Advanced Lung Cancer Inflammation Index as a Prognostic Inflammation–Nutrition Marker in Appendiceal High-Grade Pseudomyxoma Peritonei: A 10-Year Single-Center Study

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Abstract

Background

Pseudomyxoma peritonei (PMP) prognosis remains heterogeneous. Systemic inflammation and nutrition are linked to cancer survival, but their role in PMP is unclear. We aimed to evaluate the prognostic impact of inflammation–nutrition status in appendiceal high-grade PMP and to develop and internally validate a preoperative prognostic model.

Methods

We retrospectively included patients with pathologically confirmed appendiceal high-grade PMP who underwent cytoreductive surgery (CRS) with or without hyperthermic intraperitoneal chemotherapy (HIPEC) between January 2015 and December 2024. Baseline variables included demographics, body mass index (BMI), tumor markers (CEA, CA19-9, CA125), inflammation–nutrition indices (advanced lung cancer inflammation index [ALI], prognostic nutritional index [PNI], neutrophil-to-lymphocyte ratio [NLR], platelet-to-lymphocyte ratio [PLR], lymphocyte-to-monocyte ratio [LMR], systemic inflammation score [SIS], systemic immune–inflammation index [SII]), prior surgical score (PSS), peritoneal cancer index (PCI), completeness of cytoreduction (CCR), HIPEC, pathological subtype, and Ki-67. Overall survival (OS) was the primary endpoint. Prognostic factors were identified by univariable and multivariable Cox models, and a nomogram was developed and internally validated.

Results

Among 223 patients (146 females, 65.5%), median age was 59 years, and median OS was 21 months. On univariable analysis, higher PNI, albumin, LMR, ALI, and receipt of HIPEC were protective, whereas incomplete cytoreduction, higher PCI, pathological grade, Ki-67, elevated tumor markers, and inflammatory indices (SIS, NLR, SII) predicted worse OS (all $p < 0.05$). In the multivariable model, independent risk factors were pathological grade (hazard ratio [HR] = 2.575), elevated CA19-9 (HR = 2.189), CA125 (HR = 1.495), Ki-67 (HR = 1.976), and incomplete cytoreduction (HR = 2.705); protective factors were HIPEC (HR = 0.611) and higher ALI (HR = 0.576). The model achieved a C-index of 0.753, with 1-, 2-, and 3-year AUCs of 0.810, 0.839, and 0.775, respectively. Calibration error was low (≈ 3%–6%), and decision-curve analysis showed sustained net benefit across broad threshold ranges.

Conclusions

The ALI is an independent prognostic marker in appendiceal high-grade PMP. A nomogram incorporating ALI with tumor and pathological variables enabled reliable preoperative survival prediction with strong discrimination, calibration, and clinical utility.

1 Introduction

Pseudomyxoma peritonei (PMP) is a rare malignancy of the peritoneal cavity, most frequently originating from the appendix. Its onset is typically insidious, and early clinical manifestations are often non-specific[1]. The current standard of care involves cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC). In specialized high-volume centers, achieving complete cytoreduction (CCR 0/1) has been associated with markedly improved outcomes[2]. Nevertheless, considerable prognostic heterogeneity persists among patients with high-grade disease, even with comparable tumor burdens. Despite undergoing CCR 0/1 resection and HIPEC in expert centers, the 5-year overall survival (OS) is approximately 48%, and declines to around 14% in patients with high-grade tumors containing signet-ring cells[3]. Most existing prognostic models have predominantly focused on disease-related variables (tumor burden, extent of cytoreduction, and histopathology)[4], while comparatively little attention has been directed toward host-related factors, particularly systemic inflammation and nutritional status.

A growing body of evidence indicates that the host systemic inflammatory response and nutritional status contribute to tumor progression and influence survival outcomes[5]. While various inflammation–nutrition indices have been explored in gastrointestinal cancers, most focus on single dimensions (e.g., PNI for nutrition or NLR for inflammation)[6–8].The advanced lung cancer inflammation index (ALI), which integrates body mass index (BMI), serum albumin, and NLR, has likewise emerged as an independent prognostic marker in several gastrointestinal cancers[9]. However,the prognostic significance of these inflammation–nutrition indices has not been systematically investigated in the context of PMP.

Against this background, we aimed to evaluate the prognostic value of multiple inflammation–nutrition indices in patients with appendiceal high-grade PMP. In conjunction with established measures of tumor burden, we sought to develop and internally validate a multivariable nomogram for predicting OS. The objective was to provide a robust, clinically applicable predictive model and lay the groundwork for subsequent multicenter external validation.

2 Materials and Methods

2.1 Study Design and Data Sources

This single-center retrospective cohort study included patients with PMP who underwent surgery at the Department of Myxoma, Aerospace Center Hospital, between January 2015 and December 2024. Clinical data were retrieved from the hospital information system (HIS) and pathology database. Collected variables included demographics, hematologic and biochemical parameters obtained within 7 days before surgery, tumor-related imaging findings, intraoperative records, and postoperative pathological reports (independently reviewed by two pathologists). The study protocol was approved by the Institutional Review Board of Aerospace Center Hospital (approval No. 20161109-ST-07) and complied with institutional ethical requirements.

