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Original Research Article

Evaluation of Serum Albumin Levels and Serum Cholesterol Levels as Risk Factors for Developing Surgical Site Infection Following Elective Surgery – A Prospective Observational Study

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Abstract

Background: Post operatively surgical site infection is one of the most common complications resulting in significant physical, mental, financial impact and burden on healthcare. Hypoalbuminemia & hypocholesterolemia have been reported to be one of the risk factors for developing surgical site infection.

Aims & Objectives: To assess the role of serum albumin & serum cholesterol levels as risk factors for developing surgical site infection following elective surgery.

Material & Methods: This prospective observational study recruited 150 patients who were admitted for elective surgery in department of General Surgery. Procedures included under elective surgery were inguinal hernia surgery, appendectomy and colorectal surgery, cholecystectomy, breast surgeries and other major elective procedures. Preoperatively, complete blood count, liver function tests, lipid profile, bleeding time, clotting time, urine examination, chest x-ray and ECG were performed. The duration of surgery & number of hospitalization days were recorded. Daily monitoring of pulse rate, blood pressure, temperature, surgical dressing of the study participants was done until their discharge. Any surgical site infection observed was registered.

Results: Hypoalbuminemia was observed in 92 (61.4%) & surgical site infections in 42 (28%) patients. Prevalence of total cholesterol levels were observed to be less than 100mg % in 30 (20%), between 100-200mg % in 99(66%) patients and more than 200 mg% in 21(14%) of the patients. Mean albumin levels were statistically significantly lower in patients with SSI (3.01±0.27) as compared to none(3.31±0.49) ($p<0.05$).Mean serum cholesterol levels observed no statistically significantly difference in patients with SSI (157.53±66.36) as compared to none (158.29±55.81) (p 0.68). No statistically significant difference was observed in the incidence of surgical site infections with respect to serum cholesterol levels (p 0.162).

Conclusion: Preoperative low serum albumin levels below 3mg/dl has been observed to be a significant & reliable risk factor for the development of surgical site infection. Serum cholesterol levels were not found to be statistically significantly associated with the development of surgical site infections.

Keywords: Hypoalbuminemia, Hypercholesterolemia, Surgical Site Infections, Elective Surgeries.

Introduction

Surgical site infections (SSI) are the third most commonly reported nosocomial infection.

The risk factors for developing SSI can be either patient related, hospital acquired or surgery related factors. Surgical factors include ASA score, Surgical wound class, blood transfusion, creation of ostomy, types of operation, use of drainage & surgical technique were important in predicting SSI after surgery. [1] It has a significant financial loss to the patient & family & also poses a burden on the healthcare system as hospitalization days are increased. SSI can either be superficial infections or deep infections or organ space infections. [2]

Serum albumin & total cholesterol are markers of nutritional status of an individual but their role as a risk factor for SSI has been less discussed. A low HDL, high LDL & total cholesterol have been linked to cardiovascular disease related mortality. Sacks noted hypocholestrolemia to be a predictor of death in geriatric patients . [3] In renal failure, there is a switch in protein synthesis from albumin to acute phase reactants (C reactive protein, cytokines). [4] Also albumins, adsorbs the small molecules thus suppressing the effects of mediators released from activated cells, with generalized increase in vascular permeability .[5] Role of cholesterol is significant as it is a precursor of five major classes of steroid

hormones. The synthesis of these hormones takes place in the adrenal gland and gonads in response to tissue-specific trophic hormones. Thus cholesterol is required for membrane biosynthesis, maintenance of membrane fluidity, and cell signaling. Thus the presence of hypocholestrolemia may be a risk factor for the occurrence of complications postoperatively.[6]

Thus, the present study was undertaken to determine the role of serum albumin & serum cholesterol levels as a risk factor for developing SSI following elective surgery. [7]

Material & methods

This prospective observational study was conducted between February 2023 and September 2023 in a tertiary healthcare center. The study recruited 150 patients who were undergoing elective surgery in Department of General Surgery. A prior approval from institutional ethical Committee was undertaken. A written informed consent was obtained from the study participants. Patients with comorbid diseases, diabetes mellitus, immunocompromised, critically ill patients, pregnant females or in whom the surgical site was previously infected were excluded.

