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Original Research Article

Risk Factors Affecting Wound Healing in Surgical Patients

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Abstract

Background: Wound healing is a normal biological process in the human body. It has to undergo four phases before healing: hemostasis, inflammation, proliferation, and remodeling. For early or successful healing, these four stages must have a proper sequence and be within a proper time frame. Many factors can interfere with these phases of wound healing, which can impair the quality of life.

Method: 85 (eighty-five) adult patients who underwent general orthopedic or gynecological surgical procedures were selected for study. Their clinical manifestations, risk factors, delayed and normal healing factors, mean healing time, and risk factors were compared, and significant results were recorded ($p<0.001$). Postoperative wounds were assessed at the intervals of 3, 7, and 14 days.

Results: Clinical manifestations were 24 (28.2%) type-2 DM, 28 (32.9%) HTN, 26 (30.5%) anemia, 21 (24.7%) obesity, and 16 (18.8%) malnutrition. In the comparison of risk factors between delayed and normal healing, the comparison of mean healing time and risk factors had a significant p-value ($p<0.001$).

Conclusion: The risk factors like type-2 DM, obesity, malnutrition, anemia, and surgical site infection retard the healing of wounds. Early identification and trading of these factors will enhance early healing with the least risk factors.

Keywords: Risk factors, surgical site infections, Wound healing, Elective surgery.

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Introduction

The wound healing process consists of four highly integrated and overlapping phases: hemostasis, inflammation, proliferation, and tissue remodeling or resolution [1]. These phases and their biophysiological functions must occur in the proper functions in the proper sequence, at a specific time, and continue for a specific duration at an optimal intensity. There are many factors that can affect wound healing, which interfere with one or more phases in this process, thus causing improper or impaired tissue repair [2].

Wounds that exhibit impaired healing, including delayed acute wounds and chronic wounds, generally have failed to progress through the normal stages of healing; such wounds frequently enter a state of pathologic inflammation due to a postponed, incomplete, or uncoordinated healing process [3].

Most chronic wounds are ulcers that are associated with ischemia, diabetes mellitus, venous stasis disease, or pressure. Non-healing wounds result in enormous health care expenditures [4]. Hence, an attempt is made to evaluate the risk factors that affect the wound healing in adult patients.

Material and Method

85 (eighty-five) patients aged between 22 and 45 years who regularly visited the General Surgery department of Srinivas Institute of Medical Sciences and Research Centre, hospital, were studied.

Inclusive Criteria: The patients above 18 years of age who underwent elective or emergency surgical procedures encompassing general orthopaedic and gynaecological disciplines were enrolled. The patients available for six (6) weeks for follow-up produced all related documents of surgery. The patients who gave their consent for study in writing were selected.

Exclusion Criteria: The patients are below 18 years of age. The patients with pre-existing chronic non-healing wounds, immune-compromised

patients, and malignant patients undergoing concurrent chemotherapy or radiotherapy and those who refused to give the consent in writing for the study were excluded.

Method: Related history and comorbidities like type-II DM, hypertension (HTN), hypothyroidism, chronic kidney disease (CKD), lifestyle (sedentary or active), smoking, alcohol consumption, nutritional status indices (serum albumin, haemoglobin), and surgical parameters, types of surgery, operative duration, wound classification, and intraoperative blood loss were recorded in each patient. Postoperative wound assessments were performed at intervals of 3, 7 and 14 days post-surgery, and each patient's follow-up visit was up to six weeks. The outcomes documented included surgical site infection, wound dehiscence, haematoma seroma and the requirement for resutering or secondary intervention. Delayed wound healing was defined as the absence of satisfactory wound closure within 10-14 days of surgery or the presence of any of the above complications necessitating secondary intervention. The duration of the study was April 2024 to March 2026.

Statistical Analysis: Clinical manifestations, comparison of delayed and normal healing and comparison of mean healing time and risk factors were studied with p-value. The statistical analysis was carried out in SPSS software; the ratio of male and female was 2:1.