2.2 Inclusion Criteria

Patients were eligible for inclusion if they met all of the following criteria: (1) Diagnosis of PMP according to the 2016 Peritoneal Surface Oncology Group International (PSOGI) consensus[10], with clinical presentation and immunohistochemical findings excluding non-appendiceal origins (e.g., ovarian, colorectal, pancreatobiliary tract, or urachal). (2) Postoperative histopathology confirming high-grade PMP or high-grade PMP with signet-ring cells. (2) Underwent CRS with or without HIPEC. (3) Availability of essential clinical and laboratory data, including preoperative blood samples obtained within 7 days before surgery. (4) Availability of complete follow-up information.

2.3 Exclusion Criteria

Exclusion criteria were as follows: (1) Conditions affecting immune cell counts or inflammatory status, including active hematologic disease, inflammatory or autoimmune disease, myeloproliferative disorders, prior splenectomy, acute myocardial infarction or stroke within 1 month, or a concurrent primary malignancy. (2) Use of agents with significant immunomodulatory effects within the preceding 12 months (e.g., systemic corticosteroids, immunosuppressants, or immunostimulants) or receipt of blood transfusion within 1 month prior to surgery. (3) Missing key variables not amenable to imputation. (4) Loss to follow-up.

2.4 Study Flow and Sample Size

A total of 1,034 patients with appendiceal-origin PMP were screened. Among these, 312 patients were identified as having high-grade PMP or high-grade PMP with signet-ring cells. Thirty-three patients with incomplete clinical data, 24 who had received preoperative chemoradiotherapy, and 32 who were lost to follow-up were excluded. Ultimately, 223 patients met all criteria and were included in the analysis (Fig. 1).

2.5 Variables and Definitions

Data extracted from the HIS included demographics, preoperative laboratory tests (hematology, biochemistry, and tumor markers), intraoperative findings, and oncologic characteristics. Tumor and Surgical Parameters:

1.Peritoneal Cancer Index (PCI): Assessed using the Sugarbaker method (0–39).

2.Completeness of Cytoreduction (CCR)[10]: Graded as CCR0 (no visible disease) to CCR3 (> 2.5 cm). CCR0–1 were considered favorable for this high-grade cohort analysis.

3.Prior Surgical Score (PSS): Defined by the extent of previous surgical interventions.

3.Prior Surgical Score (PSS)[10]: Defined by the extent of previous surgical interventions.

4.Pathological Grade: Classified as high-grade (HG) or high-grade with signet-ring cells (HG-SRC) per PSOGI criteria.

The Integrated Inflammation–Nutrition Index (ALI): While multiple indices were evaluated, the Advanced Lung Cancer Inflammation Index (ALI) was designated as the primary host-related marker due to its comprehensive integration of nutritional and inflammatory status. ALI was calculated as: ALI = BMI (kg/m²) × Albumin (g/L) / NLR Other inflammation–nutrition indices, including PNI, NLR, PLR, SII, LMR, and SIS, were also calculated for comparative and sensitivity analyses (definitions and formulas are provided in Supplementary Table S1)[12–17].

2.6 Follow-up

Follow-up information was obtained from outpatient records and telephone interviews. The index date (time zero) was defined as the date of surgery. Follow-up was continued until June 1, 2025, or death, whichever occurred first. The primary endpoint was overall survival (OS), defined as the interval between surgery and death from any cause or censoring at the last follow-up.

2.7 Statistical Analysis

All analyses were performed in R software (version 4.5.1). Statistical tests were two-tailed, with a significance threshold of $\alpha = 0.05$. Survival distributions were estimated using the Kaplan–Meier method, and the between-group differences were assessed using the log-rank test. Univariable and stagewise multivariable Cox proportional hazards models were constructed, and results were reported as hazard ratios (HRs) with 95% confidence intervals (CIs). Continuous variables were expressed as mean ± standard deviation for normally distributed data (compared using the *t*-test) or as median (interquartile range [IQR]) for non-normally distributed data (compared using the Wilcoxon rank-sum test). Categorical variables were summarized as frequencies and percentages and compared using the χ^2 test or Fisher's exact test, as appropriate.

A prognostic model integrating tumor-burden parameters and inflammation–nutrition indices was developed, from which a nomogram was derived. Collinearity among variables was assessed using the variance inflation factor (VIF). Model discrimination was quantified using time-dependent receiver operating characteristic (ROC) curves to determine 1-year, 2-year, and 3-year areas under the curve (AUC), along with the concordance index (C-index). Internal validation was performed via bootstrap resampling (B = 500) to generate calibration plots. Decision-curve analysis was employed to assess clinical utility.

3 Results

3.1 Baseline Characteristics

A total of 223 patients (146 females [65.5%] and 77 males [34.5%]) with appendiceal high-grade PMP were included. The median age was 59 years (IQR 51–66). During a median follow-up of 54 months (95% CI, 47–72), 152 deaths were recorded, with a median overall survival (OS) of 21 months. As detailed in the Methods, optimal cut-off values for continuous variables (including ALI, PNI, and NLR) were

determined using the maximal Youden index derived from ROC analysis (specific thresholds are listed in Supplementary **Table S2).** Based on these cut-offs, categorical variables were generated for subsequent analysis. These thresholds were subsequently used for categorical grouping in descriptive analyses (Detailed demographic, clinical, and laboratory characteristics are provided in Table 1 and Supplementary Table S3.).Collectively, poorer nutrition and heightened inflammatory status, greater tumor activity and burden (reflected by elevated tumor markers, PCI, and Ki-67), suboptimal cytoreduction, and greater perioperative stress were all associated with increased mortality. These parameters were therefore prioritized as candidate variables for subsequent Cox proportional hazards modeling and nomogram construction.

