The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 6, 2025

COMPARISON OF SERUM CHOLESTEROL LEVELS IN PATIENTS WITH AND WITHOUT SURGICAL SITE INFECTION AFTER ELECTIVE SURGERY

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DOI: https://doi.org/10.5281/zenodo.17205045

Keywords
Cholesterol, Serum, Surgical Wound Infection, Elective Surgical Procedures, Postoperative Complications, Risk Factors.

Article History
Received on 26 June 2025
Accepted on 28 June 2025
Published on 30 June 2025

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Abstract

Background: *Surgical site infections complicate elective surgeries and increase healthcare burdens. Cholesterol impacts immune response and healing but studies show conflicting findings. This study investigates serum cholesterol differences in patients with and without infections in the local population.*

Objectives: *To compare mean serum cholesterol level in patients with and without SSI after elective surgery.*

Duration: *Three months w.e.f 24-03-2025 to 23-06-2025*

Methodology: *After ethical approval, 100 elective surgery patients meeting inclusion criteria were enrolled with consent. Preoperative serum cholesterol was measured. Standard surgical protocols and antibiotics were followed. On day 10, SSI was assessed. Patients were grouped accordingly, with data collected uniformly to minimize bias and control confounding variables.*

Results: *A total of 100 patients undergoing elective general surgery were included. There was no significant baseline difference between patients with and without surgical site infection. Serum cholesterol was significantly lower in infected patients across all subgroups including age, gender, BMI and type of surgery ($p = 0.000$).*

Conclusion: *A total of 100 patients undergoing elective general surgery were included. There was no significant baseline difference between patients with and without surgical site infection. Serum cholesterol was significantly lower in infected patients across all subgroups including age, gender, BMI and type of surgery ($p = 0.000$).*

INTRODUCTION

A surgical site infection (SSI) is defined as an infection occurring at the site of a surgical incision; typically presenting with local symptoms such as redness, discharge, or swelling, and in severe cases;

systemic signs like fever or elevated white blood cell count.[1] SSIs represent a major portion of hospital-acquired infections, accounting for approximately 20% to 39% of all nosocomial infections.[2] Although the timing could vary, most SSIs appear between the 5th and 10th postoperative days.[2] The incidence of SSIs varies across regions: between 2%–5% in the United States, 2%–10% in Europe, and 4%–6% in China.[3] In contrast, data from Pakistan reported an alarmingly high frequency of 33.68%.[4]

Patients undergoing complex or lengthy surgeries are at a greater risk of developing SSIs, which significantly prolongs hospital stays and increases the overall physical, psychological and financial burden on affected individuals.[3,4] Several risk factors contribute to the development of SSIs, including both patient-specific factors (such as obesity, smoking, diabetes, and age) as well as procedure-related elements (including type of incision, use of laparoscopy or presence of a stoma). Recent studies also emphasize that different types of SSIs might have varying risk profiles, indicating the need for tailored prevention strategies.[5]

Cholesterol plays a vital role in human physiology as a precursor to steroid hormones and a structural component in cell membranes[6]. It also supports various metabolic and immune functions, including gluconeogenesis and transport of fat-soluble vitamins and drugs[7]. Steroidogenic tissues depend on cholesterol not only for hormone synthesis but also for membrane fluidity and cell signaling.[6,7] Given these functions, researchers began exploring its role in immune competence and its potential link to infections such as SSIs.[7]

One study by Sucheta et al. (2024) in India reported a significant difference in mean serum cholesterol levels between patients with and without SSIs. Patients with SSIs had a mean level of 139.87 ± 49.48 mg/dl, while those without had a level of 181.95 ± 39.7 mg/dl (p = 0.001), indicating that lower cholesterol levels may be linked to higher SSI risk.[8] Based on these findings, the authors recommended that serum cholesterol levels be routinely assessed preoperatively and interventions such as dietary changes or medications be considered to optimize cholesterol before surgery to potentially reduce the risk of SSIs. However, opposing evidence also exists. A study by Singh et al. (2023) conducted in India reported no significant difference in serum cholesterol levels between patients with and without SSIs. Their findings show mean levels of 155.57 ± 67.44 mg/dl in patients with SSIs and 156.18 ± 52.97 mg/dl in those without (p = 0.94), challenging the idea of a consistent link.[9] These contradictory findings reflect a lack of consensus in the current literature regarding cholesterol's role in SSI development.[8,9]

Due to this ongoing controversy and the limited data available in the local population, the present study was conducted to compare serum cholesterol levels in patients with and without surgical site infections following elective surgery. The aim was to clarify whether a meaningful relationship existed in the local context, which could influence future preoperative planning and SSI prevention strategies.

