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Original Research Article

Preoperative Prognostic Nutritional Index as a Predictor of Split-Thickness Skin Graft Take in Burn Patients: A Prospective Observational Study

Nitish Kumar[1], Siddharth Azad[2], Sanjay Kumar Gupta[3]

[1]MBBS, D Ortho, Ms (Gen Surgery), Senior Resident, Mch Plastic and Reconstructive Surgery, PMCH, Patna, Bihar, India

[2]MBBS, DNB (General Surgery), , Academic Senior Resident 2nd Year, Mch Plastic and Reconstructive Surgery, Department of Plastic and Reconstructive Surgery, PMCH, Patna, Bihar, India

[3]MBBS, MS (General Surgery) Head of Department, Mch Plastic and Reconstructive Surgery, Department of Plastic and Reconstructive Surgery, PMCH, Patna, Bihar, India

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Corresponding author: Dr. Siddharth Azad

Conflict of interest: Nil

Abstract

Background: Successful split-thickness skin graft (STSG) take is influenced by local wound conditions as well as the overall physiological status of the patient. Burn injury is associated with increased metabolic demand, protein loss, systemic inflammation and altered immune function, all of which may affect wound healing. The Prognostic Nutritional Index (PNI), calculated using serum albumin and peripheral lymphocyte count, provides a simple assessment of nutritional and immune status. This study aimed to evaluate the relationship between preoperative PNI and STSG take in burn patients.

Materials and Methods: This prospective observational study included 40 adult patients with burn wounds undergoing STSG. Preoperative serum albumin and absolute lymphocyte count were recorded, and PNI was calculated for each patient. Graft take was assessed on postoperative day 14 and expressed as a percentage of the total grafted area. Correlation analysis was used to evaluate the relationship between PNI and graft take. Receiver operating characteristic (ROC) curve analysis was performed to assess the predictive ability of PNI for satisfactory graft take.

Results: The mean preoperative PNI was 37.4 ±6.1, while the mean graft take on postoperative day 14 was 86.8 ±10.7%. A significant positive correlation was observed between PNI and percentage graft take ($r=0.61$, $p<0.001$). Twenty-seven (67.5%) patients achieved satisfactory graft take (≥85%). Their mean PNI was significantly higher than that of patients with graft take <85% (40.0 ±4.6 vs. 32.1 ±5.1; $p<0.001$). ROC analysis showed an area under the curve (AUC) of 0.86. A PNI cut-off of 36.5 showed a sensitivity of 81.5% and specificity of 76.9% for predicting satisfactory graft take.

Conclusion: Higher preoperative PNI was associated with better STSG take in burn patients. PNI may be a simple and readily available marker for identifying patients at increased risk of suboptimal graft healing.

Keywords: Burn Injury; Split-Thickness Skin Graft; Graft Take; Prognostic Nutritional Index; Serum Albumin; Lymphocyte Count.

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Introduction

Burn injuries remain an important cause of morbidity, prolonged hospitalization and disability, particularly in low- and middle-income countries. Patients with deep dermal and full-thickness burns frequently require surgical wound coverage to achieve timely wound closure and reduce complications. Split-thickness skin grafting remains one of the most widely used reconstructive procedures for coverage of adequately prepared burn wounds [1,2]. Successful skin graft take is a complex process. During the initial phase, the graft receives nutrients from the wound bed through plasmatic imbibition. This is followed by inosculation and subsequent development of a new vascular supply. Adequate contact between the graft and recipient bed, good vascularity, control of infection, prevention of hematoma and appropriate immobilization are important for successful graft healing [2,3]. Apart from local wound factors, the systemic condition of the patient can influence graft survival. Burn injury produces a marked inflammatory and hypermetabolic response characterized by increased energy expenditure, accelerated protein breakdown and loss of lean body mass. Protein and other nutrients may also be lost through burn wound exudate. These changes increase the risk of nutritional depletion during the course of treatment [4].

Nutritional impairment may adversely affect immune function, collagen synthesis, tissue regeneration and wound healing. Assessment of nutritional status is therefore an important component of the overall management of patients with significant burns [4,5].