Table 1
Baseline clinicopathological characteristics of the study cohort (N = 223)

Variable	Overall (N = 223)	Mortality(N = 152)	Survival(N = 71)	P-value
Age, years, median (IQR)	59 (51–66)	59.5 (52–67)	58 (49–65)	0.231
Sex, n (%)				0.996
Male	77 (34.5%)	53 (34.9%)	24 (33.8%)	
Female	146 (65.5%)	99 (65.1%)	47 (66.2%)	
BMI, kg/m², n (%)				0.441
< 18.5 (Underweight)	8 (3.6%)	7 (4.6%)	1 (1.4%)	
≥ 18.5	215 (96.4%)	145 (95.4%)	70 (98.6%)	
Pathological Grade, n (%)				0.001
High-grade	165 (74.0%)	102 (67.1%)	63 (88.7%)	
High-grade with SRC	58 (26.0%)	50 (32.9%)	8 (11.3%)	
PCI Score, n (%)				< 0.001
Low (< 15)	34 (15.2%)	13 (8.6%)	21 (29.6%)	
High (≥ 15)	189 (84.8%)	139 (91.4%)	50 (70.4%)	
Completeness of Cytoreduction, n (%)				< 0.001
CCR-0/1	37 (16.6%)	14 (9.2%)	23 (32.4%)	
CCR-2/3	186 (83.4%)	138 (90.8%)	48 (67.6%)	
Intraoperative HIPEC, n (%)				0.262
Yes	198 (88.8%)	132 (86.8%)	66 (93.0%)	
No	25 (11.2%)	20 (13.2%)	5 (7.0%)	
Tumor Markers, n (%)				
CEA High (> 7.36)	145 (65.0%)	115 (75.7%)	30 (42.3%)	< 0.001

Variable	Overall (N = 223)	Mortality(N = 152)	Survival(N = 71)	P-value
CA19-9 High (> 466)	44 (19.7%)	41 (27.0%)	3 (4.2%)	< 0.001
CA125 High (> 72)	110 (49.3%)	90 (59.2%)	20 (28.2%)	< 0.001
ALI Score, n (%)				0.016
High (≥ 341.0)	86 (38.6%)	50 (32.9%)	36 (50.7%)	
Low (< 341.0)	137 (61.4%)	102 (67.1%)	35 (49.3%)	

3.2 Univariable Cox Analyses

Using OS as the endpoint, 34 candidate variables were assessed in univariable Cox models (full results provided in Supplementary Table S4). In general, favorable nutrition/inflammation profiles conferred protection, whereas greater tumor burden/residual disease, increased tumor activity, and higher perioperative burden were associated with significantly poorer survival. Protective factors included higher PNI, ALB, LMR, and ALI (all $p \le 0.016$), as well as receipt of intraoperative HIPEC ($p < 0.001$). Risk factors for reduced survival included unfavorable CCR (CCR1–3) and higher PCI (both $p < 0.001$), higher pathological grade ($p < 0.001$), elevated tumor markers (CA19-9, CA125, and CEA), and higher Ki-67 (all $p \le 0.002$), greater inflammatory load (SIS = 1/2, elevated SII, elevated NLR; all $p \le 0.038$), longer postoperative hospital stay ($p < 0.001$), and higher renal indices (BUN, Cr; both $p \le 0.030$).

Other variables (e.g., sex, age group, BMI group, hypertension, diabetes, PSS, interval between surgeries, peripheral blood cell counts, transaminases/bilirubin) were not significantly associated with OS. Detailed HRs with 95% CIs are provided in Supplementary Table S4.

In summary, poorer nutritional status and heightened inflammatory status, along with greater tumor burden/residual disease, were consistently associated with adverse prognosis. In contrast, PNI, ALB, LMR, and ALI demonstrated stable protective effects and were therefore selected as core variables for multivariable modeling(Fig. 2).

3.3 Multivariable Cox Analyses

Guided by clinical rationale, a stagewise modeling strategy was employed. The base model incorporated key oncologic and procedural variables: intraoperative perfusion (HIPEC), pathological grade, CA125, CA19-9, Ki-67, CCR grade, and PCI (C-index = 0.751, AIC = 1350.83). Next, candidate inflammation–nutrition variables (ALB, PNI, NLR, PLR, LMR, ALI, SII, SIS) were evaluated incrementally. A variable was considered to provide meaningful incremental prognostic value if it achieved a reduction in Akaike information criterion ($\Delta AIC \le -2$) and/or a significant improvement over the base model on the

likelihood-ratio test ($p < 0.05$). The C-index was treated as a supportive metric to prevent overemphasis on small performance fluctuations, and collinearity was monitored using variance inflation factors. In the final multivariable model, eight parameters were retained (base-model variables plus ALI), corresponding to approximately 19 events per variable, ensuring adequate model stability. ALI demonstrated the clearest incremental value (ΔAIC = − 6.94, $p = 0.003$, ΔC-index = + 0.0018). The final model achieved AIC = 1343.90 and C-index = 0.7533, reflecting excellent discriminative capacity. Detailed HRs with 95% CIs are provided in Table 2 and Fig. 3.