METHODOLOGY

This study was a comparison cross-sectional study conducted in the Department of General Surgery, Pakistan Atomic Energy Commission (PAEC) / General Hospital, Islamabad. The duration of the study was three months after the approval of the synopsis. Using the WHO sample size calculator, a total sample size of 100 patients (50 in each group) undergoing elective surgery was calculated by taking the expected mean serum cholesterol level to be 139.87 ± 49.48 in patients with surgical site infection and 181.95 ± 39.7 in patients without surgical site infection.[8] Group I included patients with surgical site infection while group II included patients without surgical site infection. Non-probability consecutive sampling was done. The sample selection was based on inclusion and exclusion criteria. The inclusion criteria included all patients of both genders undergoing elective surgery in the Department of General Surgery with age between 18–60 years. The exclusion criteria included pregnant women, patients with diabetes mellitus as per record, patients with immunocompromised states like HIV positive or those on corticosteroids as per record, pre-existing conditions like active liver, thyroid or renal disease affecting cholesterol and current antibiotic use for unrelated infections within the last 30 days. Elective surgery was defined as a surgical procedure performed as scheduled in advance and not in emergency; including various types such as hernia surgery, appendectomy, colorectal surgery and

cholecystectomy. Serum cholesterol was defined as the concentration of total cholesterol in the blood measured in milligrams per deciliter (mg/dL) by taking a blood sample and presented as mean ± SD. Surgical site infection was labelled clinically by a consultant within 10 days after surgery if any of the following criteria were met: redness around the wound, serosanguinous discharge or fever greater than 100°F. After approval from the hospital's Ethical Review Board, 100 patients undergoing elective surgery at the Department of General Surgery, Pakistan Atomic Energy Commission (PAEC) / General Hospital, Islamabad who met the inclusion criteria were enrolled in the study after taking informed written consent. Their demographics were recorded. Before surgery, a blood sample of approximately 5 mL was taken to measure serum cholesterol levels and sent to the hospital's laboratory. All the patients underwent their surgical procedures as per the hospital's standard protocol and were discharged accordingly. The antibiotic regimen included intravenous Ceftriaxone (1–2 grams) on the day of surgery, followed by continued use for 3–5 days post-surgery or as deemed appropriate on a case-by-case basis. The patients were requested to make a follow-up visit on the 10th day after surgery. Then, a senior consultant inspected the surgical site and labelled surgical site infection as per the operational definition. Two groups were then assimilated for further data analysis: Group I (patients with surgical site infection) and Group II (patients without surgical site infection). All findings were given by a single senior consultant, all the lab tests were conducted by a single hospital laboratory, and all the findings were recorded by the resident herself to avoid bias in the results. Confounding variables were controlled through exclusion. All the collected data were entered and analyzed using SPSS version 26. Numerical variables such as age, BMI, and serum cholesterol level were presented as mean ± SD. Categorical variables such as gender and elective surgical procedures were presented as frequency and percentage. Mean serum cholesterol levels between the groups were compared using an independent sample t-test, taking a p-value ≤0.05 as significant. Comparison of mean serum cholesterol levels between the groups was stratified for age, gender, BMI, and elective surgical procedure to address effect modifiers. Post-stratification, the independent sample t-test was applied, taking a p-value ≤0.05 as significant.

RESULTS

A total of 100 patients undergoing elective general surgical procedures were included in the study. The mean age of the patients was 39.86 ± 12.07 years, with 46% in the 18–40 years age group and 54% in the 41–60 years group. Among the participants, 60% were male and 40% were female. The mean BMI was 25.34 ± 3.50 kg/m², with 39% of the individuals having a normal weight, while 61% were classified as overweight or obese. Regarding the type of elective general procedures performed, 15% of patients underwent hernia surgery, 33% had appendectomy, 20% underwent colorectal surgery, and 32% had cholecystectomy. Data is given in Table 1.0. There was no significant difference between Group A and Group B at baseline (p-value>0.05). Demonstrating no significant difference between Group A and Group B at baseline strengthens the internal validity of the study. Data is given in table 2.0. The mean serum cholesterol level was significantly lower in Group A (148.84 ± 8.81 mg/dl) compared to Group B (168.62 ± 10.29 mg/dl), with a p-value of 0.000, indicating a statistically significant difference between the two groups. Data is given in table 3.0. Stratified analysis showed that mean serum cholesterol levels were significantly lower in Group A than Group B across all subgroups (p = 0.000). Both age groups, 18–40 and 41–60 years, had lower levels in Group A (147.71 ± 8.64 vs. 169.09 ± 11.28 mg/dl and 149.88 ± 8.81 vs. 168.25 ± 9.63 mg/dl). This was consistent in males (148.39 ± 7.57 vs. 167.34 ± 10.25 mg/dl) and females (149.41 ± 10.35 vs. 170.89 ± 10.24 mg/dl), as well as normal weight (148.19 ± 8.24 vs. 170.67 ± 8.94 mg/dl) and overweight/obese groups (149.31 ± 9.32 vs. 167.47 ± 10.94 mg/dl). All elective surgeries showed lower cholesterol in Group A, notably hernia surgery (146.00 ± 6.40 vs. 176.17 ± 5.64 mg/dl) and cholecystectomy (148.12 ± 9.12 vs. 169.00 ± 12.52 mg/dl). Data is given in Table 4.0.