Serum albumin is commonly measured in burn patients and has often been used as an indicator of nutritional and clinical status. However, albumin concentration can be influenced by systemic inflammation, capillary leakage, fluid administration, hepatic synthesis and ongoing protein loss. Therefore, albumin alone may not adequately reflect the nutritional and immunological condition of a burn patient [5,6].

The Prognostic Nutritional Index (PNI) combines serum albumin concentration with peripheral lymphocyte count. It provides a numerical measure incorporating both nutritional reserve and immune status. Since albumin and lymphocyte count are routinely available laboratory parameters, PNI can be calculated easily without requiring an additional specialized investigation.

The potential role of PNI in burn surgery has been explored in recent studies. Hu et al. evaluated patients with severe burns undergoing Meek grafting and found that higher preoperative PNI was associated with improved graft survival [7]. More recently, Kawilarang et al. reported a significant positive correlation between preoperative PNI and STSG take in patients with severe burns [8].

Other studies evaluating nutritional parameters have produced variable results. Soedjana et al., in a prospective study of burn patients undergoing STSG, did not observe a statistically significant relationship between serum albumin alone and graft outcome, although albumin showed moderate discriminatory ability on ROC analysis [6]. These observations suggest that a combined index such as PNI may provide more useful information than a single laboratory parameter.

Recent prospective evidence has also shown that graft survival is affected by several systemic factors, including burn severity, infection, and albumin, prealbumin and inflammatory markers [9]. This further supports the need for a simple preoperative marker that can be interpreted along with clinical characteristics.

PNI may be particularly useful in resource-limited settings because it involves no additional cost beyond routine investigations. However, prospective evidence regarding PNI and conventional STSG take remains limited.

The present study was therefore conducted to evaluate the association between preoperative PNI and STSG take in burn patients and to assess its usefulness in predicting satisfactory graft healing.

Aim and Objectives

Aim: To evaluate preoperative Prognostic Nutritional Index as a predictor of split-thickness skin graft take in burn patients.

Primary Objective: To determine the relationship between preoperative PNI and percentage STSG take on postoperative day 14.

Secondary Objectives

1. To compare preoperative PNI between patients with satisfactory and suboptimal graft take.
2. To evaluate the predictive performance of PNI for satisfactory graft take.
3. To determine an optimal PNI cut-off value with corresponding sensitivity and specificity.
4. To assess the individual relationships of serum albumin and absolute lymphocyte count with percentage graft take.

Materials and Methods

Study Design: This was a prospective observational study.

Study Setting: The study was conducted from July 2025 to June 2026 in the Department of Plastic Surgery and Burn Unit of a tertiary care teaching hospital, PMCH, Patna.

Study Population: Adult patients with burn wounds who underwent split-thickness skin grafting during the study period were screened for eligibility.

Sample Size: The sample size was estimated on the basis of the expected correlation between preoperative PNI and graft take. Based on previous literature 40 patients were included in the study (8).

Sampling Technique: Consecutive sampling was used. All eligible patients presenting during the study period were considered for inclusion until the required sample size was achieved.

Inclusion Criteria

1. Patients aged 18 years or above.
2. Patients with burn wounds requiring split-thickness skin grafting.
3. Patients with an adequately prepared recipient wound suitable for grafting.
4. Availability of preoperative serum albumin and differential leukocyte count.
5. Patients providing written informed consent.

Exclusion Criteria

1. Known chronic liver disease.
2. Advanced chronic kidney disease or nephrotic syndrome.
3. Known hematological disorder significantly affecting lymphocyte count.
4. Patients receiving long-term immunosuppressive therapy.
5. Uncontrolled systemic or local infection at the time of grafting.
6. Patients in whom postoperative day-14 graft assessment could not be completed.

Data Collection and Preoperative Assessment: After enrolment, demographic and clinical information was recorded using a predefined study pro-forma.

The recorded variables included age, sex, body mass index (BMI), mechanism of burn, percentage of total body surface area (TBSA) involved, relevant co-morbidities and time from burn injury to skin grafting.

