. Identification of the risk factors prevalent in the population is hence of utmost importance in preventing surgical mortality and morbidity.

Factors Influencing Wound Healing

Age

Fetal tissue heals without scarring. Protein turnover reduces with age and delays the healing process. Dermal collagen content decreases with age; the aging collagen fibers show distorted architecture and organization.

Infection

The most common cause of delayed wound healing is infection. Bacteria prolong the inflammatory phase and interfere with epithelialization, contraction, and collagen deposition. Once an infection occurs, the fibroblasts are deprived of oxygen and nutrients by the bacteria.

Malnutrition

This is associated with defective synthesis of both collagen and ground substance. Severe protein-calorie malnutrition is associated with the failure of wounds to heal, while similar, lesser degrees of malnutrition, delays healing. Albumin must be below 2.0 g/dL to have an effect on wound healing. Vitamin C is necessary for the cross-linking of collagen. Vitamin A promotes epithelialization. Calcium, manganese, and other trace elements also play some role. Zinc is a necessary cofactor for RNA polymerase and DNA polymerase; a deficiency resulting in early wound healing delay. Vitamin K deficiency limits the synthesis of prothrombin and factors VII, IX, and X.

Hypoxia

Ischemia is caused by various factors, such as atherosclerosis, cardiac failure, or simple wound tension preventing localized perfusion.

Uremia

Urea inhibits the growth of fibroblasts. Hence, uremia is implicated in the retardation of wound healing in patients.

Jaundice

The appearance of fibroblasts and formation of new blood vessels are both delayed, hence wound strength is not achieved.

Steroids

Steroids have a profound anti-inflammatory action. It interferes with the process of inflammation. New vessels formed are abnormal and sparse, as are fibroblasts.[1-7]

MATERIALS AND METHODS

The proposed study was conducted with the approval of the Institutional Ethics Committee, Government Medical College, Amritsar.

Study Design

Prospective.

Sample Size

Forty patients who underwent laparotomy.

Study Population

All patients for emergency or elective laparotomy in the Department of General Surgery, GMC Amritsar, were included in the study.

Inclusion Criteria

Patients of either sex, aged 15–75 years, who underwent laparotomy elective or emergency, with midline incisions.

Exclusion Criteria

1. Patients who died within 7 days of surgery
2. Patients who underwent right paramedian, grid iron and transverse incisions.
3. Patients who underwent second laparotomy or relook-laparotomy
4. Patients with clean wounds
5. Patients who refused consent.

Methodology

The patients were chosen randomly, irrespective of gender and the nature of the disease. After obtaining complete written informed consent in vernacular language, eligible subjects were evaluated, on the basis of a pre-designed standard pro forma, which included patient information, that is, history of the patient, general physical and systemic examination, clinical signs of perforation, such as abdominal distension, absent bowel sounds. Necessary investigations were done.

Investigations or interventions conducted on patients are described:

1. Blood
   - Hemoglobin
   - Total count
   - Differential count
   - Random blood glucose
   - Blood urea, serum creatinine
   - Serum electrolytes
   - Total protein, serum albumin
2. Urine routine
3. Electrocardiogram
4. Chest X-ray

Table 1: Comparison of the duration of hospital stay in both groups

Hospital stay	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<10	5	25.00	6	30.00	11	27.50
11–20	13	65.00	12	60.00	25	62.50
21–30	2	10.00	1	5.00	3	7.50
>30	0	0.00	1	5.00	1	2.50
Total	20	100.00	20	100.00	40	100.00
Mean±SD	14.95±4.69		14.05±6.88		14.50±5.83	
P-value	0.632					

SD: Standard deviation

Table 2: Comparison of the hemoglobin (Hb) level of both groups

Hb (g%)	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<10	8	40.00	12	60.00	20	50.00
>10	12	60.00	8	40.00	20	50.00
Total	20	100.00	20	100.00	40	100.00
Mean±SD	10.71±2.17		9.96±1.48		10.33±1.85	
P-value	0.209					

SD: Standard deviation

Table 3: Comparison of the total leucocyte count of both groups

TLC	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<5000	1	5.00	1	5.00	2	5.00
5001–10,000	4	20.00	9	45.00	13	32.50
10,001–20,000	11	55.00	10	50.00	21	52.50
>20,000	4	20.00	0	0.00	4	10.00
Total	20	100.00	20	100.00	40	100.00
Mean± SD	15600.00±12318.60		10880.00±3209.65		13240.00±92.74	
P-value	0.106					

SD: Standard deviation

Table 4: Comparison of the blood sugar levels of both groups

Blood sugar	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<100	11	55.00	7	35.00	18	45.00
101–140	8	40.00	8	40.00	16	40.00
>140	1	5.00	5	25.00	6	15.00
Total	20	100.00	20	100.00	40	100.00
Mean±SD	102.65±22.71		119.70±33.57		111.17±29.58	
P-value	0.068					

