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Original Article

Preoperative Albumin, Glycosylated Haemoglobin, Body Mass Index and it's Association with Surgical Site Infection in Patients Undergoing Open Mesh Repair for Incisional Hernia

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ABSTRACT

Background: Surgical site infection (SSI) is a common and serious complication following incisional hernia repair, particularly when prosthetic mesh is used. SSIs contribute to prolonged hospital stay, increased healthcare costs, and poor surgical outcomes. Several patient-related factors such as poor nutritional status, inadequate glycaemic control, and obesity are potentially modifiable risk factors that influence postoperative wound healing. Serum albumin, glycosylated haemoglobin (HbA1c), and body mass index (BMI) are simple, routinely measured parameters that may help identify patients at high risk of SSI, especially in resource-limited tertiary care settings.

Objectives: To determine the incidence of surgical site infection in patients undergoing open mesh repair for incisional hernia and to analyse the association of preoperative serum albumin, HbA1c, and BMI with the occurrence of SSI.

Methods: A prospective observational study was conducted over 18 months in the Department of General Surgery at a tertiary care teaching hospital. Thirty adult patients undergoing elective open mesh repair for incisional hernia were enrolled using consecutive sampling. Preoperative serum albumin, HbA1c, and BMI were recorded. Patients were followed for 30 days postoperatively, and SSIs were identified and classified according to Centers for Disease Control and Prevention criteria. Data were analysed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results: The overall incidence of SSI was 73.3%. Organ/space infections were the most common type, followed by superficial and deep incisional infections. All patients with hypoalbuminemia (<3.5 g/dL) developed SSI, and this association was statistically significant ($p = 0.041$). Elevated HbA1c levels (≥6.5%) were also significantly associated with SSI ($p = 0.009$). Although most SSIs occurred in overweight and obese patients, the association between BMI and SSI was not statistically significant ($p = 0.100$). Patients with SSI had a significantly longer hospital stay compared to those without infection.

Conclusion: Preoperative hypoalbuminemia and poor glycaemic control are significant predictors of surgical site infection following open mesh repair for incisional hernia. Routine assessment and optimization of these modifiable risk factors may reduce postoperative complications and improve surgical outcomes.

Keywords*: Surgical site infection; Incisional hernia; Serum albumin; HbA1c; Body mass index.*

INTRODUCTION

Incisional hernia is a common long-term complication following abdominal surgery, with reported incidence ranging from 10% to 20%, depending on patient-related and surgical factors. The condition poses a significant burden on healthcare systems due to associated morbidity, impaired quality of life, and the need for re-operation. Mesh-based repair has become the standard of care for incisional hernias, as it significantly reduces recurrence compared to suture repair[1]. However, the use of prosthetic material increases the risk of postoperative complications, particularly surgical site infections (SSIs).

Surgical site infections remain one of the most frequent and preventable causes of postoperative morbidity worldwide. According to the Centers for Disease Control and Prevention (CDC), SSIs occur within 30 days of surgery or within one year when prosthetic material is implanted[2]. Globally, SSIs account for a substantial proportion of healthcare-associated infections, with disproportionately higher rates reported in low- and middle-income countries[3]. Indian studies have reported SSI rates following hernia surgery ranging from 20% to over 30%, highlighting region-specific challenges related to patient optimization and infection control practices[4–6].

Several patient-related, potentially modifiable preoperative risk factors have been implicated in the development of SSIs. Nutritional status, commonly assessed using serum albumin, plays a critical role in wound healing and immune function. Hypoalbuminemia has been consistently shown to increase the risk of postoperative infections in abdominal surgeries[7–9]. Similarly, poor glycaemic control adversely affects leukocyte function and tissue perfusion, predisposing patients to infection. Glycosylated haemoglobin (HbA1c) is a reliable marker of long-term glycaemic control, and elevated levels have been associated with increased SSI rates across surgical disciplines[10–12].

Obesity is another important risk factor for SSIs, particularly in abdominal wall surgeries. Increased adipose tissue compromises wound perfusion, increases operative difficulty, and promotes dead space formation, all of which contribute to infection risk[13,14]. While these associations are well established in international literature, there is limited prospective data from South Indian tertiary care hospitals evaluating the combined effect of nutritional status, glycaemic control, and body mass index (BMI) on SSI following open mesh repair for incisional hernia.