The recipient wound was examined before surgery to assess the condition of the wound bed. Grafting was performed after adequate wound preparation and control of clinically significant infection.

Routine preoperative laboratory investigations were performed according to institutional protocol. Serum albumin and absolute lymphocyte count obtained during the preoperative period were recorded for calculation of PNI.

Calculation of Prognostic Nutritional Index

PNI was calculated using the following formula [7,8]:

PNI = 10 × serum albumin (g/dL) + 0.005 × total lymphocyte count (/mm^3)

PNI was primarily evaluated as a continuous variable.

Surgical Procedure: The recipient wound was adequately prepared before grafting. Necrotic or unhealthy tissue, when present, was removed to obtain a healthy vascular wound bed.

After achieving satisfactory haemostasis, a split-thickness skin graft was harvested from an appropriate donor site using the standard technique followed in the department. The harvested graft was placed uniformly over the recipient wound and secured appropriately. Care was taken to avoid collection of blood or fluid beneath the graft. A non-adherent dressing followed by an appropriate secondary dressing was applied.

Postoperative immobilization, wound care, analgesia, antibiotics when clinically indicated and nutritional support were provided according to standard institutional practice.

No treatment decision was made on the basis of PNI because the study was purely observational.

Assessment of Graft Take: The primary outcome was the percentage of STSG take on postoperative day 14.

The graft was assessed clinically for viability, adherence and incorporation into the recipient bed.

Percentage graft take was calculated as:

Graft take (%) = (Successfully taken graft area / Total grafted area) × 100

For secondary categorical analysis, graft take of ≥85% was considered satisfactory, while graft take <85% was considered suboptimal [8].

Outcome Measures

Primary Outcome: Percentage STSG take on postoperative day 14.

Secondary Outcomes

1. Correlation between preoperative PNI and percentage graft take.
2. Difference in PNI between satisfactory and suboptimal graft-take groups.
3. AUC of PNI for predicting satisfactory graft take.
4. Optimal PNI cut-off with sensitivity and specificity.
5. Relationship between serum albumin and graft take.
6. Relationship between absolute lymphocyte count and graft take.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using appropriate statistical software. Continuous variables were expressed as mean ±SD or median (IQR), as appropriate, and categorical variables as frequency and percentage. Correlation between preoperative PNI and graft take was assessed using Pearson's or Spearman's correlation.

Between-group comparisons were performed using Student's t-test/Mann–Whitney U test and Chi-square/Fisher's exact test, as appropriate. Simple linear regression was used to assess the relationship between PNI and graft take. ROC curve analysis was performed to determine the AUC, optimal PNI cut-off using the Youden index, sensitivity and specificity. A p-value <0.05 was considered statistically significant

Ethical Considerations: The study was conducted after approval from the Institutional Ethics Committee. Written informed consent was obtained from each participant before enrolment. Participation in the study did not alter the standard treatment provided to the patient. Patient identity and clinical information were kept confidential throughout the study.

Results

A total of 40 patients undergoing STSG for burn wounds were included in the analysis.

The mean age of the participants was 38.6 ±13.2 years. Twenty-four (60.0%) patients were male and 16 (40.0%) were female. Mean BMI was 21.8 ±2.9 kg/m². The mean extent of burn was 27.4 ±10.6% TBSA. Flame injury was the most common mechanism and was observed in 27 (67.5%) patients (Table 1).

Table 1: Baseline demographic and burn characteristics of the study population

Variable	Value
Number of patients	40
Age (years)	38.6 ± 13.2
Male, n (%)	24 (60.0)
Female, n (%)	16 (40.0)
BMI (kg/m²)	21.8 ± 2.9
TBSA burned (%)	27.4 ± 10.6
Flame burn, n (%)	27 (67.5)
Scald burn, n (%)	7 (17.5)
Electrical burn, n (%)	4 (10.0)
Other mechanisms, n (%)	2 (5.0)

Preoperative Nutritional Parameters: The mean serum albumin concentration before surgery was 2.93 ±0.52 g/dL. The mean absolute lymphocyte count was 1624 ±463 cells/mm³. The calculated mean preoperative PNI was 37.4 ±6.1. The mean graft take on postoperative day 14 was 86.8 ±10.7%. (Table 2; Figure1)