SD: Standard deviation

5. Plain X-ray abdomen in erect posture
6. Contrast X-rays, such as barium meals whenever applicable

Table 5: Comparison of the blood urea levels of both groups

Blood urea	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<40	10	50.00	7	35.00	17	42.50
41–80	8	40.00	10	50.00	18	45.00
>80	2	10.00	2	10.00	4	10.00
Total	20	100.00	20	100.00	40	100.00
Mean±SD	50.85±20.71		54.74±29.03		52.80±24.97	
P-value	0.628					

SD: Standard deviation

Table 6: Comparison of the serum creatinine levels of both groups

S. Creatinine	Group 1		Group 2		Total	
	No.	%	No.	%	No.	%
<1.0	8	40.00	2	10.00	10	25.00
1.1–2.0	9	45.00	13	65.00	22	55.00
2.1–3.0	3	15.00	5	25.00	8	20.00
Total	20	100.00	20	100.00	40	100.00
Mean±SD	1.40±0.67		1.82±1.20		1.61±0.98	
P-value	0.178					

SD: Standard deviation

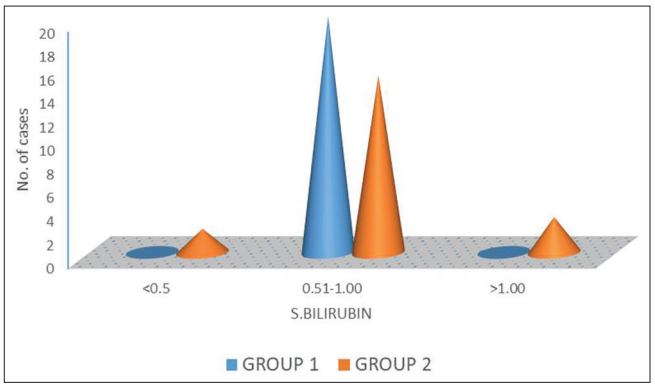

Figure 1: Comparison of the serum bilirubin level of both groups

7. Upper gastrointestinal (GI) endoscopy whenever applicable
8. Abdominal ultrasound and computed tomography scan whenever applicable.

The data from the present study were systematically collected, compiled, and statistically analyzed using software IBM SPSS 23.0 (Armonk, NY: IBM Corp.) to draw relevant conclusions. Data were expressed as mean, standard deviation, number, and percentages. The patient characteristics (non-parametric data) were analyzed using the "Chi-square tests" and the inter-group comparison of the parametric data was done using the 'Unpaired "t" test. The "*P*"-value was determined to finally evaluate the levels of significance. The $P < 0.05$ was considered as significant

