

Factors Affecting Wound Healing after Laparotomy at a Tertiary Care Hospital, Odisha, India: A Prospective Interventional Study

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ABSTRACT

Introduction: Wound healing after the injury occurs after various phases and is affected by multiple factors. It plays a psychological role for the surgeon and patients, influencing morbidity and hospital stay. Factors like age, nutrition, use of steroids, type of incision, diabetes and infection plays an essential role in wound healing.

Aim: To assess the factors influencing patients and affecting wound healing after laparotomy.

Materials and Methods: This prospective interventional study was carried in the Department of General Surgery, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Sambalpur, Odisha, India, between October 2019 and September 2021 on 100 patients undergoing laparotomy, admitted in the surgical ward. Data was collected regarding clinical history including co-morbid conditions (diabetes, hypertension, anaemia), general physical and systemic examination and relevant diagnostic investigations. The collected data was tabulated as mean±Standard Deviation (SD), frequency (n) and

percentage (%) for proper analysis, represented in form of pie-charts and bar diagrams.

Results: A total of 100 patients undergoing laparotomies were studied, with maximum participants in 61-70 years of age. Out of these, 40 patients were found to have delayed wound healing (mean age: 62.2 years), 10 (25%) were females and 30 (75%) were males. Wound infection was most common (n=38) factor for delayed healing followed by diabetes (16 patients out of 30 known diabetics), and consumption of alcohol (14 patients out of 24 known alcoholics) and smoking (20 out of 25 known chronic smokers).

Conclusion: The incidence of delayed healing was higher in the present study with an increased incidence of wound infection. Clinical factors of low haemoglobin, low serum albumin, history of diabetes mellitus, alcohol and smoking, were observed to be associated with delayed wound healing along with physiological predisposing factors of increasing age and gender. These factors should be considered and efforts can be made to manage these risk factors for proper care of patients.

Keywords: Alcohol, Diabetes, Fibroplasia, Infection, Smoking, Tissue regeneration

INTRODUCTION

Tissue regeneration in humans is limited and most of them are healed by repairing. Healing in human body goes through different phases coagulation, inflammation, matrix synthesis and deposition [1,2]. Normally in the body only epithelium and liver can regrow, the tissue healing phase is followed by angiogenesis, fibroplasia, epithelialisation, contraction, remodelling and scar maturation [3]. Poor healing risk increases with older age (>65 years), infection in a wound, pulmonary diseases, using steroids, high blood pressure, sepsis and obesity [4]. Hyperproteinaemia, uraemia and malignancy are also other risk factors associated with poor wound healing [1,4]. As for optimal collagen synthesis, oxygen tension plays an important role, so decreased oxygen tension also leads to increased rates of wound infection [5]. So, the oxygen delivery is affected due to various systemic reasons or any local factors, reducing wound healing.

Chronic condition like diabetes contributes towards wound infection and failures towards wound healing [6,7]. It also affects the various phases of wound healing and decreases the tissue healing rate. In surgery, the epithelium is cut, which allows infection through bacterial access to tissue and bloodstream and act as a deterrent towards wound healing [6,7]. Additionally, dietary disorders and patients with malabsorption, hypermetabolic, or catabolic states slow the healing of wounds [8]. Deficits in a vitamin, mineral, protein, carbohydrate, or lipid may prevent the body from producing wound repair components properly. Infection could be a significant issue as a result of immunodeficiency brought on by malnutrition [9]. The

present study was aimed to to assess the various factors influencing postlaparotomy wound healing and identify the preoperative, operative and postoperative risk factors in patients with poor wound healing.

MATERIALS AND METHODS

This prospective interventional study was conducted in the Department of General Surgery, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Sambalpur, Odisha, India, between October 2019 and September 2021 on 100 patients undergoing laparotomy. Ethical clearance was obtained from Institutional Ethics Committee (19219/Dated 30.11.2019/IST-233/19) along with written informed consent from all participants.

Inclusion criteria: Those patients aged more than 18 years, undergoing emergency or elective abdominal laparotomy at the chosen study centre during the study time period were included in the study.

Exclusion criteria: Those patients who underwent relaparotomy and are known to be suffering from collagen vascular diseases were excluded from the study.

Study Procedure

Total of 100 patients were included in the present study. After admission, data were collected regarding clinical history, general physical and systemic examination and relevant diagnostic investigations like haemoglobin level and serum albumin. Data on

co-morbid factors like anaemia, hypertension, diabetes mellitus were collected. All patients who reported to the emergency room began receiving antibiotics as part of their preoperative care, and their courses were extended as necessary after surgery in each case. In all elective situations, an antibiotic preventive dosage and any necessary antibiotic extension was administered. From the third postoperative day onward, the wound was examined, and this inspection included examination for any redness, oedema or the presence of discharge like pus or serosanguinous fluid. The examination was continued till scar development and suture removal. Normal healing was defined as the removal of sutures from all wounds by the 10th postoperative day. Any complication or delay was deemed delayed wound healing.