Table 2: Preoperative nutritional parameters and graft outcome

Parameter	Mean ± SD
Serum albumin (g/dL)	2.93 ± 0.52
Absolute lymphocyte count (cells/mm³)	1624 ± 463
PNI	37.4 ± 6.1
Day-14 graft take (%)	86.8 ± 10.7

Correlation between Nutritional Parameters and Graft Take: A significant positive correlation was observed between preoperative PNI and percentage graft take (r=0.61, p<0.001). Thus, patients with higher preoperative PNI generally demonstrated a greater percentage of successful graft take. Serum albumin also showed a significant positive correlation with graft take (r=0.54, p<0.001).

Absolute lymphocyte count showed a weaker positive correlation with graft take (r=0.34, p=0.031).

Table 3: Correlation of nutritional parameters with percentage graft take

Parameter	Correlation coefficient (r)	p-value
PNI	0.61	<0.001
Serum albumin	0.54	<0.001
Absolute lymphocyte count	0.34	0.031

Comparison According to Graft Outcome: Twenty-seven (67.5%) patients achieved satisfactory graft take of ≥85%, whereas 13 (32.5%) patients had graft take below 85%. Patients with satisfactory graft take had a mean PNI of 40.0 ±4.6 compared with 32.1 ±5.1 among patients with suboptimal graft take. This difference was statistically significant (p<0.001). Preoperative serum albumin was also significantly higher in the satisfactory graft-take group (3.10 ±0.43 vs. 2.58 ± 0.50 g/dL; p=0.002). TBSA tended to be greater among patients with suboptimal graft take, although the difference did not reach statistical significance (p=0.054). (Table 4; figure 3)

Table 4: Comparison of patients according to graft outcome

Variable	Graft take ≥85% (n=27)	Graft take <85% (n=13)	p-value
Age (years)	37.4 ± 12.8	41.1 ± 14.0	0.409
BMI (kg/m²)	22.0 ± 2.8	21.4 ± 3.1	0.541
TBSA (%)	25.2 ± 9.6	32.0 ± 11.4	0.054
Serum albumin (g/dL)	3.10 ± 0.43	2.58 ± 0.50	0.002
Lymphocyte count (/mm³)	1715 ± 438	1435 ± 468	0.070
PNI	40.0 ± 4.6	32.1 ± 5.1	<0.001

Linear Regression Analysis: Simple linear regression demonstrated a significant positive relationship between PNI and percentage graft take. Each one-unit increase in PNI was associated with an estimated 1.07 percentage-point increase in graft take (B=1.07; 95% CI: 0.61–1.53; p<0.001). The model explained approximately 37% of the observed variability in graft take (R^2=0.37).

Table 5: Linear regression analysis for percentage graft take

Predictor	Regression coefficient (B)	95% CI	p-value
Preoperative PNI	1.07	0.61–1.53	<0.001

R^2 = 0.37

ROC Curve Analysis: ROC curve analysis was performed to assess the ability of preoperative PNI to predict satisfactory graft take. PNI demonstrated good discriminatory performance with an AUC of 0.86 (95% CI: 0.74–0.97; p<0.001). A PNI cut-off value of 36.5 provided a sensitivity of 81.5% and specificity of 76.9% for predicting graft take ≥85%. (Table 6; Figure 2)

Table 6: ROC analysis of PNI for prediction of satisfactory graft take

ROC parameter	Value
AUC	0.86
95% CI	0.74–0.97
Optimal PNI cut-off	36.5
Sensitivity	81.5%
Specificity	76.9%
p-value	<0.001