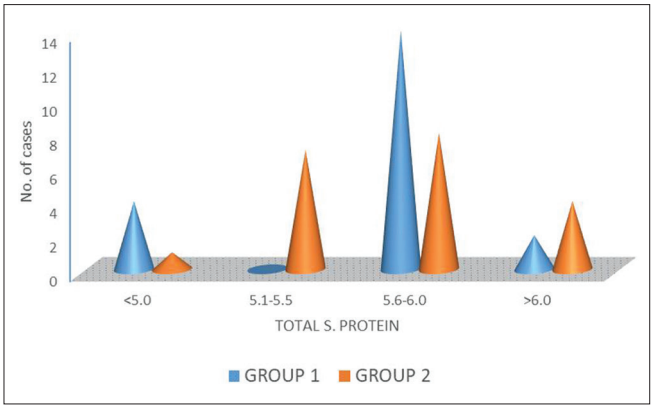

Figure 2: Comparison of the total protein level of both groups

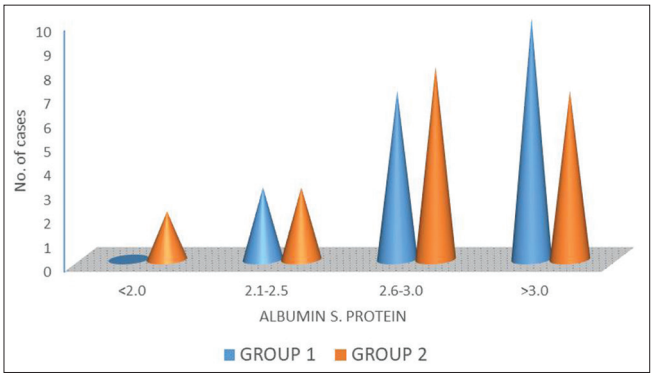

Figure 3: Comparison of the serum albumin level of both groups

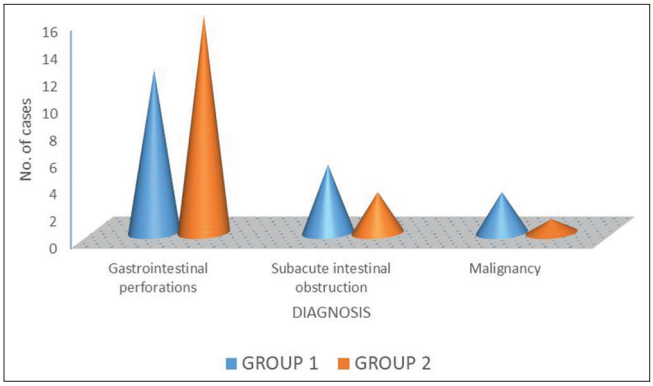

Figure 4: Comparison of the diagnosis of both groups

at 5% significance level; $P < 0.01$ was considered significant at 1% significance level and a $P < 0.001$ was considered as highly significant.

There is no significant difference between mean age of the groups. Group 1 has mean age of 41.7 years and group 2 has a mean age of 42.2 years. Most of the patients were around the age of 20–60 years. Disease burden affects more younger population in developing countries.

In both groups, the majority of the patients were male. This can be attributed to the sex ratio in the state as well as trauma and GI perforations being significantly higher in males.

The number of days spend in the hospital was not much different. In both groups, patients stayed for about 14 days. Post-operative care was same in both groups.

The study population was found to have less than the normal levels of hemoglobin. In adult male, the normal level is 14–16 g/dL and adult female it is 12–14 g/dL. Although this result can be mostly due to their disease condition but one may reflect on the general deficiency in the population.

The leukocyte count is elevated in both groups because in the Indian setup infectious etiology is more prevalent.

After estimating the blood sugar levels, most of our patients were found to be non-diabetic. It may be attributed to the fact that the study population was of a younger age group and etiologies were mostly acute.

Blood urea levels were found to be on the higher side. This can be the result of dehydration and shock. Pre-renal failure is quite common in shock.

Creatinine levels were corresponding with the urea level and were mildly elevated due to dehydration and shock.

The serum bilirubin levels were found to be normal in the study population. Increased bilirubin levels delay wound healing.

Protein levels were generally normal as expected in a younger age group.

The serum albumin levels were found to be normal as expected in younger age group.

All preoperative parameters, such as hemoglobin, renal function, and total protein, were comparable in both groups, with no significant difference between the two study groups.

The etiology was mainly gastro intestinal perforations 70%. In an Indian setup infectious etiology is more common [Figures 1-4 and Tables 1-6].

DISCUSSION

Laparotomy is associated with significant morbidity, including adhesions, intestinal obstruction, burst abdomen and incisional hernia. The patient's physiologic status before laparotomy is important for a successful outcome. Efforts should be made to optimize the patient's general

condition. Correction of fluid and electrolyte imbalances, blood transfusions, and antibiotics and nebulizations for respiratory improvement helps in improving the successful outcome after laparotomy. Many factors affect wound healing. This study was to evaluate the prevalence of various factors prevalent in patients undergoing midline laparotomy in GMC, Amritsar. The risk factors assessed were age, sex, anemia, diabetes, jaundice, uremia and hypoprotenemia. The study included 40 patients who underwent midline laparotomy in GMC, Amritsar.

Age

There is no significant difference between the mean age of the groups. Group 1 has a mean age of 41.7 years and group 2 has a mean age of 42.2 years. Most of the patients were around the ages of 20–60 years. Disease burden affects more younger population in developing countries.

Sex

In both groups, the majority of the patients were male. This can be attributed to the sex ratio in the state, as well as trauma and GI perforations being significantly higher in males.

Anemia

The study population was found to have less than the normal levels of hemoglobin. In adult male, the normal level is 14–16 g/dL and adult female it is 12–14 g/dL. Although this result can be mostly due to their disease condition but one may reflect on the general deficiency in the population.

Diabetes

After estimating the blood sugar levels most of our patients were found to be non-diabetic. It may be attributed to the fact that study population was of younger age group and etiologies were mostly acute.

Renal Failure

Blood urea levels were found to be on the higher side. This can be the result of dehydration and shock. Pre-renal failure is quite common in shock. Creatinine levels were corresponding with the urea level and was mildly elevated due to dehydration and shock.

Hypoprotenemia

Protein levels were generally normal as expected in a younger age group. The serum albumin levels were found to be normal as expected in younger age group.

Diagnosis

The etiology was mainly gastrointestinal perforations, 70%. In an Indian setup, infectious etiology is more common.

CONCLUSION

The predominant risk factor present in the study population was the infectious etiology leading to midline laparotomy mainly GI perforations. Anemia and renal failure are also prevalent in the study population.

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