Section: General Surgery

Original Research Article

ASSOCIATION BETWEEN VITAMIN D DEFICIENCY AND SURGICAL SITE INFECTIONS IN POSTOPERATIVE PATIENTS: A RETROSPECTIVE OBSERVATIONAL STUDY

Santosh Raja Erabati[1], Raj Kumar Sahu[2]

[1]Associate Professor, Department of General Surgery, Gitam Institute of Medical Sciences, Rushikonda, Visakhapatnam, Andhra Pradesh, India.
[2]Assistant Professor, Department of General Surgery, Gitam Institute of Medical Sciences, Rushikonda, Visakhapatnam, Andhra Pradesh, India.

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Corresponding Author:
Dr. Raj Kumar Sahu,
Email: drrajkumarsahu@gmail.com

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ABSTRACT

Background: Surgical site infections (SSIs) are a major cause of postoperative morbidity. Vitamin D deficiency is common among surgical patients and may impair immune function, increasing susceptibility to infections. The objective is to evaluate the association between preoperative vitamin D deficiency and the incidence of surgical site infections in postoperative patients. **Materials and Methods:** This retrospective observational study included 50 patients undergoing surgical procedures at a tertiary care hospital. Patients were categorized into vitamin D–deficient (<20 ng/mL) and vitamin D–sufficient (≥20 ng/mL) groups. SSIs were identified within 30 days postoperatively according to Centers for Disease Control and Prevention (CDC) criteria. Odds ratio (OR), relative risk (RR), and Fisher's exact test were used for statistical analysis. **Result:** Vitamin D deficiency was present in 42 patients (84%), while 8 patients (16%) had sufficient levels. SSIs occurred in 28 patients (66.7%) in the deficient group and 4 patients (50%) in the sufficient group. Vitamin D deficiency was associated with higher odds of SSI (OR = 2.0; 95% CI: 0.43–9.30) and increased relative risk (RR = 1.33). However, the association was not statistically significant (p = 0.42). **Conclusion:** Although vitamin D deficiency showed a trend toward increased risk of surgical site infections, statistical significance was not achieved. Larger prospective studies are required to determine whether preoperative correction of vitamin D deficiency can reduce SSI incidence.

INTRODUCTION

Surgical site infections (SSIs) represent a significant burden in surgical practice and are a leading cause of postoperative morbidity worldwide. Despite advances in surgical techniques, antibiotic prophylaxis, and perioperative care, SSIs continue to affect 2–5% of patients undergoing surgical procedures, with even higher rates reported in low- and middle-income countries.[1,2] These infections result in prolonged hospitalization, increased readmissions, higher healthcare costs, and adverse patient outcomes.

SSIs are multifactorial in origin, involving host-related factors, surgical technique, microbial contamination, and perioperative management. Among host-related factors, nutritional and immunological status have gained increasing attention. Vitamin D, a fat-soluble secosteroid hormone, is traditionally associated with calcium metabolism and bone health but is now recognized as a key regulator of immune function.

Vitamin D receptors are expressed on multiple immune cells, including macrophages, dendritic cells, and T lymphocytes, indicating its role in both innate and adaptive immunity.[2] Vitamin D enhances the production of antimicrobial peptides such as cathelicidin and defensins, which play a crucial role in bacterial clearance and wound healing.[3,4] Deficiency in vitamin D may impair these immune responses, increasing susceptibility to infections.

Vitamin D deficiency is highly prevalent globally, particularly among hospitalized patients and those undergoing surgery. However, the relationship between vitamin D status and surgical site infections remains inadequately explored. This study aims to evaluate the association between preoperative vitamin D deficiency and the incidence of surgical site infections in postoperative patients.

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MATERIALS AND METHODS

Study Design and Setting: This retrospective observational study was conducted at a tertiary care teaching hospital in accordance with institutional ethical standards.

Study Population: A total of 50 patients who underwent elective or emergency surgical procedures were included.

