Official Title: Investigation & Comparison of the Effects of Preoperative Nutritional Status Scores to Predict Post-op Pulmonary Complications Among Elderly Patients With Cardiac Surgery

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Study design and setting

This prospective cohort study was conducted at Songklanagarind Hospital, Prince of Songkla University, Thailand, a tertiary-care university hospital and referral center for cardiac surgery. Consecutive older adults scheduled for elective cardiac surgery between June 2024 and April 2026 were screened for eligibility.

Study participants

Patients were eligible for inclusion if they were aged 60 years or older and underwent elective on-pump cardiac surgery, including coronary artery bypass grafting (CABG), valve surgery, combined CABG and valve procedures. The exclusion criterion was emergency cardiac surgery.

Ethical considerations

This study protocol was approved by the Institutional Review Board of the Faculty of Medicine, Prince of Songkla University, Hat Yai, Thailand (approval number: REC.67-018-8-1; 21 March 2024). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments. This study was registered at ClinicalTrials.gov (NCT06340464) on March 25, 2024, in accordance with International Committee of Medical Journal Editors (ICMJE) recommendations. This manuscript was reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cohort studies.

Nutritional assessment

Preoperative nutritional status using four nutritional assessment tools:

- GNRI [17]: was calculated according to the formula:

GNRI = [1.489 × serum albumin (g/L)] + [41.7 × (current body weight / ideal body weight)]

Ideal body weight was defined as 22 × height^2 (m^2).

Patients with GNRI < 91 were classified as being at nutritional risk

- MNA-SF [18]: consists of six items evaluating food intake, weight loss, mobility, psychological stress or acute illness, neuropsychological problems, and body mass index (or calf circumference when BMI is unavailable). Scores range from 0 to 14 and were categorized as follows: normal nutritional status (12-14), risk of malnutrition (8-11), or malnutrition (0-7)
- PNI [19]: was calculated using the following equation:

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

Malnutrition was defined as PNI < 38

- NAF [11]: is a nutritional screening tool developed and validated in hospitalized Thai patients. The NAF incorporates anthropometric measurements, recent weight changes, dietary intake, gastrointestinal symptoms, functional capacity, comorbidities, and selected laboratory parameters. Scores were categorized as follows: normal or mild nutrition (0-5), moderate malnutrition (6-10), and severe malnutrition (≥ 11)

Data collection

Baseline demographic and clinical characteristics were prospectively collected, including age, sex, body mass index, smoking status, hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, chronic obstructive pulmonary disease, heart failure, previous myocardial infarction, and other relevant comorbidities. Cardiac surgical risk was evaluated using EuroSCORE II and New York Heart Association (NYHA) functional classification. Operative variables included procedure type, cardiopulmonary bypass time, aortic cross-clamp time, duration of surgery, blood product transfusion, and perioperative hemodynamic data.

Outcomes

The primary outcome was the occurrence of PPCs during hospitalization following cardiac surgery. PPCs were defined as the occurrence of one or more of the following complications: pneumonia (respiratory symptoms, new infiltrative opacity on chest radiography, fever >38°C and/or elevated white blood cell count), prolonged mechanical ventilation (>24 h), pleural effusion, pulmonary embolism, reintubation after 72 hrs. The primary objective of this study was to compare the predictive performance of GNRI, MNA-SF, PNI, and NAF for postoperative pulmonary complications. The discriminative ability of each nutritional assessment tool was evaluated using sensitivity, specificity, receiver operating characteristic (ROC) curve analysis, and the area under the ROC curve (AUC).

Sample size calculation

The sample size was calculated based on the expected incidence of postoperative pulmonary complications in elderly cardiac surgical patients 2-70% [20]. Assuming a PPC incidence of 30%, an anticipated area under the receiver operating characteristic curve (AUC) of at least 0.80, a two-sided alpha error of 0.05, and a power of 90%, a minimum sample size of 206 patients was required. To compensate for potential missing data and attrition, the final target sample size was increased to 229 participants.

Statistical analysis

Continuous variables are presented as mean ± standard deviation (SD) or median (interquartile range [IQR]) according to data distribution. Categorical variables are reported as frequencies and percentages. Comparisons between patients with and without PPCs were performed using the Student's t-test or Mann–Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. The predictive performance of GNRI, MNA-SF, PNI, and NAF for PPCs was evaluated using receiver operating characteristic (ROC) curve analysis. Areas under the ROC curve (AUCs) with 95% confidence intervals (CIs) were calculated

and compared using the DeLong method. Optimal cutoff values were determined using the Youden index. Sensitivity, specificity, positive predictive value, negative predictive value, and likelihood ratios were calculated. Univariable logistic regression analyses were initially performed to identify factors associated with PPCs. Variables with $p < 0.20$ in univariable analyses and clinically relevant variables were entered into multivariable logistic regression models. Adjusted odds ratios (aORs) with 95% confidence intervals were reported. All statistical analyses were performed using R software (version 4.6.0, R Foundation for Statistical Computing, Vienna, Austria). A two-sided p-value < 0.05 was considered statistically significant.