Therefore, this study was undertaken to determine the incidence of SSI in patients undergoing open mesh repair for incisional hernia and to analyse the association of preoperative serum albumin, HbA1c, and BMI with the development of postoperative SSIs.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery at Mysore Medical College and Research Institute (MMCRI), K.R. Hospital, Mysuru, over a period of 18 months. Adult patients aged more than 18 years with clinically and radiologically confirmed incisional hernia who underwent elective open mesh repair during the study period were included. Patients undergoing emergency hernia repair, pregnant women, individuals deemed unfit for general or spinal anaesthesia, and those with incomplete follow-up or missing preoperative biochemical parameters were excluded. Consecutive non-probability sampling was employed, and a total of 30 eligible patients were enrolled after obtaining informed written consent.

Preoperative evaluation included detailed clinical assessment and laboratory investigations. Serum albumin levels, glycosylated haemoglobin (HbA1c), and body mass index (BMI) were recorded for all patients prior to surgery. Body mass index was calculated as weight in kilograms divided by the square of height in meters. Serum albumin levels below 3.5 g/dL were considered indicative of hypoalbuminemia, while HbA1c values ≥6.5% were classified as poor glycaemic control. All patients underwent standard open mesh hernioplasty performed by experienced surgeons following institutional protocols.

Postoperatively, patients were followed up for a period of 30 days for the development of surgical site infections. Surgical site infections were identified and classified as superficial incisional, deep incisional, or organ/space infections according to the Centers for Disease Control and Prevention (CDC) criteria. Wound assessment was performed through daily clinical examination during hospital stay and at follow-up visits after discharge. Relevant clinical outcomes, including duration of hospital stay and need for rehospitalization, were documented.

Data were entered into Microsoft Excel and analyzed using SPSS version 22.0 (IBM SPSS Statistics, Somers, NY, USA). Normality of continuous variables was assessed using the Shapiro–Wilk test. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between categorical variables was analysed using the Chi-square test or Fisher's exact test when expected cell counts were less than five. Continuous variables between two independent groups were compared using the independent

samples t-test or the Mann–Whitney U test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 30 patients undergoing elective open mesh repair for incisional hernia were included in the study. The mean age of the study population was 52.0 ± 9.20 years, and the majority were female (76.7%). Most participants were either overweight (36.7%) or obese (46.7%), with a mean body mass index of 29.40 ± 4.49 kg/m². Hypoalbuminemia (serum albumin <3.5 g/dL) was present in 10% of patients, while 63.3% had elevated HbA1c levels (≥6.5%), indicating poor glycaemic control (Table 1).

The overall incidence of surgical site infection (SSI) was 73.3%, with 22 patients developing SSI within 30 days of surgery. Among the infected cases, organ/space infections were the most common (26.7%), followed by superficial incisional and deep incisional infections, each accounting for 23.3% of cases (Table 2).

A statistically significant association was observed between preoperative serum albumin levels and the occurrence of SSI. All patients with hypoalbuminemia (<3.5 g/dL) developed SSI, compared to 86.4% of patients with normal albumin levels, and this difference was statistically significant (p = 0.041) (Table 3). Similarly, poor glycaemic control was significantly associated with SSI, with 77.3% of patients having HbA1c ≥6.5% developing infection compared to 22.7% among those with HbA1c <6.5% (p = 0.009) (Table 3).

Although a higher proportion of SSIs was observed among overweight and obese patients, the association between BMI categories and SSI did not reach statistical significance (p = 0.100). Overweight and obese individuals together accounted for the majority of SSI cases (91.0%), suggesting a clinically relevant but statistically non-significant trend (Table 3).

Patients who developed SSI had a significantly longer duration of hospital stay compared to those without SSI (6.32 ± 2.58 days vs. 4.40 ± 1.60 days; p = 0.032). Rehospitalization was more frequent among patients with SSI (40.9%) than among those without SSI, although this difference did not achieve statistical significance (Table 4).

