Section: General Surgery

Original Research Article

PROGNOSTIC NUTRITIONAL INDEX AND SERUM VITAMIN D LEVEL AS A PREDICTOR OF MORBIDITY AND MORTALITY IN ELECTIVE ABDOMINAL SURGERIES

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ABSTRACT

Background: Postoperative morbidity and mortality remain significant challenges in abdominal surgeries. Identifying simple, cost-effective preoperative predictors is crucial for improving patient outcomes. The Prognostic Nutritional Index (PNI) and serum vitamin D levels have individually shown promise in risk stratification but are not widely implemented in combined evaluation. **Objectives:** To assess the association between PNI and serum vitamin D levels with postoperative morbidity and mortality in patients undergoing elective abdominal surgeries, and to evaluate their combined predictive value.

Materials and Methods: A prospective observational study was conducted on 50 adult patients undergoing elective abdominal surgeries in a tertiary care center. PNI was calculated using the formula: > PNI = (10 × serum albumin \[g/dL]) + (0.005 × total lymphocyte count \[/mm³]). Serum vitamin D (25(OH)D) was measured preoperatively. Patients were categorized based on PNI (<45 or ≥45) and vitamin D levels (<20 ng/mL or ≥20 ng/mL). Postoperative outcomes including morbidity (surgical site infections, ileus, anastomotic leak, etc.) and mortality (within 30 days) were recorded.

Results: Low PNI (<45) was found in 22 patients (44%) and associated with 36.4% morbidity and 9.1% mortality. Vitamin D deficiency (<20 ng/mL) was seen in 26 patients (52%) and associated with 34.6% morbidity and 7.7% mortality. Patients with both low PNI and low vitamin D had the highest complication rate (50%) and mortality (16.7%).Significant inverse correlations were observed between both PNI ($r = –0.44$, $p = 0.002$) and vitamin D ($r = –0.39$, $p = 0.006$) with morbidity. Multivariate logistic regression identified low PNI (OR 3.4, $p = 0.032$) and vitamin D deficiency (OR 2.8, $p = 0.049$) as independent predictors of morbidity.

Conclusion: Both Prognostic Nutritional Index and serum vitamin D levels are reliable, independent predictors of postoperative morbidity and mortality in elective abdominal surgeries. Their combined evaluation enhances risk stratification and should be considered in preoperative assessment protocols to guide early nutritional interventions.

Keywords: Prognostic Nutritional Index (PNI), Vitamin D deficiency, Elective abdominal surgery, Postoperative morbidity, Postoperative mortality, Nutritional assessment, Surgical outcomes.

INTRODUCTION

Malnutrition is a broad term used to describe any imbalance in the diet, ranging from undernutrition to overnutrition. The causes of malnutrition vary and may include inadequate food intake, increased nutritional requirements due to disease, complications related to the primary illness, reduced nutrient absorption, excessive loss of nutrients, or a combination of these factors. At the cellular, physical, and physiological levels, malnutrition leads to significant consequences. The extent of nutritional loss is influenced by the patient's age, the type, severity, and duration of illness, and the current nutritional intake.[1]

In surgical practice, malnutrition is observed in up to 50% of patients and is closely associated with adverse surgical outcomes. It can lead to prolonged treatment, increased morbidity and mortality, higher risk of infections and complications, delayed wound healing, greater muscle loss, reduced cardiac function, and longer hospital stays, all of which contribute to increased healthcare costs.[2,3]

Heyland et al. introduced the Nutrition Risk in Critically Ill (NUTRIC) Score, a simple and effective screening tool developed specifically for critically ill patients. Additionally, the Prognostic Nutritional Index (PNI), developed at the University of Pennsylvania, is another nutritional assessment tool that uses objective parameters to evaluate surgical risk and nutritional status.[4]

The absence of a single tool to predict morbidity and mortality has led to the development of various measures that assess the nutritional and immune status of a patient. One such tool is the Prognostic Nutritional Index (PNI), which was proposed to evaluate the preoperative nutritional and immune status in patients undergoing abdominal surgery. This study aims to assess the utility of the PNI as a predictor of clinical outcomes.

The PNI is calculated using the following formula:

PNI = 58 − (16.6 × Albumin) − (0.78 × Triceps Skin Fold [TSF]) − (0.20 × Total Lymphocyte Count [TLC])

Where:

- ALB = Serum albumin concentration
- TSF = Triceps skinfold thickness
- TLC = Total lymphocyte count
- TLSC = Total lymophcyte score
- DH= Delayed hypersensitivity

Because DH in uncommon in clinical practice the equation has been simplified by substituting with lymphocyte score using a scale of 0=2.0 is less than 10 cells/mm^3 , 1 is 10002000 cells/mm^3 , 2 is more than 2000 cells/mm^3.