The direction and magnitude of effects were consistent with clinical expectations:

Higher risk of mortality: CCR (HR = 2.705, 95% CI 1.295–5.648, $p = 0.008$), pathological grade (HR = 2.575, 95% CI 1.749–3.790, $p < 0.001$), CA19-9 (HR = 2.189, 95% CI 1.501–3.192, $p < 0.001$), Ki-67 (HR = 1.976, 95% CI 1.238–3.154, $p = 0.004$), and CA125 (HR = 1.495, 95% CI 1.050–2.127, $p = 0.026$).

Lower risk of mortality: intraoperative perfusion (HIPEC) (HR = 0.611, 95% CI 0.377–0.991, $p = 0.046$) and higher ALI (HR = 0.576, 95% CI 0.398–0.834, $p = 0.003$).

Although PCI did not remain statistically significant after multivariable adjustment (HR = 1.129, 95% CI 0.533–2.391, $p = 0.751$), it was retained in the model for clinical interpretability and to maintain consistency with established prognostic frameworks.

Table 2
Multivariable Cox proportional hazards regression results

Variable	HR_(95% CI)	Z_statistic	P_label
intra_perfusion_status	0.611 (0.377–0.991)	-1.995	P = 0.046
Pathological_grade	2.575 (1.749–3.790)	4.796	P < 0.001
CA125_group	1.495 (1.050–2.127)	2.233	P = 0.026
CA19-9_group	2.189 (1.501–3.192)	4.071	P < 0.001
Ki67_group	1.976 (1.238–3.154)	2.857	P = 0.004
CCR_Postoperative_group	2.705 (1.295–5.648)	2.649	P = 0.008
PCI_Intraoperative_group	1.129 (0.533–2.391)	0.317	P = 0.751
ALI_group	0.576 (0.398–0.834)	-2.925	P = 0.003

3.4 Nomogram

An eight-variable nomogram was constructed based on the final multivariable Cox model (Fig. 4). The model incorporated pathological grade, Ki-67 group, CCR group, PCI group, CA125 group, CA19-9 group, receipt of intraoperative HIPEC, and ALI. Points were assigned to each variable according to their respective regression coefficients, and 1-year, 2-year, and 3-year OS probabilities were displayed on the nomogram scale. Overall, residual disease and tumor biological activity were the dominant determinants

of prognosis, while inflammation–nutrition indices, particularly ALI, added incremental prognostic value. The model achieved a C-index of 0.753 (95% CI 0.715–0.789).

Risk stratification based on the nomogram-derived linear predictor (total points) demonstrated clear separation between groups. When dichotomized at the median, Kaplan–Meier survival curves showed distinct divergence, with the high-risk group exhibiting consistently lower survival throughout follow-up. Further stratification by tertiles revealed a stepwise decline from low- to intermediate- to high-risk groups (Figs. 5 and 6). These findings indicate that the proposed nomogram provides individualized estimates of 1-year, 2-year, and 3-year OS, effectively distinguishing cohort-level risk tiers. This model thus showed a combination of robust predictive performance and clinical interpretability.

Variables were coded as binary (0 = reference; 1 = risk) as follows:

CCR (postoperative), 0 = CCR0 (no visible disease), 1 = CCR1–3 (residual disease); PCI, 0 = low (study cutoff), 1 = high; ALI, 0 = high, 1 = low; Intraoperative HIPEC, 0 = yes, 1 = no; Pathological grade, 0 = high-grade (no signet-ring cells), 1 = high-grade with signet-ring cells; CA125, 0 = low, 1 = high; CA19-9 category, 0 = low, 1 = high; Ki-67, 0 = low, 1 = high.

Figure 5A. **Kaplan–Meier survival curves for groups stratified by the median of the nomogram-derived total score.** The high-prediction (high-risk) group is shown in blue, and the low-prediction (low-risk) group in red.

3.5 Model Validation

3.5.1 Discrimination

Internal validation using 500 bootstrap resamples yielded a concordance index (C-index) of 0.753 (95% CI [bootstrap, *B* = 500]: 0.715–0.789). At predefined time horizons of 1, 2, and 3 years, the AUCs were 0.810, 0.839, and 0.775, respectively, with the highest discriminative accuracy observed at 2 years (Fig. 6).

3.5.2 Calibration

Calibration plots at 1-, 2-, and 3-year time points were constructed using bin-wise median predicted probabilities, with horizontal error bars representing mean ± standard deviation and vertical bars indicating Kaplan–Meier 95% confidence intervals. Across all time horizons, the model demonstrated excellent calibration, with overall prediction error ranging from approximately 3% to 6% and calibration slopes close to 1.0 (Fig. 7).