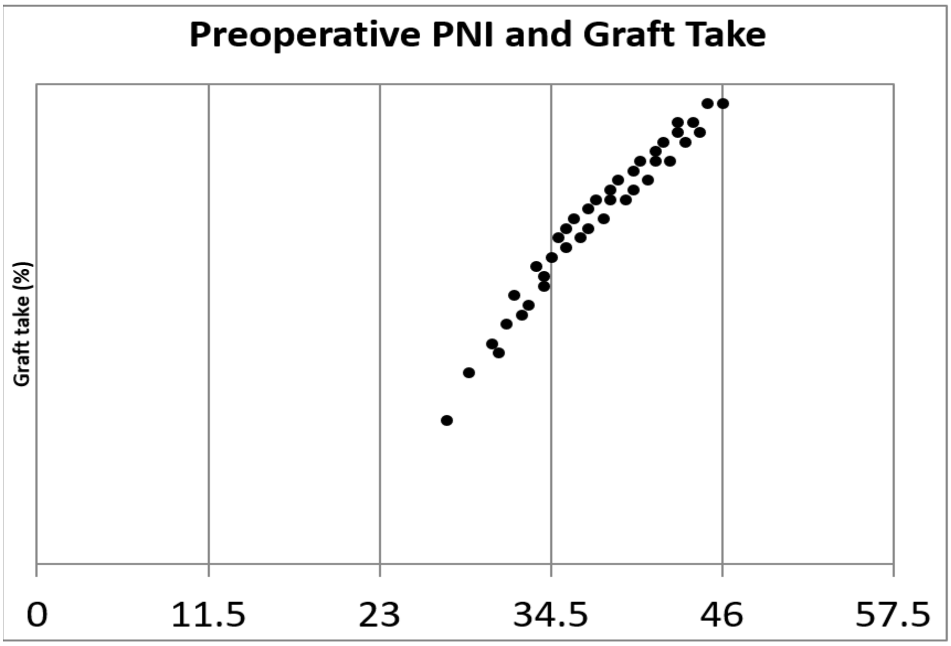

Figure 1: Relationship between preoperative Prognostic Nutritional Index (PNI) and percentage split-thickness skin graft take on postoperative day 14.

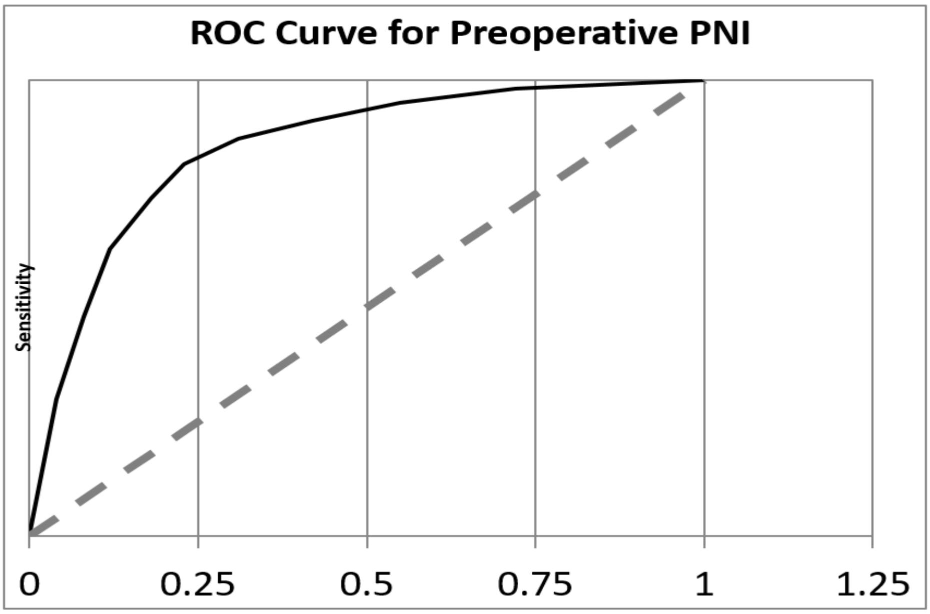

Figure 2: Receiver operating characteristic (ROC) curve for preoperative PNI in predicting satisfactory graft take (≥85%). AUC = 0.86 (95% CI: 0.74–0.97). A PNI cut-off of 36.5 showed 81.5% sensitivity and 76.9% specificity.