Observation and Results

Table-1: Clinical manifestations of patients with wound healing problems - 24 (28.2%) had type-II DM, 28 (32.9%) had HTN, 19 (22.9%) Anemia: 26 (30.5%) were smokers, 21 (24.7%) had obesity, and 16 (18.8%) were malnourished.

Table-2: Out of 85 patients, 23 (27%) had delayed and 62 (72.9%) had normal healing of the wound.

- Type-II MD: 15 (65.2%) delayed, healing 9 (14.4%) had normal healing.
- Anemia: 11 (47.8%) had delayed healing; 17 (27.4%) had normal healing.
- Smokers: 10 (43.4%) were delayed, and 9 (14.5%) had delays.
- Obesity: 9 (39.1%) had delayed healing, and 17 (27.4%) had normal healing.
- Malnutrition: 8 (37.7%) had delayed and 13 (20.9%) had normal healing.
- Surgical site infection: 7 (30.4%) had delayed healing, and 3 (5.7%) had normal healing.

Table-3: Comparison of mean healing time and risk factors.

- Type-II DM: 24.6 (± 4.4) was the mean healing time, with 33% being the risk factor.
- Anemia: 22.2 (± 3.9) was the mean healing time, with 24% being a risk factor.
- Smoking: 22.1 (± 4.8) was the mean healing time with a 26% risk factor.
- Obesity: 23.2 (± 5.9) was the mean healing time with 28% of risk factors.
- Malnutrition: 22.6 (± 5.5) was the mean healing time with a 22% risk factor.
- No major risk factors: Patients had a mean healing time of 13.3 (± 2.8) with 5% risk factors.

Table 1: Clinical manifestations of the patients with wound healing problems [Total no of patients = 85]

Clinical Manifestations	No. of Patient (85)	Percentage %
Diabetes Mellitus (type-II DM)	24	28.2%
Hypertension (HTN)	28	32.9%
Anemia (Hb<10 g/dL)	19	22.3%
Smoking	26	30.5%
Obesity (BMI>30)	21	24.7%
Malnutrition (Albumin <3.5 g/dL	16	18.8%

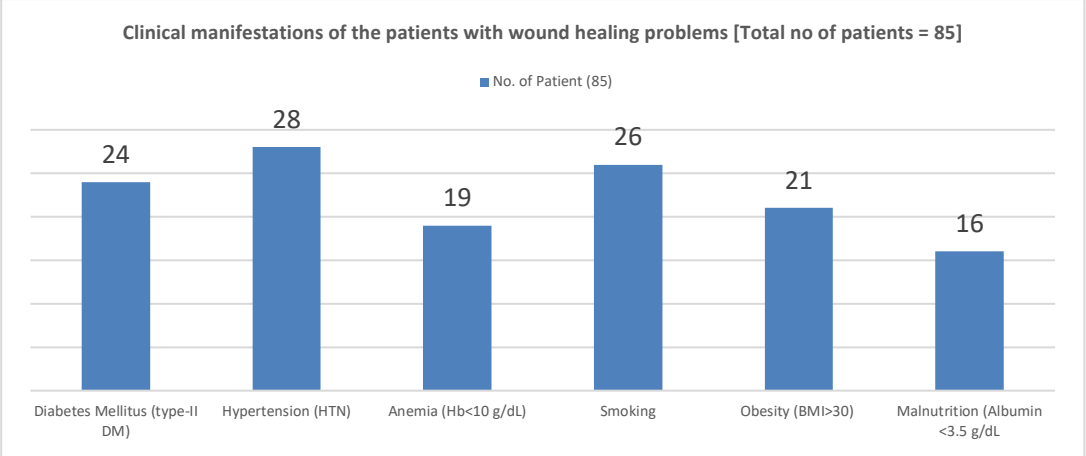

Figure 1: Clinical manifestations of the patients with wound healing problems [Total no of patients = 85]

Table 2: Comparison of risk factors between delayed and normal healing [Total no of patients = 50]