Procedures included under elective surgery were inguinal hernia surgery, appendectomy and colorectal surgery, cholecystectomy, breast surgeries and other major elective procedures. After a detailed clinical history taking, following investigations were carried out :Complete blood count, liver function tests, Lipid profile, bleeding time, clotting time, urine examination, chest x-ray and ECG were performed.

The duration of surgery & number of hospitalization days were recorded. Daily monitoring of pulse rate, blood pressure, temperature, surgical dressing, and the study participants was done until their discharge. Any surgical site infection observed was registered. The study did not take into consideration the antimicrobial prophylaxis, sensitivity test of the microorganism & treatment of SSI & culture.

Wound condition was graded according to the Southampton Wound Grade system. The surgical site was evaluated for signs of erythema, discharge, tenderness, seroma and hematoma, wound dehiscence etc. SSI was defined as per the CDC (Centre for Disease Control) criteria –

1. Superficial SSI: wound cellulitis /erythema /purulent discharge from the wound

2. Deep SSI: as any wound infection requiring surgical interventions, such as removal of sutures or clips, drainage of deep pus, packings.

Statistical Analysis

The collected data was tabulated & put to statistical analysis. The data was expressed as mean & standard deviation. Pearson's Chi Square test was used for analysis. P-value <0.05 was considered statistically significant.

Results

This prospective observational study recruited 150 patients who were undergoing elective surgery. Hypoalbuminemia was observed in 92 (61.4%) out of 150 patients. Prevalence of total cholesterol levels were observed to be less than 100 mg% in 30 (20%), between 100-200mg% in 99(66%) patients and more than 200 mg% in 21(14%) of the patients. Out of a total of 200 patients, SSI was observed in 42 (28%) patients. Mean albumin levels were statistically significantly lower in patients with SSI (3.01±0.27) as compared to none(3.31±0.49) ($p<0.05$).(Table 2) Mean serum cholesterol levels observed no statistically significantly difference in patients with SSI (157.53±66.36) as compared to none(158.29±55.81) (p 0.68). (Table 2) Mean duration of hospitalisation was statistically significantly higher in patients who developed SSI (17.23 vs 8.01days) ($p<0.01$). Incidence of surgical site infections were 33.7% in patients with Hypoalbuminemia as compared to 17.4% in patients with normal albumin levels (p-value 0.021) which was statistically significant.(Table 3) Incidence of surgical site infections were 30% in patients with <100mg% cholesterol levels, 27.7% in patients with 100-200mg% cholesterol levels & 28.5% in patients with >200mg% cholesterol levels .But , the difference was not statistically significant (p 0.162).

Table 1: Distribution of study groups as per cholesterol levels

Total Cholesterol Levels (mg%)	N	%
<100	30	20.00%
100-200	99	66.00%
>200	21	14.00%
Total	150	100.00%

Table 2: Mean serum albumin & serum cholesterol levels in patients with SSI

Parameter	SSI	N	Mean ± SD	p-value
Low Serum albumin	Yes	42	3.01±0.27	<0.05
	No	108	3.31±0.49	
High Serum cholesterol levels	Yes	42	157.53±66.36	0.68
	No	108	158.29±55.81	

Table 3: Association of serum albumin levels with SSI

Hypoalbuminemia	SSI		Total	p-value
	Yes	No		
Yes	31 (33.7%)	61(66.3%)	92 (61.4%)	0.021 Significant
No	10(17.4%)	48(82.6%)	58 (38.6)	
	42	108	150	

Table 4: Association of serum cholesterol levels with SSI

Total Cholesterol Levels (mg%)	N (%)	SSI		%	P value
		Yes	No		
<100	30(20%)	9(30%)	21(70%)	20.00%	0.162 Non-significant
100-200	99	27(27.7%)	72(72.3%)	66.00%	
>200	21	6(28.5%)	15(71.5%)	14.00%	
Total	150	42	108	100.00%	

Discussion

Surgical site infections account for third most frequent hospital acquired infection, responsible for 14%-16% of infections among hospitalized patients & 38% of infections in patients undergoing surgery. Its occurrence leads to increased number of days of hospitalization with a significant mental, physical & financial impact. It not only hampers the quality of life of the patient but also poses a burden on the healthcare system.[8]

Risk factors for SSI include patient-related factors (old age, nutritional status, pre-existing infection, and comorbid illness) and procedure-related factors (suture material, suboptimal surgical technique, prolonged duration of surgery, pre-operative part preparation, and insufficient sterilization of surgical instruments).[9] Chien J-Y 2005 reported low serum albumin level and low cholesterol level in surgical site infection to be a risk factor for increased hospitalization & mortality in patient who underwent elective surgery.[10]