Table 1. Baseline characteristics of study participants (n = 30)

Characteristic	Value
Age (years)	52.0 ± 9.20
Sex	
Male	7 (23.3)
Female	23 (76.7)
Body Mass Index (kg/m²)	
Normal (18.5–24.9)	5 (16.7)
Overweight (25–29.9)	11 (36.7)
Obese (≥30)	14 (46.7)
BMI (Mean ± SD)	29.40 ± 4.49
Serum albumin (g/dL)	
< 3.5	3 (10.0)
≥ 3.5	27 (90.0)
Albumin (Mean ± SD)	4.14 ± 0.66
HbA1c (%)	
< 6.5	11 (36.7)
≥ 6.5	19 (63.3)
HbA1c (Mean ± SD)	7.34 ± 1.51

Table 2. Incidence and type of surgical site infection following open mesh repair (n = 30)

Variable	Frequency (%)
Surgical site infection	
Present	22 (73.3)
Absent	8 (26.7)
Type of SSI	
Superficial incisional	7 (23.3)
Deep incisional	7 (23.3)
Organ / space	8 (26.7)

SSI classified according to CDC criteria.

Table 3. Association of preoperative risk factors with surgical site infection (n = 30)

Risk factor	SSI Present n (%)	SSI Absent n (%)	p-value
Serum albumin (g/dL)			
< 3.5	3 (13.6)	0 (0.0)	**0.041***
≥ 3.5	19 (86.4)	8 (100.0)	
HbA1c (%)			
< 6.5	5 (22.7)	6 (75.0)	**0.009***
≥ 6.5	17 (77.3)	2 (25.0)	
Body Mass Index (kg/m²)			
Normal (18.5–24.9)	2 (9.1)	3 (37.5)	0.100†
Overweight (25–29.9)	10 (45.5)	1 (12.5)	
Obese (≥30)	10 (45.5)	4 (50.0)	

Chi-square test used
† Fisher's exact test

Table 4. Clinical outcomes associated with surgical site infection

Outcome	SSI Present (n = 22)	SSI Absent (n = 8)	p-value
Hospital stay (days)	6.32 ± 2.58	4.40 ± 1.60	**0.032***
Rehospitalization			
Yes	9 (40.9)	0 (0.0)	0.062†
No	13 (59.1)	8 (100.0)	

Independent samples t-test
† Fisher's exact test

DISCUSSION

In this prospective observational study, the incidence of surgical site infection following open mesh repair for incisional hernia was 73.3%, which is considerably higher than rates reported in international literature. However, similar trends have been observed in Indian studies, where SSI rates following hernia surgery range between 20% and 35%[4–6]. The higher incidence observed in the present study may reflect underlying factors such as malnutrition, suboptimal glycaemic control, obesity, and infrastructural limitations commonly encountered in public sector tertiary care hospitals.

A significant association was observed between preoperative serum albumin levels and the development of SSI. All patients with hypoalbuminemia (<3.5 g/dL) developed postoperative infections. This finding is consistent with previous studies demonstrating that low serum albumin is a strong predictor of postoperative morbidity due to impaired collagen synthesis, delayed angiogenesis, and compromised immune response[7–9]. These findings emphasize the importance of preoperative nutritional assessment and optimization, particularly in elective abdominal wall surgeries.

Poor glycaemic control, as indicated by elevated HbA1c levels (≥6.5%), was also significantly associated with SSI in the present study. Patients with elevated HbA1c accounted for more than three-quarters of all SSI cases. Similar observations have been reported in both systematic reviews and prospective studies, which highlight chronic hyperglycaemia as a key determinant of impaired wound healing and increased susceptibility to infection[10–12]. This underscores the need for stringent preoperative glycaemic optimization before elective hernia repair.

Although the association between BMI and SSI did not reach statistical significance, the majority of infected patients were either overweight or obese. Previous studies have consistently reported obesity as an independent risk factor for SSI due to poor tissue perfusion, increased wound tension, and technical difficulties during surgery[13],[14]. The lack of statistical significance in the present study may be attributed to the small sample size.

Patients who developed SSI had a significantly longer duration of hospital stay, reflecting the added clinical and economic burden of postoperative infections. Similar findings have been reported in earlier studies, where SSIs were associated with prolonged hospitalization and increased healthcare costs[17].

CONCLUSION

This prospective observational study demonstrates a high incidence of surgical site infection following open mesh repair for incisional hernia in a tertiary care public hospital setting. Preoperative hypoalbuminemia and poor glycaemic control, as reflected by elevated HbA1c levels, were significantly associated with the development of surgical site infections, while higher body mass index showed a clinically relevant but statistically non-significant trend. Patients who developed infections experienced prolonged hospital stay, indicating increased healthcare burden. Routine assessment and

preoperative optimization of nutritional status and glycaemic control, along with weight management, may substantially reduce postoperative complications and improve surgical outcomes in elective incisional hernia repair.

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