Risk factors	Delayed Healing (n=23)	Normal Healing (n=62)	p-value
Diabetes Mellitus	15 (65.2%)	9 (14.5%)	P<0.001
Anemia	11 (47.8%)	17 (27.4%)	P<0.004
Smoking	10 (43.4%)	9 (14.5%)	P<0.002
Obesity (BMI>30)	9 (39.1%)	17 (27.4%)	P<0.001
Malnutrition	8 (34.7%)	13 (20.9%)	P<0.004
Surgical site infection	7 (30.4%)	3 (5.7%)	P<0.001

(p<0.001 = highly significant)

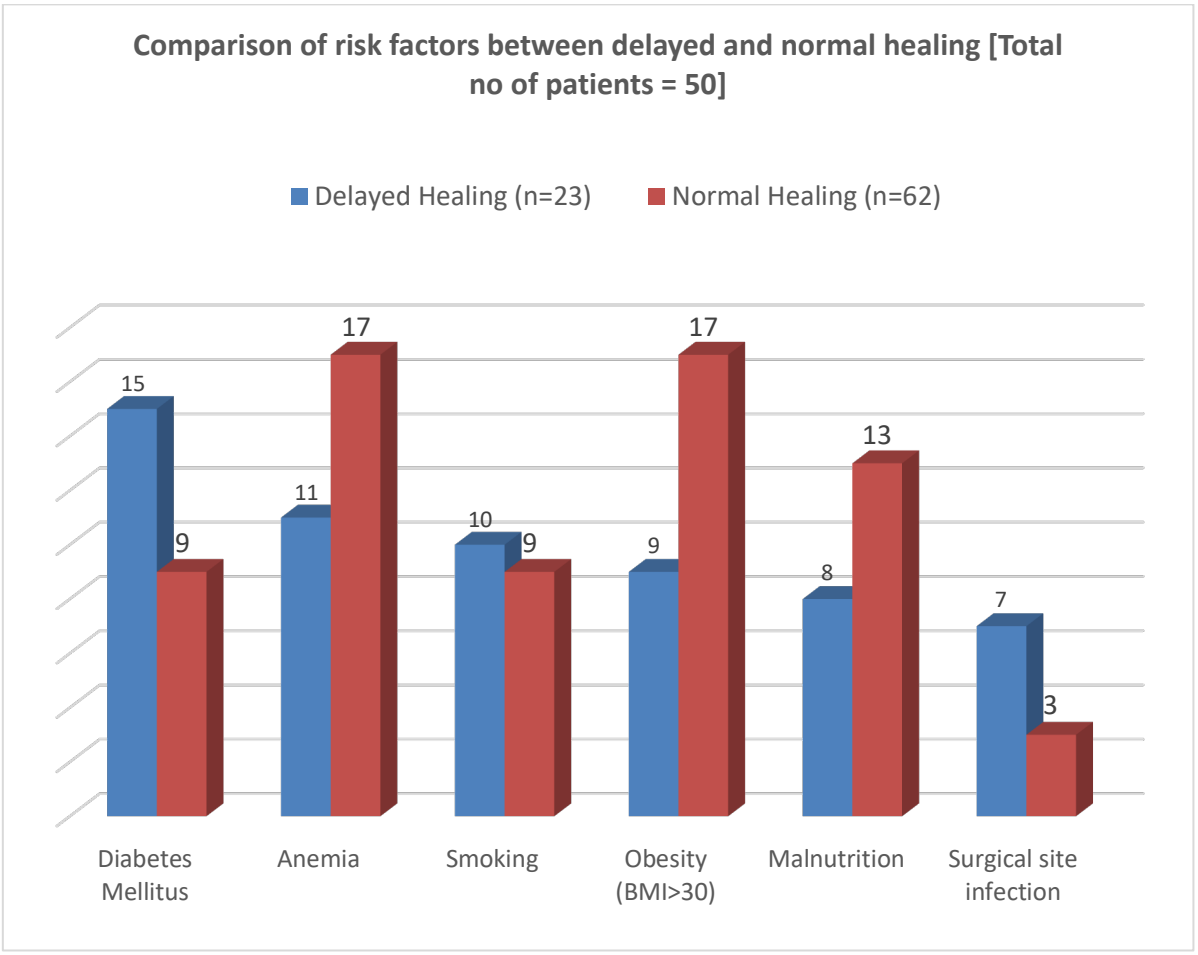

Figure 2: Comparison of risk factors between delayed and normal healing [Total no of patients = 50]