In the present study, mean age of the patients undergoing elective surgeries was 41.2 yrs. Out of total 150 patients, 55.7% were males & 44.3% were females. Out of a total of 150 patients, SSI was observed in 42 (28%) & Hypoalbuminemia in 92 (61.4%) patients. Incidence of SSI was statistically significant higher in patients with Hypoalbuminemia (33.7%) as compared to patients with normal albumin levels (17.4%) (p-value 0.021) (Table 3). Accordingly, the rates of SSI reported by various studies are 23% by Giri S et al [11], 22% by Khadilkar R et al [12] study. Tevlin R et al reported SSI rate to be 24.7% with 8.6% superficial and 16.1% organ space SSI.[13] Nwankwo E et al studied 2880 patients 585 (20.3%) developed SSI.[14]

Serum albumin levels directly correlate with the nutrition status of an individual & act as a reliable predictor of surgical complications. Malnourished patients are at a greater risk to suffer from complications & mortality than those who have adequate nutritional reserves.[15] is also a negative acute phase protein.[16] In Singh et al study, ROC curve analysis showed that only albumin levels significantly predicted development of SSI (p<0.01). [7] Nowshad M et al studied found an association between the preoperative levels of albumin with postoperative surgical site infection. Hypoalbuminemia was noted to be present in 33% of the patients & associated with SSI at relative risk of 1.98.[17] Sodavadiya KB et al observed that 44.6% patients developed SSI in hypoalbuminemia. The Relative Risk between hypoalbuminemia and SSI was observed to be 4.17 (p <0.001).[5]

In the present study, Mean serum cholesterol levels observed no statistically significantly difference in patients with SSI (157.53±66.36) and without SSI (158.29±55.81) (p 0.68). (Table 2) No statistically significant difference observed between incidence of surgical site infections among <100mg%, 100-200mg % & >200mg % serum cholesterol levels (p 0.162).

Accordingly, in Singh et al study, mean cholesterol levels were comparable in patients with and without SSI. Incidence of SSI was higher (36.4%) in patients with low cholesterol levels, as compared to normal (33.3%) & high cholesterol levels(22.2%) with no statistically significant difference (p-0.134). [7]

Delgado-Rodríguez M et al, study showed HDL-C, and LDL-C levels to have an independent, significant & inverse relationships with days of hospitalisation & incidence of nosocomial infections. [18] Nowshad M et al study studied whether there is an association between the preoperative levels of cholesterol with postoperative surgical site infection. Only 1% patients with high cholesterol levels developed SSI. [17] In contrast, Sodavadiya KB et al, observed a significant positive correlation between low cholesterol levels & SSI.[5]

Cholesterol has an important role to play in gluconeogenesis and immune function. Non conclusive evidence has supported the fact that low total serum

cholesterol may contribute to the development of infections. This may be attributed to the fact that circulating cholesterol-rich lipoproteins and triglyceride-rich lipoproteins act as transport vehicles not only for -soluble vitamins, antioxidants, drugs, and toxins but they also act as binders & detoxifiers for bacterial lipopolysaccharide (LPS). High density lipoprotein (HDL) competes with LPS binding protein (LBP) for binding to LPS. This LPS-LBP complex attaches to the CD-14 receptor on cells, which, in turn, stimulates TNF production, IL-1, and IL-6, helping in counteracting infections.[6]

Mean duration of hospitalisation was statistically significantly higher in patients who developed SSI (17.23 vs 8.01days) ($p<0.01$). Similarly, Singh et al study 2023, reported mean hospitalization days to be significantly higher in patients with SSI (18.11 vs 7.99 days; $p<0.01$). [7] Similar, results were noted by Malik AZ et al. Long-term hospitalization predisposes the patients to resistant microorganisms influencing the host resistance & vulnerability to other infections.[19]

Conclusion

Thus the present study summarizes serum albumin levels to a reliable predictor for determining the development of surgical site infections .It should be evaluated prior to surgery & adequately corrected to diminish the morbidity & complications. Also, total cholesterol levels were not found to be significantly decreased in patients who developed surgical site infections. But its levels should be assessed preoperatively to predict cardiovascular diseases & associated morbidities.

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