3.5.3 Decision-curve analysis

Decision-curve analysis (DCA) demonstrated favorable clinical utility of the nomogram across broad threshold ranges (Fig. 8). For 1-year OS prediction, a net clinical benefit was observed for threshold

probabilities between approximately 0.03 and 0.84, peaking at 0.27. For 2-year OS, the range extended from 0.08 to 0.92 with a peak of 0.47, and for 3-year OS, from 0.13 to 0.94 with a peak of 0.60.

4 Discussion

Prior studies have established that CRS combined with HIPEC markedly improves long-term outcomes in patients with PMP, with CCR and the PCI emerging as independent adverse prognostic factors in multivariable analyses[18–21].A nomogram reported in JAMA Surgery[22] integrated pathological grade, PCI, CCR, and the presence of any elevated tumor marker, achieving an internally validated C-index of 0.74. However, important limitations remain. The predictive value of Ki-67 for recurrence has not been consistent, with variability likely attributable to cutoff selection and sampling heterogeneity, which affect its reproducibility[23]. Similarly, cross-center variability in distinguishing CCR0 from CCR1 may introduce classification bias in pooled analyses[24], while PCI scoring retains an element of subjectivity due to surgeon-assigned regional assessments, particularly in cases with extensive adhesions[25]. Thus, although PCI, CCR, and pathological grade remain the bedrock of PMP prognostication, their limitations in reproducibility, interobserver consistency, and accessibility, particularly in high-grade cohorts, underscore the need for complementary and objective prognostic approaches.

Across malignancies, systemic inflammation and nutritional status have been consistently linked to survival outcomes[26].The ALI has been validated as an independent prognostic factor in metastatic non-small-cell lung cancer, where an ALI < 18 conferred an adjusted HR of 1.42 (95% CI 1.003–2.01)[14]. Similarly, the PNI, originally developed in surgical oncology, has repeatedly been shown to predict adverse outcomes in gastric cancer, with PNI < 45 associated with an HR of 1.8 (95% CI 1.6–2.2) and a higher risk of postoperative complications, suggesting that undernutrition compromises both treatment tolerance and long-term survival[27].

Within PMP, integrating host inflammation nutritional indices appears to enhance prognostic precision. Kusamura et al. developed a composite model incorporating NLR, Onodera's prognostic nutritional index (Onodera PNI), and CA19-9, demonstrating that both systemic inflammation and nutritional status independently influenced survival. However, that model was derived largely from lower-grade disease and included a substantial proportion of preoperatively treated patients (23.9%), which limits its generalizability to high-grade PMP[28]. Among composite scores, the modified Glasgow Prognostic Score (mGPS), based on C-reactive protein and albumin, has also shown prognostic relevance[29]. Nevertheless, most recent studies continue to identify CCR, PCI, and pathological grade as the dominant predictors of prognosis, while standardized cross-center recommendations for inflammation–nutrition indices in PMP have not yet been established[1].

Using preoperative and intraoperative clinical variables, we integrated CCR, PCI, pathological grade, and host inflammation–nutrition status (ALI) to construct an OS prediction model with a C-index of 0.753. Model discrimination was stable across time horizons (AUCs of 0.810, 0.839, and 0.775 at 1, 2, and 3

years, respectively). Calibration plots demonstrated close alignment with the ideal line, and DCA showed sustained net benefit across wide threshold ranges, supporting the model's utility for preoperative risk screening and early-intervention triggers[30,31].

Conceptually, ALI integrates two physiological domains: energy/protein reserves (through BMI and serum albumin) and the systemic inflammatory/immune balance (via NLR). Adequate BMI and albumin reflect a stable internal milieu and enhanced stress recovery capacity, which collectively improve surgical resilience and antitumor response[32]. In contrast, a high NLR (low ALI) signifies a neutrophil-dominant pro-inflammatory milieu, promoting angiogenesis, epithelial–mesenchymal transition, and immunosuppression, thereby facilitating peritoneal adhesion, implantation, and disease progression[33–35]. The inverse holds for lower NLR states, where anti-inflammatory and immune-preserving conditions favor improved oncologic outcomes.

Integrating tumor burden (PCI/CCR), pathology, and host status (inflammation/nutrition) into a single framework may enhance the interpretability and clinical applicability of preoperative stratification in PMP. The literature on PMP prognostication has evolved along two major practical trajectories. First, large-sample nomograms have achieved maturity and reproducibility. For example, the Basingstoke group's tool, developed from 1,102 patients who achieved complete cytoreduction, demonstrated a C-index of 0.74 with stable calibration[22]. Second, systematic reviews have consistently affirmed pathological grade, CCR, and PCI as the core prognostic anchors, with selective but limited incremental value contributed by inflammation–nutrition indices, which currently lack consensus cutoffs and standards[1,36]. Nevertheless, some gaps persist. Many published models combine low- and high-grade disease, which can dilute discriminative accuracy in high-grade subsets[20,25]. In addition, external validation and net-benefit assessment are often incomplete[36,37], and both minimal data sets and methodological standardization remain under development. In contrast, the present study focused on a single, high-risk cohort (appendiceal high-grade PMP) and integrated oncologic and host inflammation–nutrition variables to develop a multivariable OS prediction tool internally validated through bootstrap resampling. The model's AUC exceeding 0.8 at 1 and 2 years indicates strong early-to-mid-term discriminative performance, while excellent calibration and positive decision-curve net benefit support its clinical robustness. Collectively, this study advances two key translational dimensions: "population purification" and "validation plus decision analytics". These advances provide a practical instrument for risk stratification in resource-constrained settings.