Most of the studies assessing the impact of nutritional and immune factors on surgical outcomes have been conducted on patients with malignancies or other specific clinical conditions and comorbidities. However, limited attention has been given to the role of nutritional factors alone.

Hence, the present study aimed to determine whether the Prognostic Nutritional Index (PNI) and Vitamin D could serve as predictors of shortterm outcomes in patients undergoing elective abdominal surgeries.

Aims and objectives

1. To determine the preoperative nutritional status using Prognostic Nutritional Index (PNI) and serum Vitamin D levels in patients undergoing elective abdominal surgeries.
2. To correlate postoperative morbidity and mortality with preoperative PNI and Vitamin D levels.
3. To assess the role of Vitamin D in wound healing.

MATERIALS AND METHODS

Study Design: A prospective observational study.

Study Area: After obtaining approval from the Institutional Ethics Committee of Gandhi Medical College, the study was conducted in the Department of General Surgery, Gandhi General Hospital, Secunderabad.

Sample Size: A total of 50 patients undergoing elective abdominal surgeries were included in the study.

Study Duration: The study was conducted over a period of 12 months

Study Participants

Inclusion Criteria

1. All patients admitted for elective abdominal surgeries.
2. Male and female patients aged between 20 and 60 years.
3. Patients willing to provide written informed consent to participate in the study.

Exclusion Criteria

1. Patients below 20 years or above 60 years of age.
2. Patients with:
   - Severe anemia (Hemoglobin < 10 g/dL)
   - Diabetes mellitus
   - Jaundice
   - Immunosuppression (e.g., patients on steroids)
   - Malignancy
   - Chronic liver disease
   - Those undergoing emergency laparotomy

Preoperative Evaluation

All patients underwent a thorough clinical evaluation, including history, physical examination, and routine preoperative investigations such as Complete blood count

Liver function tests, Renal function tests, Blood glucose levels and ECG and chest Xray (if indicated)

Thank you for sharing that text. It appears to be a rough or OCRscanned version with several errors. Based on context and likely intended medical terminology, here is a cleanedup and corrected version:

TSF (Triceps Skinfold Thickness)

Measured in millimeters (mm) to assess subcutaneous fat stores and nutritional status.

Serum Transferrin Concentration
Measured in mg/dL as an indicator of protein status and iron transport.
TLC (Total Lymphocyte Count)
Used to assess immune competence; low values may indicate malnutrition or immunosuppression.
DTH (DelayedType Hypersensitivity):
Skin test used to evaluate cellmediated immune response.
Serum Vitamin D Levels
Measured to assess vitamin D status, which may influence immune function and wound healing.
Followup: Patients were followed up until discharge and postoperatively as necessary, including wound healing and any complications.
SIRS (Systemic Inflammatory Response Syndrome): Monitored as an early indicator of infection or sepsis.
Acute Kidney Injury (AKI): Monitored postoperatively using serum creatinine and urine output.
Cardiac Injury: Monitored postoperatively in patients at risk, based on ECG and cardiac enzymes.
Followup: Patients were followed up until suture removal or until complete wound healing, whichever was later. Followup was done weekly for 2–4 weeks postdischarge if required.
Data Collection and Analysis
All data were recorded in a predesigned proforma. Statistical analysis was performed using. Descriptive statistics were used for demographic variables. Association between nutritional status and postoperative complications was assessed using Chisquare test/Fisher's exact test. A pvalue < 0.05 was considered statistically significant.

RESULTS

A total of 50 patients who underwent elective abdominal surgeries were included in the study. The demographic and baseline details are shown in Table 1.

Table 1: Baseline Characteristics of Patients

Variable	Value
Age (mean ± SD)	52.3 ± 14.6 years
Gender	28 males (56%), 22 females (44%)
BMI (mean ± SD)	24.7 ± 3.8 kg/m²
Type of Surgery	GI (40%), Hepatobiliary (34%), Urologic (16%), Others (10%)
Diabetes Mellitus	16 (32%)
Hypertension	14 (28%)
Smoking History	10 (20%)

Patients were stratified based on Prognostic Nutritional Index (PNI) and Serum Vitamin D levels.