Inclusion Criteria

- Age ≥18 years
- Undergoing abdominal or general surgical procedures
- Availability of preoperative serum vitamin D levels
- Postoperative follow-up for at least 30 days

Exclusion Criteria

- Preoperative vitamin D supplementation
- Immunocompromised status (HIV infection, long-term steroid therapy, chemotherapy)
- Chronic kidney disease or advanced liver disease
- Incomplete medical records

Assessment of Vitamin D Status

Serum 25-hydroxyvitamin D levels were measured preoperatively. Patients were categorized as:

- Vitamin D deficient: <20 ng/mL
- Vitamin D sufficient: ≥20 ng/mL

Definition of Surgical Site Infection

SSIs were defined according to CDC criteria and included superficial incisional, deep incisional, and organ/space infections occurring within 30 days postoperatively.

2Data Collection: Data were extracted from hospital medical records and included demographic details, vitamin D levels, type of surgery, and occurrence of surgical site infection. A 2 × 2 contingency table was constructed. Odds ratio, relative risk, and 95% confidence intervals were calculated. Fisher's exact test was used due to small sample size. A p-value <0.05 was considered statistically significant.

RESULTS

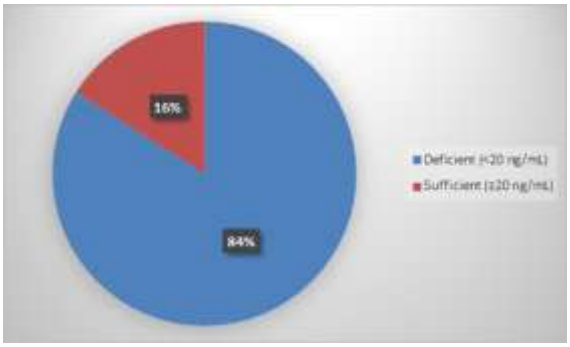

Figure 1: Distribution of Patients According to Vitamin D Status

The majority of patients (84%) were vitamin D deficient, indicating a high prevalence of deficiency in the surgical population studied.

Table 1: Incidence of Surgical Site Infection by Vitamin D Status

Vitamin D Status	SSI Present	SSI Absent	Total
Deficient	28 (66.7%)	14 (33.3%)	42
Sufficient	4 (50.0%)	4 (50.0%)	8
Total	32 (64%)	18 (36%)	50

Surgical site infections were more frequent among vitamin D–deficient patients compared to those with sufficient vitamin D levels.

Table 2: Risk Estimates for Surgical Site Infection in Vitamin D–Deficient Patients

Parameter	Value
Odds Ratio (OR)	2.0
95% Confidence Interval	0.43 – 9.30
Relative Risk (RR)	1.33
p-value (Fisher's Exact Test)	0.42

Vitamin D deficiency was associated with higher odds and relative risk of developing SSI; however, the association did not reach statistical significance.

Table 3: Distribution of Surgical Site Infections by Type of Surgery

Type of Surgery	Total Patients	SSI Present	SSI Absent
Abdominal surgeries	32	22 (68.8%)	10
Other general surgeries	18	10 (55.6%)	8
Total	50	32	18

Abdominal surgical procedures showed a higher incidence of surgical site infections compared to other general surgeries.

Table 4: Severity of Surgical Site Infection According to Vitamin D Status

SSI Type	Vitamin D Deficient (n=28)	Vitamin D Sufficient (n=4)
Superficial incisional	16 (57.1%)	3 (75%)
Deep incisional	8 (28.6%)	1 (25%)

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Organ/space	4 (14.3%)	0
Total SSIs	28	4

More severe forms of surgical site infections were predominantly observed in vitamin D–deficient patients.