STATISTICAL ANALYSIS

The data of all participants was tabulated using Microsoft (MS) excel software and mean±Standard Deviation (SD), frequency (n) and percentage (%) analysis was done. Observations were represented as bar diagrams and pie charts.

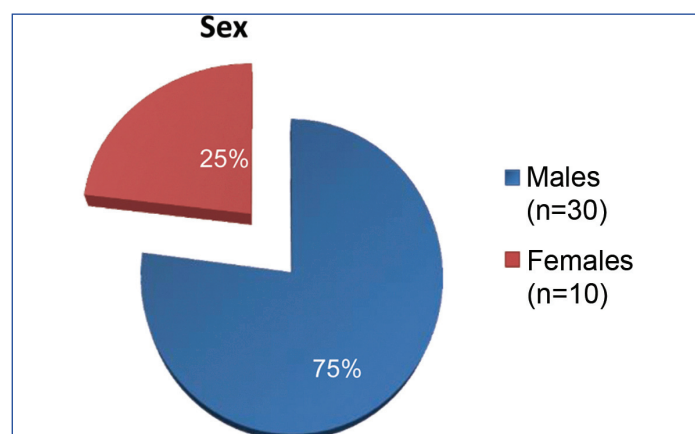
RESULTS

The study included a total of 100 patients. All patients underwent abdominal laparotomy either under emergency or elective basis. Two patients underwent relaparotomy during the study tenure and were excluded from the final analysis. Out of 100 patients who underwent the study, 40 patients had delayed wound healing. Among the 40 patients with delayed healing the average age was 62.2 years [Table/Fig-1].

Age groups (years)	n (N=100)	Delayed wound healing (n=40) n (%)
18-30	4	1 (25)
31-40	15	0
41-50	22	5 (22.7)
51-60	13	6 (46.2)
61-70	34	22 (64.7)
>70	12	6 (50)

[Table/Fig-1]: Age group distribution of all participants and those with delayed wound healing.

Out of the 40 patients with delayed wound healing, 30 (75%) were males and 10 (25%) were females [Table/Fig-2]. The average haemoglobin among the patients with delayed wound healing was 9.7 mg/dL [Table/Fig-3].



[Table/Fig-2]: Gender distribution of patients with delayed wound healing (n=40).

Haemoglobin level (mg/dL)	Patients with delayed healing (n=40) n (%)
<7	1 (2.5)
7-9	7 (17.5)
>9-11	24 (60)
>11	8 (20)

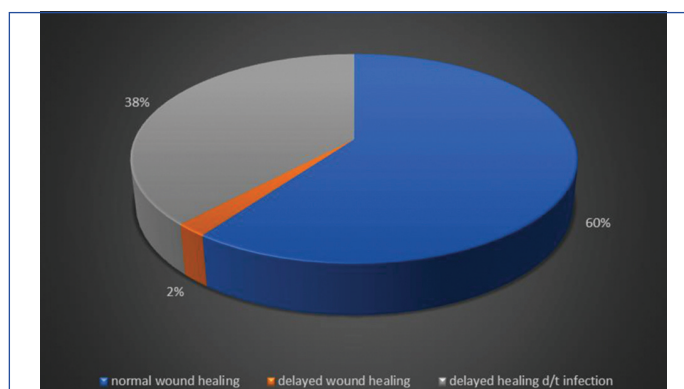
[Table/Fig-3]: Haemoglobin level distribution in all patients with delayed wound healing.

The average serum albumin among patients with delayed wound healing was 2.3 mg/dL. Highest percentage of patients, 6 (66.7%) out of 9 patients of delayed wound healing were seen where serum albumin level was ≤ 2 mg/dL group, and lowest 13 (32.5%) patients in 3-3.5 mg/dL group [Table/Fig-4].

Albumin level (mg/dL)	n (N=100)	Delayed wound healing (n=40) n (%)
≤ 2	9	6 (66.7)
2-2.5	10	6 (60)
2.5-3	21	8 (38.09)
3-3.5	40	13 (32.5)
≥ 3.5	20	7 (35)

[Table/Fig-4]: Distribution of patients with delayed wound healing with serum albumin levels.

Amongst total 100 patients, 30 patients had diabetes mellitus, of which 16 patients were observed delayed wound healing. A total of 25 patients reported chronic smokers, out of whom, 20 had delayed wound healing. Amongst total study participants, 24 patients were reported consuming alcohol on a regular basis and 14 (58.3%) out of those, had delayed wound healing. Wound infection was found in patients [Table/Fig-5].