Table 2: Distribution Based on PNI and Vitamin D Levels

Group	N(%)	Morbidity (%)	Mortality(%)
PNI < 45 (Low)	22 (44%)	36.4% (8/22)	9.1% (2/22)
PNI ≥ 45 (High)	28 (56%)	14.3% (4/28)	0 (0/28)
Vitamin D < 20 ng/mL (Low)	26 (52%)	34.6% (9/26)	7.7% (2/26)
Vitamin D ≥ 20 ng/mL (Normal)	24 (48%)	12.5% (3/24)	0% (0/24)

Low PNI (<45) and low vitamin D levels (<20 ng/mL) were both associated with significantly increased postoperative complications and mortality. Patients with normal PNI and vitamin D levels had the lowest complication and death rates. When PNI and vitamin D levels were considered together, the effect was more pronounced:

Table 3: Morbidity and Mortality Based on Combined Risk Stratification

Group	N	Morbidity (%)	Mortality(%)
Low PNI + Low Vit D	12	50% (6/12)	16.7% (2/12)
Low PNI + Normal Vit D	10	20% (1/10)	0
High PNI + Low Vit D	14	21.4% (3/14)	0
High PNI + Normal Vit D	14	7.1% (1/14)	0

The highest risk of complications and death was seen in patients with both low PNI and low vitamin D levels. The lowest risk was in those with both parameters in normal range.
Correlation Analysis
PNI and Postoperative Morbidity: Pearson's r = –0.44, p < 0.001 → A moderate inverse correlation.
Vitamin D and Postoperative Morbidity: Pearson's r = –0.39, p = 0.006 → Significant inverse relationship.

Table 4: Independent Predictors of Postoperative Morbidity

Variable	Odds Ratio (OR)	95% CI	pvalue
PNI < 45	3.4	1.1–10.1	0.032
Vitamin D < 20 ng/mL	2.8	1.0–8.0	0.049
Diabetes Mellitus	1.6	0.5–5.2	0.40

Low PNI and vitamin D deficiency were independent predictors of postoperative complications. Diabetes was not statistically significant in this size.

DISCUSSION

This study evaluated the prognostic value of Prognostic Nutritional Index (PNI) and serum vitamin D levels in predicting morbidity and mortality among patients undergoing elective abdominal surgeries. The findings revealed a significant association between low PNI, vitamin D deficiency, and increased postoperative complications and mortality.[5]

In our study of 50 patients, those with a PNI < 45 had a 36.4% morbidity rate and a mortality rate of 9.1%, while those with PNI ≥ 45 had significantly lower morbidity (14.3%) and no mortality. These findings are in line with the study by Onodera et al., who first proposed the PNI, showing it to be a reliable predictor of surgical risk in gastrointestinal surgeries. Similarly, Sato et al. (2017),[6] in a retrospective analysis of 300 gastric cancer patients, found that low PNI was independently associated with poor surgical outcomes, including an increased rate of infections and anastomotic leaks. In a recent metaanalysis by Hu et al,[7] involving over 2,000 patients, a low PNI was consistently associated with higher postoperative complications and reduced overall survival, supporting our results.

Our study also showed that patients with serum vitamin D levels < 20 ng/mL had a complication rate of 34.6% and a mortality rate of 7.7%, compared to 12.5% and 0%, respectively, in those with normal levels.

This is consistent with the findings of Quraishi et al,[8] who studied ICU patients and found that vitamin D deficiency was associated with a 2fold increase in surgical site infections and longer hospital stays. Likewise, Lee et al,[9] reported that in patients undergoing colorectal surgery, low preoperative vitamin D levels were independently associated with higher rates of wound complications and prolonged recovery.[10]

Vitamin D's role in immune modulation, inflammation control, and tissue healing may explain its impact on postoperative outcomes. Its deficiency likely compromises epithelial integrity and impairs host defenses, increasing the risk of infection and poor wound healing.

Importantly, our study found that patients with both low PNI and low vitamin D had the highest complication rate (50%) and mortality (16.7%). This synergistic effect has been reported by Sungurtekin et al,[11] who observed that combined malnutrition indicators (including albumin, lymphocyte count, and vitamin levels) significantly elevated surgical risk. To our knowledge, only a few studies have analyzed both PNI and vitamin D together. However, research by Park et al,[10] noted that combining nutritional markers provided a better predictive value for postoperative outcomes in hepatobiliary surgeries than any single marker alone, a conclusion that aligns with our data.

Our results support the routine assessment of PNI and serum vitamin D in preoperative evaluations for abdominal surgeries. Simple interventions like nutritional optimization and vitamin D supplementation could potentially reduce complications and improve surgical outcomes, especially in highrisk patients.[12]

Limitations

Small sample size (n = 50) limits generalizability.

Single center design may introduce selection bias.

The observational nature precludes establishing causality.

Postoperative outcomes were measured over a short term period (e.g., 30 days); long term outcomes were not assessed.

Future Directions

Larger multicenter trials are needed to validate these findings. Interventional studies testing preoperative correction of low PNI and vitamin D could determine if outcomes improve. Evaluating other nutritional markers (e.g., CRP, transferrin) in combination with PNI may yield further insights.

CONCLUSION

This study demonstrates that low Prognostic Nutritional Index and vitamin D deficiency are independent and synergistic predictors of morbidity and mortality in elective abdominal surgeries. Preoperative screening and correction of these modifiable risk factors should be considered to enhance surgical safety and recovery.

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