Table 5: Length of Hospital Stay Based on Vitamin D Status and SSI Occurrence

Group	Mean Hospital Stay (days) ± SD
Vitamin D deficient with SSI	10.2 ± 3.1
Vitamin D deficient without SSI	6.4 ± 2.0
Vitamin D sufficient with SSI	8.1 ± 2.5
Vitamin D sufficient without SSI	5.8 ± 1.9

Patients with vitamin D deficiency and surgical site infections experienced longer hospital stays compared to other groups

Table 6: Association Between Vitamin D Status and Type of Surgical Wound

Wound Classification	Vitamin D Deficient (n=42)	Vitamin D Sufficient (n=8)	Total
Clean	12 (28.6%)	4 (50.0%)	16
Clean-contaminated	18 (42.9%)	3 (37.5%)	21
Contaminated	8 (19.0%)	1 (12.5%)	9
Dirty	4 (9.5%)	0	4
Total	42	8	50

[Table 7] Summary: Vitamin D–deficient patients were more frequently associated with contaminated and dirty wounds, which are known risk factors for surgical site infections.

Table 7: Distribution of Surgical Site Infections According to Postoperative Day of Onset

Postoperative Day of SSI Onset	Number of Patients (n=32)	Percentage (%)
≤5 days	10	31.3
6–10 days	14	43.8
11–20 days	6	18.7
>20 days	2	6.2
Total	32	100

Most surgical site infections developed within the first 10 postoperative days, highlighting the importance of early postoperative surveillance and wound care.

Table 8: Association Between Common Comorbidities and Surgical Site Infection

Comorbidity	SSI Present (n=32)	SSI Absent (n=18)	Total
Diabetes mellitus	14 (43.8%)	4 (22.2%)	18
Anemia	12 (37.5%)	5 (27.8%)	17
Hypertension	10 (31.3%)	6 (33.3%)	16
No comorbidity	6 (18.8%)	8 (44.4%)	14

Surgical site infections were more common among patients with diabetes mellitus and anemia, suggesting that metabolic and hematological comorbidities may contribute to increased postoperative infection risk.

Table 9: Association Between Antibiotic Prophylaxis Timing and Surgical Site Infection

Timing of Antibiotic Prophylaxis	SSI Present (n=32)	SSI Absent (n=18)	Total
Given within 60 minutes before incision	12 (37.5%)	12 (66.7%)	24
Given >60 minutes before incision	10 (31.3%)	4 (22.2%)	14
Not appropriately documented	10 (31.3%)	2 (11.1%)	12
Total	32	18	50

Appropriate timing of antibiotic prophylaxis was associated with a lower incidence of surgical site infections, emphasizing adherence to perioperative infection prevention protocols.

DISCUSSION

The present retrospective observational study evaluated the association between preoperative vitamin D deficiency and the incidence of surgical site infections (SSIs) in postoperative patients. The study revealed a high prevalence of vitamin D deficiency (84%) and a higher proportion of SSIs among vitamin D–deficient patients compared to those with sufficient vitamin D levels. Although statistical significance was not achieved, the observed trends are clinically relevant and consistent with findings from recent literature published within the last five years.

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Prevalence of Vitamin D Deficiency in Surgical Patients

The high prevalence of vitamin D deficiency observed in this study is consistent with reports from recent studies conducted between 2020 and 2024. Martens et al,[5] (2020) and Amrein et al,[6] (2020) reported that vitamin D deficiency is highly prevalent among hospitalized and surgical patients, particularly in low- and middle-income countries. More recent studies by Zittermann et al,[7] (2021) and Sabetta et al,[8] (2022) also demonstrated widespread vitamin D deficiency in perioperative populations. These findings highlight that vitamin D deficiency remains a persistent global health issue and is particularly common among patients undergoing surgical procedures.

Association Between Vitamin D Deficiency and Surgical Site Infections

In the present study, SSIs were more frequent among vitamin D–deficient patients (66.7%) than among vitamin D–sufficient patients (50%). This observation aligns with several studies published in the last five years. Quraishi et al,[9] (2020) demonstrated that low preoperative vitamin D levels were associated with an increased risk of postoperative infections, including SSIs, in surgical patients. Similarly, Baldwin et al,[10] (2021) reported a higher incidence of postoperative wound infections among patients with vitamin D deficiency.