[Table/Fig-5]: Distribution of all participants of the study based on wound healing and wound infection (N=100).

Out of the 100 patients included in the study, 75 underwent laparotomy through vertical midline incision, in which wound healing was delayed in 30. A 16 underwent laparotomy through right subcostal incision, in which wound healing was delayed in five patients. Nine patients underwent laparotomy through paramedian incisions, and wound healing was delayed in five patients. Highest percentages of patients 5 (55.6%) out of nine patients, of delayed wound healing were seen with paramedian incision, and lowest 5 (31.35%) out of 16 patients, with right subcostal incision [Table/Fig-6].

Type of incision	n (N=100)	Delayed wound healing (n=40), n (%)
Vertical midline	75	30 (40)
Right subcostal	16	5 (31.3)
Paramedian	9	5 (55.6)

[Table/Fig-6]: Distribution of all participants according to incision of laparotomy and delayed wound healing observed.

DISCUSSION

The present study was conducted to highlight all factors associated with patient recovery and wound healing after laparotomy procedure. According to the collected data and observation, males were presenting with delayed wound healing almost three times as common as females. A study by Campbell L et. al., in Manchester revealed a comparable ratio of males presenting two and a half times more frequently than females [10]. In the present study, the average age of patients with delayed wound healing was found to be 62.2 years. A prospective study carried out by Guo SA and DiPietro LA, showed a higher average age of 68.6 years [11]. The study participants' average haemoglobin level was 9 g/dL,

which is comparable to the findings reported by Hong WX et al., Northwestern University, Chicago [9]. The study found a haemoglobin less than 10 g/dL was associated with poor wound healing. The average albumin in the present study was found to be 2.56 mg/dL. This is consistent with findings reported by Arnold M and Barbul A, in a study conducted at Johns Hopkins Medical Institutions, Baltimore; they discovered that patients with delayed healing had a mean albumin of 2.2 g/dL [12]. In the present study, 16 out of 30 of the diabetics suffered from delayed wound healing. This is more than the results published by Sibbald RG et al., The New Woman's Hospital, Toronto, Ontario, Canada who found a 23% incidence of delayed healing among diabetics [13].

In the present study, only four patients took glucocorticoids and had delayed healing. This is a significant improvement over the findings reported by the study of Wagner AE et al., at the University of Luebeck in Germany. They reported that 42% of their steroid-using patients experienced delayed wound healing [14]. In the present study, 66% of patients with chronic cough had delayed healing. This is much higher than as reported by Hollender LF et al., which shows 31% of patients with delayed healing attributed to chronic cough [15]. In the present study, 80% of patients who were smokers, developed delayed wound healing. Similar findings were reported by Ahn C et al., found that 89% of their smokers had delayed wound healing [16].

In the present study, 58.3% of alcoholics developed delayed wound healing. This is more than reported result (24%) by Radek KA et al., [17]. In the present study, 50% of emergency laparotomies and 16% of elective laparotomies developed delayed wound healing. Rodríguez-Hermosa JI et al., study findings reported delayed healing in 20% of emergency procedures and fewer than 5% in elective surgeries, which are higher than those reported here [18]. Out of the 100 patients included in the study, 75 underwent laparotomy through vertical midline incision, which delayed wound healing in 30. It came to be 75%. This is less than what was found by Mäkelä JT et al., which was 87.8% and 16 underwent laparotomy through right subcostal incision, which delayed wound healing in five patients [19]. Nine underwent laparotomy through paramedian incisions in which wound healing was delayed by 5 (12.5%). This value was more than the result for the study by Mäkelä JT et al., which was 8.2 % [19]. Multiple studies have concluded that vertical midline incision increases the risk of wound dehiscence. In the study by Rodríguez-Hermosa JI et al., 33 out of 105 patients underwent surgery with vertical midline incisions, and 8.1% of patients with right paramedian incisions had burst abdomens; thus, more than 95% of patients with vertical incisions experienced wound dehiscence [18]. Elastic fibers of the skin also run transversely, so when they are cut by vertical incision, the strength of the wound is decreased. In the present study, 95% of the patients had having delayed healing had wound infection. This is higher than the results published by Rodríguez-Hermosa JI et al, where they found wound infection attributed to 70% of patients with delayed healing [18].

Limitation(s)

The present study was a single-centre study with small sample size and short duration of follow-up, hence was limited in the generalisation of the results. Also some patients developed more than one complication.

CONCLUSION(S)

The incidence of delayed wound healing was found to be a lot higher with principal associated factor was found to be wound infection. The other factors may directly delay healing or may indirectly increase chances of wound infection. Factors that could not be altered at an age above 65 years and male sex, might alert the surgeon, that the patient has an increased risk of having delayed wound healing.

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