This study has some limitations. It was a single-center retrospective analysis with internal validation only, which introduces potential selection and information biases and limits the generalizability of the findings. Moreover, detailed data on systemic chemotherapy, targeted therapy, and immunotherapy were unavailable, and these factors may have influenced prognosis. Future research should aim to achieve external validation with model recalibration in larger multi-institutional cohorts. In addition, real-world evaluations, including assessments of decision-impact and cost-effectiveness, are warranted to

determine whether this nomogram can meaningfully inform nutritional interventions, prehabilitation strategies, and postoperative surveillance in clinical practice.

5 Conclusions

This study identified the ALI as a clinically meaningful inflammation–nutrition biomarker in appendiceal high-grade PMP. By integrating ALI with established prognostic variables, including PCI, CCR, pathological grade, Ki-67, and serum tumor markers, we developed a robust prognostic model with strong discriminative performance and practical utility for predicting OS in this population. Clinically, ALI may support tailoring of perioperative strategies: patients with low ALI may benefit from preoperative nutritional and inflammatory optimization (prehabilitation) prior to definitive surgery, whereas those with high ALI and an anticipated CCR0–1 resection may be suitable candidates for one-stage CRS ± HIPEC. Future studies should focus on multicenter, prospective external validation and evaluate whether ALI-guided optimization and prehabilitation confer real-world benefits for high-risk patients identified by the model.

Abbreviations

Abbreviation
Full Term
AIC
Akaike Information Criterion
ALI
Advanced Lung Cancer Inflammation Index
AUC
Area Under the Curve
BMI
Body Mass Index
CCR
Completeness of Cytoreduction
CI
Confidence Interval
CRS
Cytoreductive Surgery
DCA
Decision-Curve Analysis
HIPEC
Hyperthermic Intraperitoneal Chemotherapy
HIS
Hospital Information System
HR

Hazard Ratio
IQR
Interquartile Range
LMR
Lymphocyte-to-Monocyte Ratio
NLR
Neutrophil-to-Lymphocyte Ratio
OS
Overall Survival
PCI
Peritoneal Cancer Index
PLR
Platelet-to-Lymphocyte Ratio
PMP
Pseudomyxoma Peritonei
PNI
Prognostic Nutritional Index
PSOGI
Peritoneal Surface Oncology Group International
PSS
Prior Surgical Score
ROC
Receiver Operating Characteristic
SII
Systemic Immune-Inflammation Index
SIS
Systemic Inflammation Score
VIF
Variance Inflation Factor

Declarations

Competing interests

All authors declare that they have no competing interests or financial relationships that could be construed to influence the work reported in this paper.

Ethics approval and consent to participate

This study was approved by the Aerospace Center Hospital Institutional Review Board (approval No. 20161109-ST-07). Written informed consent was obtained from all participants.

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Author Contribution

Conceptualization: Yun Gao, Guangyu AnData curation: Ruiqing Ma, Zhenhai Feng, Siyi YangFormal analysis: Ruiqing Ma, Yun GaoMethodology: Yun Gao, Ruiqing MaInvestigation: Zhenhai Feng, Siyi YangWriting — original draft: Yun GaoWriting — review & editing: All authorsSupervision: Guangyu An

Data Availability

De-identified summary data generated during this study are available from the corresponding author on reasonable request.