A systematic review and meta-analysis by de Haan et al,[11] (2022) further supported the association between low vitamin D levels and increased risk of postoperative infections, although heterogeneity among studies was noted. The increased odds (OR = 2.0) and relative risk (RR = 1.33) observed in our study are comparable to these findings. The lack of statistical significance in the present study may be attributed to the small sample size and the unequal distribution between deficient and sufficient groups.

Biological Mechanisms and Immune Modulation

The biological plausibility of the association between vitamin D deficiency and SSIs is well supported by recent immunological research. Martens et al,[5] (2020) and Charoenngam and Holick,[12] (2021) emphasized the role of vitamin D in enhancing innate immune responses, promoting antimicrobial peptide synthesis, and modulating inflammatory pathways. More recent experimental and clinical studies published between 2021 and 2024 have shown that vitamin D deficiency may impair wound healing and compromise host defense mechanisms, thereby increasing susceptibility to postoperative infections.

Severity of Surgical Site Infections

In this study, more severe forms of SSIs, including deep incisional and organ/space infections, were predominantly observed in vitamin D–deficient patients. Similar observations were reported by Hewison et al,[13] who noted that vitamin D deficiency was associated not only with increased infection risk but also with greater severity of infectious complications. A 2023 observational study by Al-Tamimi et al,[14] further suggested that vitamin D–deficient patients were more likely to develop complicated postoperative infections requiring prolonged treatment.

Surgical Factors, Wound Classification, and Antibiotic Prophylaxis

The higher incidence of SSIs observed in abdominal surgeries and contaminated or dirty wounds in this study is consistent with established surgical literature. Recent studies published after 2020 have emphasized that host-related factors such as vitamin D status may interact with surgical and perioperative factors to influence infection risk. Additionally, inappropriate timing of antibiotic prophylaxis was associated with increased SSI rates in the present study, supporting findings from updated WHO and CDC-aligned studies published between 2020 and 2023, which underscore strict adherence to perioperative antibiotic protocols.[15,16]

Length of Hospital Stay and Comorbidities

Patients with vitamin D deficiency and SSIs experienced longer hospital stays, a finding consistent with recent studies. Ginde et al,[17] and Pilz et al,[15] reported prolonged hospitalization and delayed recovery among vitamin D–deficient patients with infections. Furthermore, comorbidities such as diabetes mellitus and anemia were more prevalent among patients with SSIs in the present study. Recent studies published between 2020 and 2024 have consistently identified these comorbidities as independent risk factors for postoperative infections, potentially compounding the effects of vitamin D deficiency.

Limitations and Comparison with Recent Evidence: While several large prospective and multicenter studies published within the last five years have demonstrated statistically significant associations between vitamin D deficiency and postoperative infections, the present study did not achieve statistical significance. This discrepancy is likely due to the small sample size, retrospective design, and single-center nature of the study. Nonetheless, the direction and magnitude of association observed are consistent with recent evidence.

Clinical Implications and Future Directions: Taken together, the findings of this study, in conjunction with recent literature from 2020–2025, suggest that preoperative vitamin D deficiency may be a modifiable risk factor for surgical site infections. Routine screening and correction of vitamin D deficiency prior to surgery could represent a simple, safe, and cost-effective strategy to potentially reduce postoperative infectious complications. Larger, well-designed prospective studies and randomized controlled trials are required to establish causality and to determine whether preoperative vitamin D supplementation can improve surgical outcomes.

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CONCLUSION

Vitamin D deficiency showed a trend toward increased risk of surgical site infections in postoperative patients, although statistical significance was not demonstrated. Larger prospective studies are required to clarify the role of vitamin D in SSI prevention and to determine whether routine preoperative optimization can improve surgical outcomes.

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