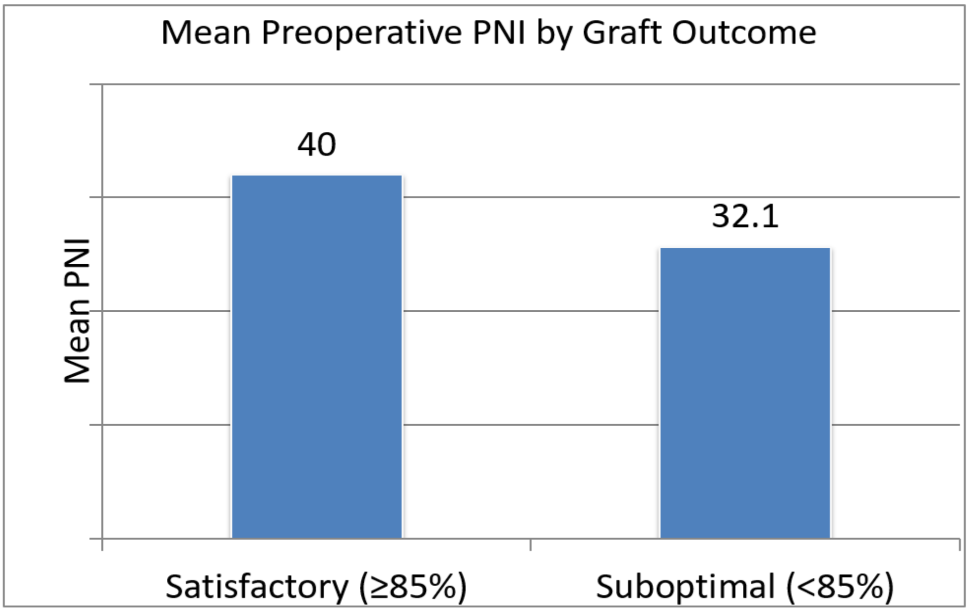

Figure 3: Comparison of mean preoperative PNI between patients with satisfactory (≥85%) and suboptimal (<85%) graft take.

Discussion

The present prospective observational study evaluated preoperative PNI as a predictor of STSG take in burn patients. The main finding was a significant positive association between PNI and percentage graft take. Patients who achieved satisfactory graft healing had substantially higher preoperative PNI values than those with suboptimal graft take. Burn injury induces a prolonged hypermetabolic and inflammatory response. Increased protein breakdown, elevated energy requirements and loss of nutrients through the burn wound may contribute to nutritional depletion [4]. These changes are clinically important because wound repair requires adequate nutritional substrates and effective immune function.

In the present study, the mean PNI was 37.4 ±6.1 and PNI showed a significant positive correlation with percentage graft take (r=0.61). This suggests that patients with better preoperative nutritional and immunological status tend to have more favourable graft healing. Our findings are comparable with those reported by Kawilarang et al. [8]. In their study of 60 patients with severe burns, a significant positive correlation was observed between preoperative PNI and STSG take (r=0.628). Their findings provide direct support for the use of PNI as a potential predictor of conventional STSG outcome.

Hu et al. [7] also demonstrated the predictive importance of PNI in severe burn patients. Their study evaluated patients undergoing Meek grafting and showed that preoperative PNI was a protective factor for graft survival. ROC analysis identified a PNI threshold of approximately 35 for prediction of graft outcome. Although the grafting technique differed from conventional STSG, their findings support the relationship between preoperative nutritional status and graft survival.

The PNI cut-off obtained in the present study was 36.5, which is relatively close to the value reported by Hu et al. [7]. However, cut-off values derived from individual studies should be interpreted cautiously because they may vary according to patient characteristics, burn severity, operative technique and outcome definition.

Serum albumin was also positively associated with graft take in the present study. Albumin may fall after significant burns because of inflammatory changes, increased vascular permeability, protein loss from the wound and altered synthesis. However, albumin should not be considered solely as a nutritional marker because it is affected by several physiological and pathological factors [4,5].