Table 3: Comparison of mean healing time and risk factors

Risk factors	Mean healing time (days)	Complication rate (%)	p<value
Diabetes Mellitus	24.6 (± 4.4)	33%	P<0.001
Anemia	22.2 (± 3.9)	24%	P<0.001
Smoking	22.1 (± 4.8)	26%	P<0.001
Obesity	23.2 (± 5.9)	28%	P<0.001
Malnutrition	21.6 (± 5.5)	22%	P<0.001
No Major risk factors	13.3 (± 2.8)	5%	P<0.001

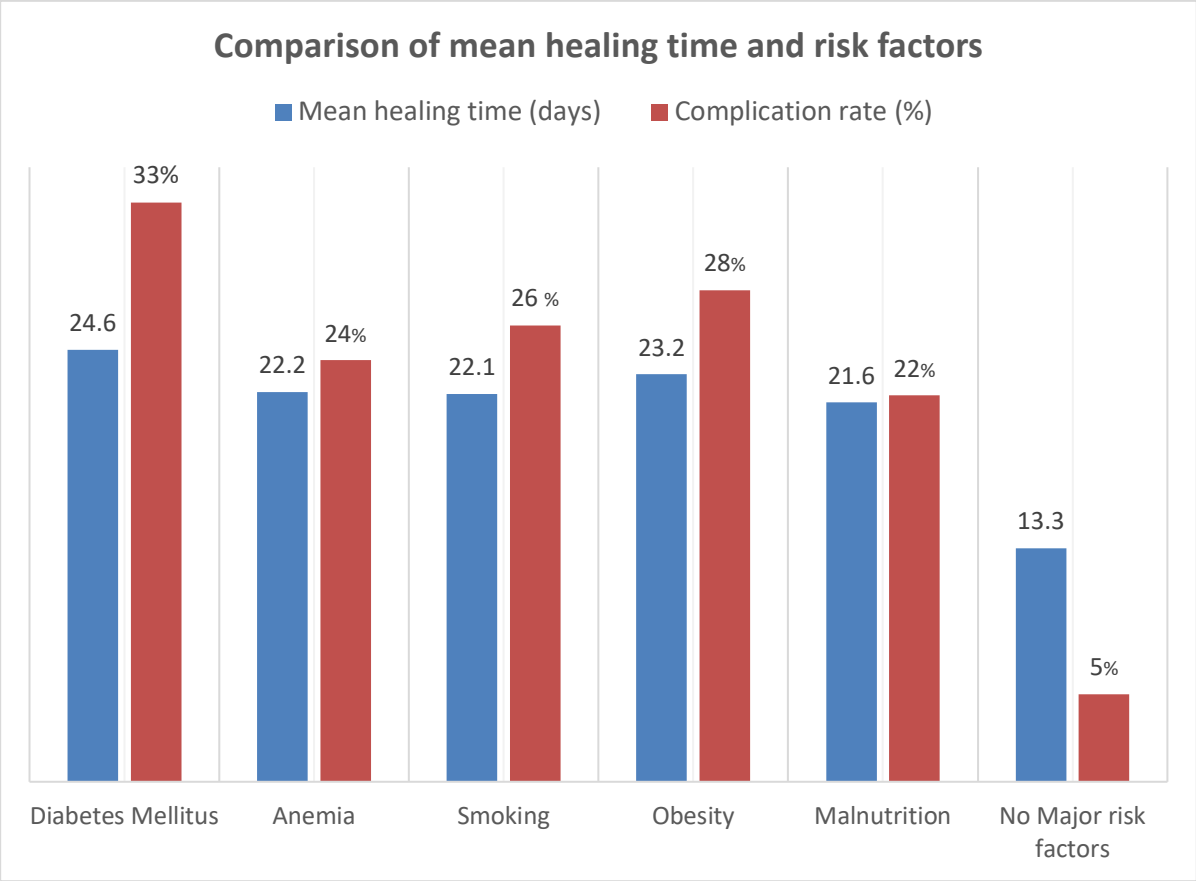

Figure 3: Comparison of mean healing time and risk factors

Discussion

Present study of risk factors affecting wound healing in surgical patients of South Karnataka. The clinical manifestations were 24 (28.2%) type-II DM, 28 (32.9%) HTN, 19 (22.3%) anemia, 26 (30.5%) smoking, 21 (24.7%) obesity, and 16 (18.8%) malnutrition (Table-1). In the comparison of risk factors between delayed and normal healing factors, there was a significant p-value (P<0.001) (Table-2). In the comparative study of mean healing time and risk factors, there was a significant p-value (p<0.001) (Table-3). These findings are more or less in agreement with previous studies [5,6,7].

Surgical errors, including faulty planning, tissue trauma, and inadequate subcutaneous tunnel leading to vascular insufficiency and tension over the suture line, may be the important factors predisposing to infection in major surgical procedures and may cause hindrance in early healing of wounds.

Prolonged duration of surgery, more than 3 to 4 hours, and causes wound exposure to the environment and dampening of the surgical drapes with the blood complexity of a procedure associated with a longer duration with more blood loss. Antibacterial scrubs may lose their effectiveness after some undisclosed time. The prophylactic antibiotics may be necessary to repeat the dose of drug during prolonged surgery to prevent delayed healing [8].

There is a significant association between wound complications and low postoperative albumin. Reduced dosage of albumin alters serum proteins of the immune system, which are essential for resistance to infection and to many toxic substances. Adequate nutrition with sufficient high

biological value proteins will accelerate the wound healing.