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Figures

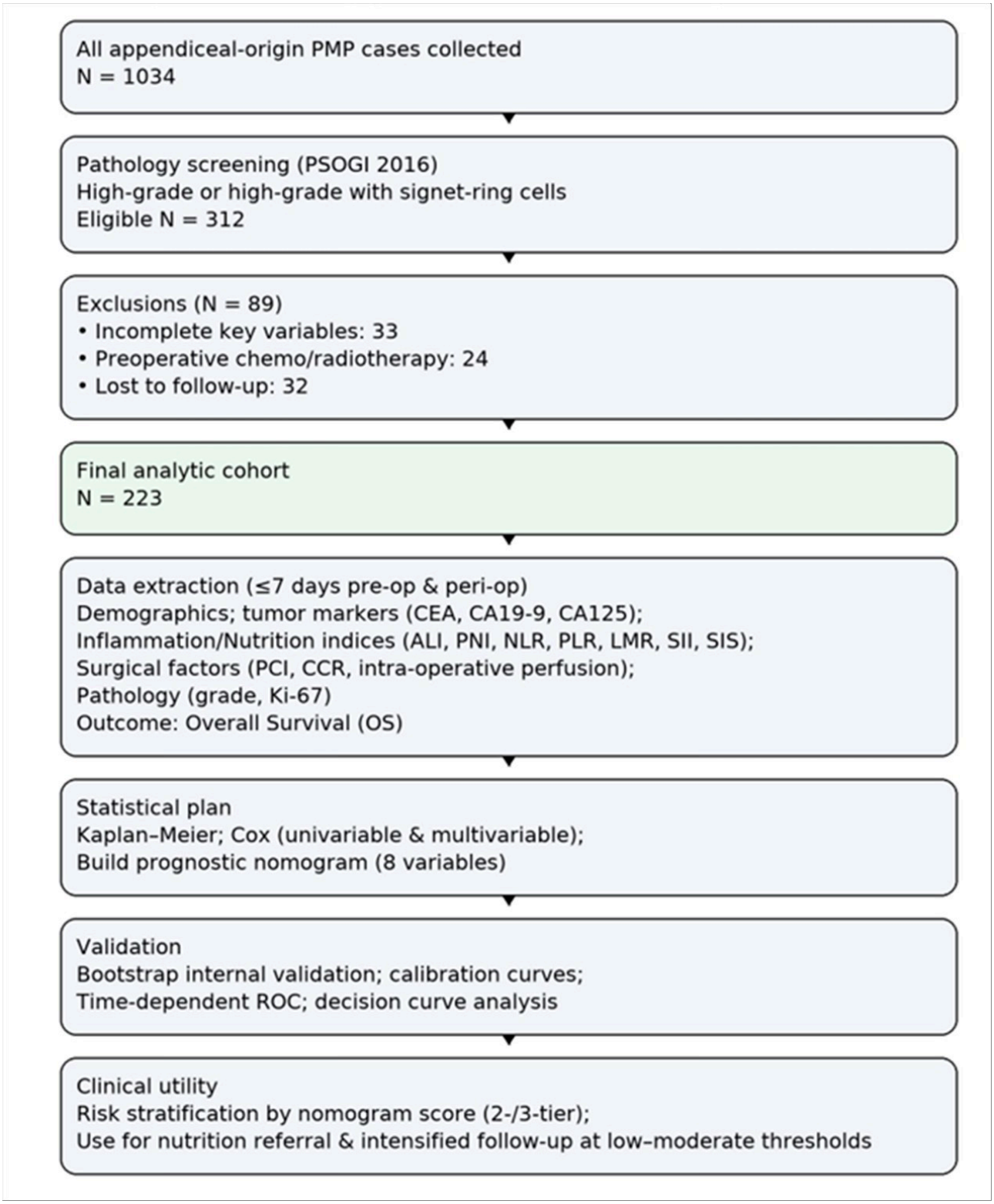

Figure 1

Schematic illustration of the study design and patient-selection criteria

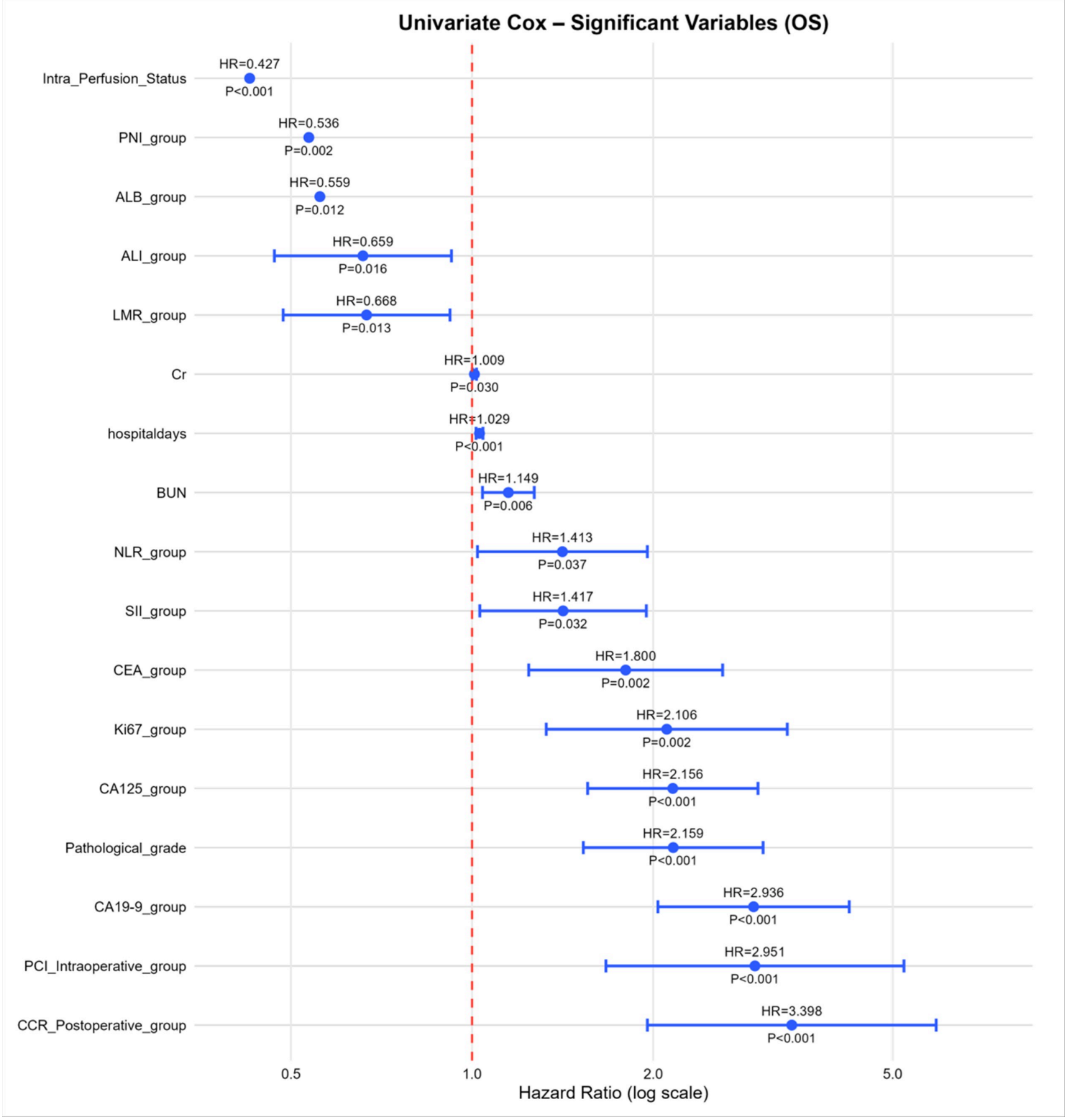

Figure 2

Forest plot of variables significantly