Table 1.0: Demographic Characteristics of Patients Undergoing Elective Surgical Procedure

Characteristics	Total (n=100)
Age (years)	39.86±12.07
• 18-40 years	46 (46.0%)
• 41-60 years	54 (54.0%)
Gender	
• Male	60 (60.0%)
• Female	40 (40.0%)
BMI (kg/m^2)	25.34±3.50
• Normal Weight	39 (39.0%)
• Overweight / Obese	61 (61.0%)
Elective General Procedure	
• Hernia Surgery	15 (15.0%)
• Appendectomy	33 (33.0%)
• Colorectal Surgery	20 (20.0%)
• Cholecystectomy	32 (32.0%)

Table 2.0: Comparison of Baseline Characteristics between the Study Groups

Characteristics	Group A (n=50)	Group B (n=50)	p-value
Age (years)	39.86±12.07	39.86±12.07	
• 18-40 years	24 (48.0%)	22 (44.0%)	0.688
• 41-60 years	26 (52.0%)	28 (56.0%)	
Gender			
• Male	28 (56.0%)	32 (64.0%)	0.414
• Female	22 (44.0%)	18 (36.0%)	
BMI (kg/m^2)	25.34±3.50	25.34±3.50	
• Normal Weight	21 (42.0%)	18 (36.0%)	0.539
• Overweight / Obese	29 (58.0%)	32 (64.0%)	
Elective General Procedure			
• Hernia Surgery	9 (18.0%)	6 (12.0%)	0.686
• Appendectomy	14 (28.0%)	19 (38.0%)	
• Colorectal Surgery	10 (20.0%)	10 (20.0%)	
• Cholecystectomy	17 (34.0%)	15 (30.0%)	

Chi Square test/ Independent sample t test, taking p-value≤0.05 as significant.

Table 3.0: Comparison of Study Outcomes between the Groups

Characteristics	Group A (n=50)	Group B (n=50)	p-value
Serum Cholesterol Level (mg/dl)	148.84±8.81	168.62±10.29	0.000

Independent sample t test, taking p-value≤0.05 as significant.

Table 4 .0: Stratification of Mean Cholesterol Level between the Groups for Various Sub Groups.

Characteristics	Group A (50)	Group B (n=50)	p-value
Age (years)			

• 18-40 years	147.71±8.64	169.09±11.28	0.000
• 41-60 years	149.88±8.81	168.25±9.63	0.000
Gender			
• Male	148.39±7.57	167.34±10.25	0.000
• Female	149.41±10.35	170.89±10.24	0.000
BMI (kg/m^2)			
• Normal Weight	148.19±8.24	170.67±8.94	0.000
• Overweight / Obese	149.31±9.32	167.47±10.94	0.000
Elective General Procedure			
• Hernia Surgery	146.00±6.40	176.17±5.64	0.000
• Appendectomy	151.57±10.60	168.79±9.78	0.000
• Colorectal Surgery	148.80±7.48	163.20±7.24	0.000
• Cholecystectomy	148.12±9.12	169.00±12.52	0.000

Independent sample t test, taking p-value≤0.05 as significant.

DISCUSSION

Surgical site infections (SSI) remain a significant complication after elective surgery, leading to increased morbidity and healthcare costs.[10] Emerging evidence suggests that serum cholesterol levels may influence the body's immune response and wound healing, potentially affecting SSI risk.[11,12] However, existing literature shows conflicting results regarding the relationship between cholesterol and postoperative infections.[8,9] Some studies report low cholesterol as a risk factor, while others find no clear link. Due to this controversy and lack of data in the local population, this study was conducted to compare serum cholesterol levels in patients with and without SSI following elective surgery, aiming to clarify this connection locally.