Inflammation is a normal part of the wound healing process and is important to the removal of contaminating micro-organisms; both bacteria and endotoxins can lead to the prolonged elevation of pro-inflammatory cytokines such as interleukin-1 (IL-1) and TNF-α and elongate the inflammatory phase. If this continues, the wound may enter a chronic state and take too long to heal [9].

Delayed wound healing in the aged is associated with an altered inflammatory response, such as delayed T-cell infiltration into the wound area with alteration in chemokine production and reduced macrophage phagocytic capacity. Moreover, sex hormones in aged females and males have significant effects on wound healing. The gene expression of the elderly is estrogen-regulated. Estrogen-related varieties of genes associated with regeneration, matrix production, and protease inhibition, epidermal functions are impaired in old age and lead to delays in wound healing. Stress on human health includes cardiovascular disease, cancer, and diabetes, which disrupts the neuroendocrine immune equilibrium in consequence to health. The pathophysiology is altered and leads to a delay in wound healing [10].

Summary and Conclusion

The present study of risk factors affecting wound healing in surgical patients is multifactorial. Wound healing is a complex biological process that consists of hemostasis, inflammation, proliferation, and remodeling. A large number of cells, including neutrophils, macrophages, lymphocytes, keratinocytes, fibroblasts, and endothelial cells, are involved in the process of healing. Out of these, any one cell function is impaired, which can lead to a delay in healing and may deteriorate the pathophysiology of wound tissue. The present study demands future genetic, nutritional, cellular, and environmental studies because the exact mechanism and factors that cause early healing are still unclear.

Limitation of study: Owing to the remote location of the research center, small number of patients, and lack of the latest techniques, we have limited findings and results.

This research work was approved by the Ethical Committee of Srinivas Institute of Medical Sciences and Research Centre, Mangalore-575001, Karnataka, India.

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