Evidence regarding albumin and STSG outcome has been inconsistent. Soedjana et al. [6] prospectively studied 47 burn patients undergoing STSG. They did not observe a statistically significant correlation between preoperative albumin and graft outcome, although ROC analysis produced an AUC of 0.758. This indicates that albumin may have some discriminatory value but may not adequately predict graft healing when used alone.

The present study found that lymphocyte count had a weaker association with graft take than either albumin or PNI. However, when lymphocyte count was combined with albumin to calculate PNI, the association with graft outcome became stronger. This supports the concept that a combined nutritional-immunological index may provide more useful information than either component considered independently.

Recent prospective research has also demonstrated the multifactorial nature of graft healing. Abdel Gawad et al. [9] studied factors influencing skin-graft take following early excision in severe burns. Poor graft take was associated with burn severity, postoperative sepsis and increased neutrophil-to-lymphocyte ratio, while higher albumin and prealbumin levels were associated with better graft survival. These findings highlight the combined roles of nutrition, inflammation and infection in graft healing.

Indian centres continue to investigate methods of improving STSG outcomes in burn patients. Behera et al. [10] reported a multicentre Indian randomized study protocol evaluating platelet-rich plasma as an adjunct to STSG in granulating burn wounds. The participating institutions include major tertiary burn centres in India, reflecting the continuing clinical importance of improving graft outcomes in this population.

Indian investigators have also explored methods of improving healing after STSG. Radharaman et al. [11] evaluated recruited minced skin grafting for STSG donor-site healing in a comparative study involving Indian plastic surgery centres. Such work highlights the importance of improving both recipient- and donor-site outcomes in patients undergoing skin grafting.

The present study adds to this field by focusing on a simple preoperative marker rather than an additional therapeutic intervention. The major advantage of PNI is that it can be calculated using laboratory investigations that are already routinely performed. It therefore does not require specialized equipment or additional expenditure.

ROC analysis in the present study demonstrated an AUC of 0.86, suggesting good ability of PNI to discriminate between satisfactory and suboptimal graft outcomes. A cut-off of 36.5 provided a sensitivity of 81.5% and specificity of 76.9%.

These findings suggest that PNI may be useful as a preoperative risk-stratification tool. A patient with a low PNI may warrant closer assessment of nutritional status, wound condition and other potentially modifiable factors before definitive grafting. However, PNI should not be considered an independent substitute for clinical assessment. Successful graft take depends on several factors, including vascularity of the recipient bed, bacterial burden, hematoma formation, graft immobilization, burn extent, operative technique and postoperative wound care [3,9].

Furthermore, because the present study was observational, it cannot determine whether actively increasing PNI before surgery would improve graft survival. An interventional study would be required to answer this question.

Strengths of the Study: The prospective design allowed preoperative nutritional parameters to be recorded before the graft outcome was known. Graft take was assessed at a predefined postoperative time point, and PNI was evaluated both as a continuous predictor and through ROC analysis.

Another practical strength is the use of routinely available laboratory parameters, making the findings potentially applicable to centres with limited resources.

Limitations: The present study has several limitations. First, the sample size was relatively small. Second, all patients were recruited from a single centre, which may limit generalizability. Third, percentage graft take was assessed clinically and may therefore be affected by observer variation. Objective digital planimetry could provide more precise measurement in future studies.

Fourth, graft survival is influenced by several local and systemic variables, and all possible confounding factors could not be controlled in a study of this size. Finally, the PNI cut-off identified in this study was derived and evaluated within the same patient population. It should therefore be externally validated before being adopted for routine clinical decision-making.

Conclusion

Preoperative Prognostic Nutritional Index showed a significant positive relationship with split-thickness skin graft take in burn patients. Patients with satisfactory graft healing had higher PNI values, and PNI demonstrated good discriminatory performance for prediction of graft outcome.

Since PNI is calculated from routinely available serum albumin and lymphocyte count, it may provide a simple and inexpensive method for identifying patients at increased risk of suboptimal graft healing. PNI should be used as an adjunct to clinical assessment rather than as an isolated determinant of surgical timing. Larger prospective multicentre studies are needed to validate its predictive performance and establish a reliable clinical cut-off.

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