In this study, a total of 100 patients undergoing elective general surgery were included. The mean age was 39.86 ± 12.07 years, with 46% aged 18–40 and 54% aged 41–60. Sixty percent were male, and the mean BMI was 25.34 ± 3.50 kg/m², with 61% overweight/obese. Procedures included hernia surgery (15%), appendectomy (33%), colorectal surgery (20%), and cholecystectomy (32%). There were no significant baseline differences between groups ($p > 0.05$). Group A showed significantly lower mean serum cholesterol (148.84 ± 8.81 mg/dl) than Group B (168.62 ± 10.29 mg/dl, $p = 0.000$), consistent across all subgroups.

The findings of the present study were compared with those of previous research to evaluate the consistency and variability in the role of serum cholesterol levels in surgical site infections (SSI). Sucheta et al., in a study conducted in India, reported a significantly lower mean serum cholesterol level in patients with SSIs (139.87 ± 49.48 mg/dL) compared to those without SSIs (181.95 ± 39.7 mg/dL), suggesting a potential link between hypocholesterolemia and the development of SSIs.[8] This observation supports the findings of the current study, which also demonstrated significantly lower serum cholesterol levels in patients who developed SSIs. These results strengthen the hypothesis that low preoperative cholesterol may be a contributing factor to increased susceptibility to postoperative wound infections.

In another study, Manjunath et al. emphasized that hypocholesterolemia remains a frequently overlooked risk factor, particularly in malnourished populations presenting at government hospitals. They advocated for greater clinical attention to cholesterol levels, highlighting that its management could lead to a meaningful reduction in preventable complications like SSI. This further aligns with the current study's premise that serum cholesterol levels may have clinical relevance in surgical outcomes and preoperative assessment.[13]

On the contrary, Paliwal et al. reported no statistically significant difference in mean cholesterol levels between patients with and without SSIs (157.53 ± 66.36 mg/dL vs. 158.29 ± 55.81 mg/dL; $p = 0.68$). Their study concluded that there was no

significant relationship between cholesterol levels and SSI incidence ($p = 0.162$), contradicting the findings observed in the current investigation. Similarly, Singh et al. analyzed 200 patients and found that although serum albumin levels were significantly lower in SSI cases ($p < 0.01$), the mean cholesterol levels did not show a significant difference ($p = 0.94$). Their study highlighted albumin as a stronger prognostic indicator than cholesterol and recommended its routine assessment in preoperative evaluations, whereas cholesterol did not emerge as a statistically significant marker.[14]

In another notable study, Sodavadiya et al. identified a significant correlation between low serum cholesterol and the occurrence of SSIs. Among 248 patients, those with SSIs were predominantly hypocholesterolemic, and the relative risk was statistically significant (RR = 3.98, CI: 2.28–6.95, $p < 0.001$). These results are consistent with the present study, reinforcing the hypothesis that hypocholesterolemia may act as a potential risk factor in SSI development.[15]

Wani et al. found that reduced levels of albumin and total cholesterol were linked to a higher likelihood of developing surgical site infections. Additionally, lower HDL-C levels were also related to an increased risk of SSIs. The study suggested that these modifiable factors could be addressed to help reduce postoperative complications.[16]

Additionally, Arora et al. studied 107 surgical cases and observed SSIs in 21.5% of patients. Although there was no statistically significant difference in preoperative or postoperative total cholesterol levels between patients with and without SSIs ($p = 0.585$ and $p = 0.778$, respectively), they found a strong association between low HDL levels and the development of SSIs ($p < 0.001$). The authors concluded that while total cholesterol levels may not directly predict SSI risk, HDL cholesterol may serve as a more reliable prognostic marker.[17]

CONCLUSION

Patients with surgical site infections after elective surgery had consistently lower serum cholesterol levels than those without infections. This suggests a potential link between low cholesterol and increased infection risk. Monitoring cholesterol may help identify high-risk patients and guide preventive strategies to improve postoperative outcomes.

LIMITATIONS & RECOMMENDATIONS

This study's strengths include a focused comparison of serum cholesterol in SSI and non-SSI patients using consistent methodology and subgroup analysis. Limitations involve its single-center design and modest sample size, which may affect generalizability. Future research should involve multicenter trials with larger cohorts to validate these findings and explore cholesterol optimization as a preventive strategy against surgical site infections. Broader biochemical profiling, including HDL and albumin, may also enhance predictive accuracy in preoperative risk assessment.

Conflict of Interest: None
Source of Funding: None

Authors Contribution

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Substantial contributions to study design, acquisition of data
Analysis & Interpretation of Data, Manuscript writing
Has given final approval of the version to be published
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