associated with overall survival in univariable Cox proportional hazards analyses (variable coding: 0 = low; 1 = high)

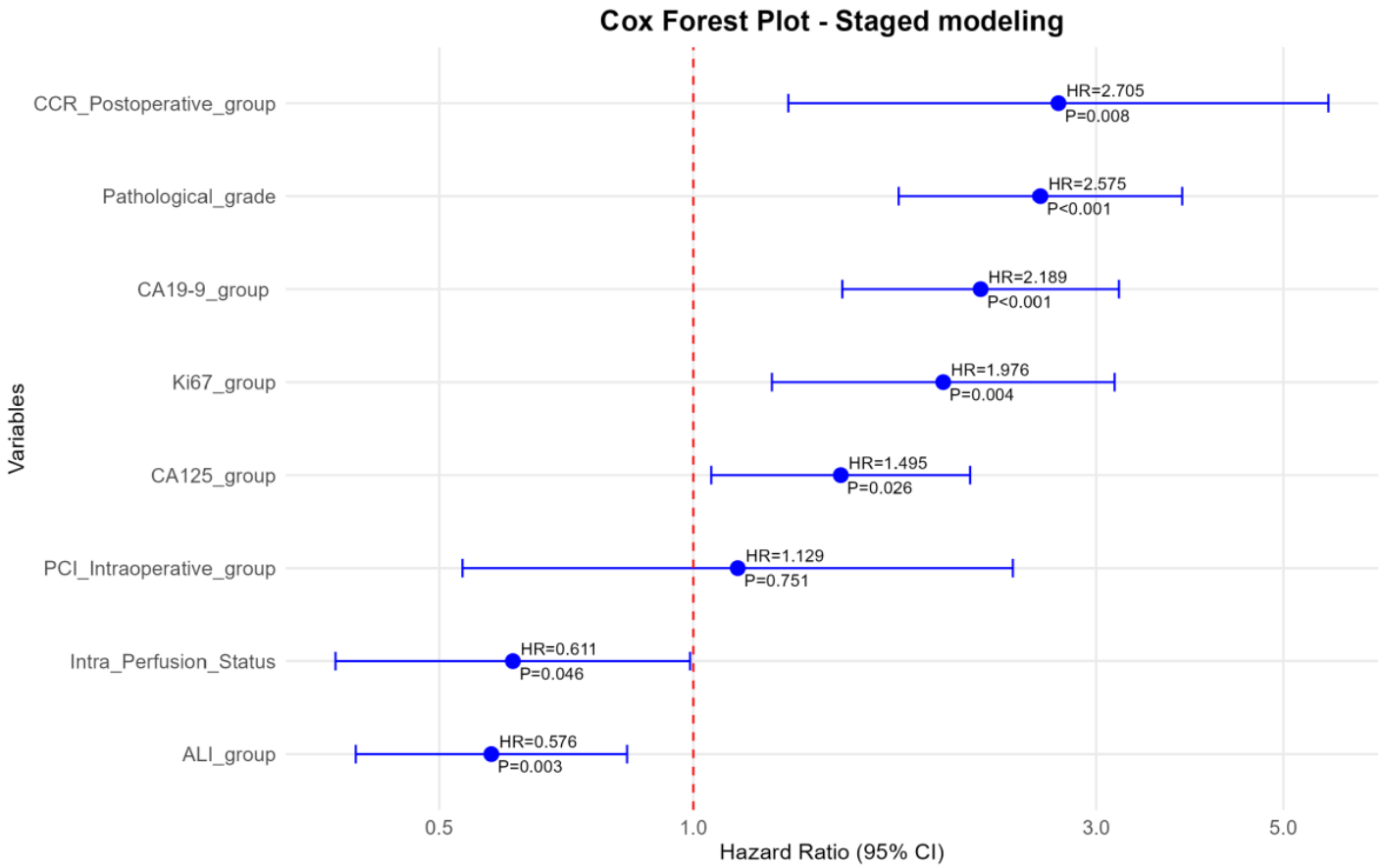

Figure 3

Forest plot showing adjusted hazard ratios for variables included in the multivariable Cox proportional hazards model

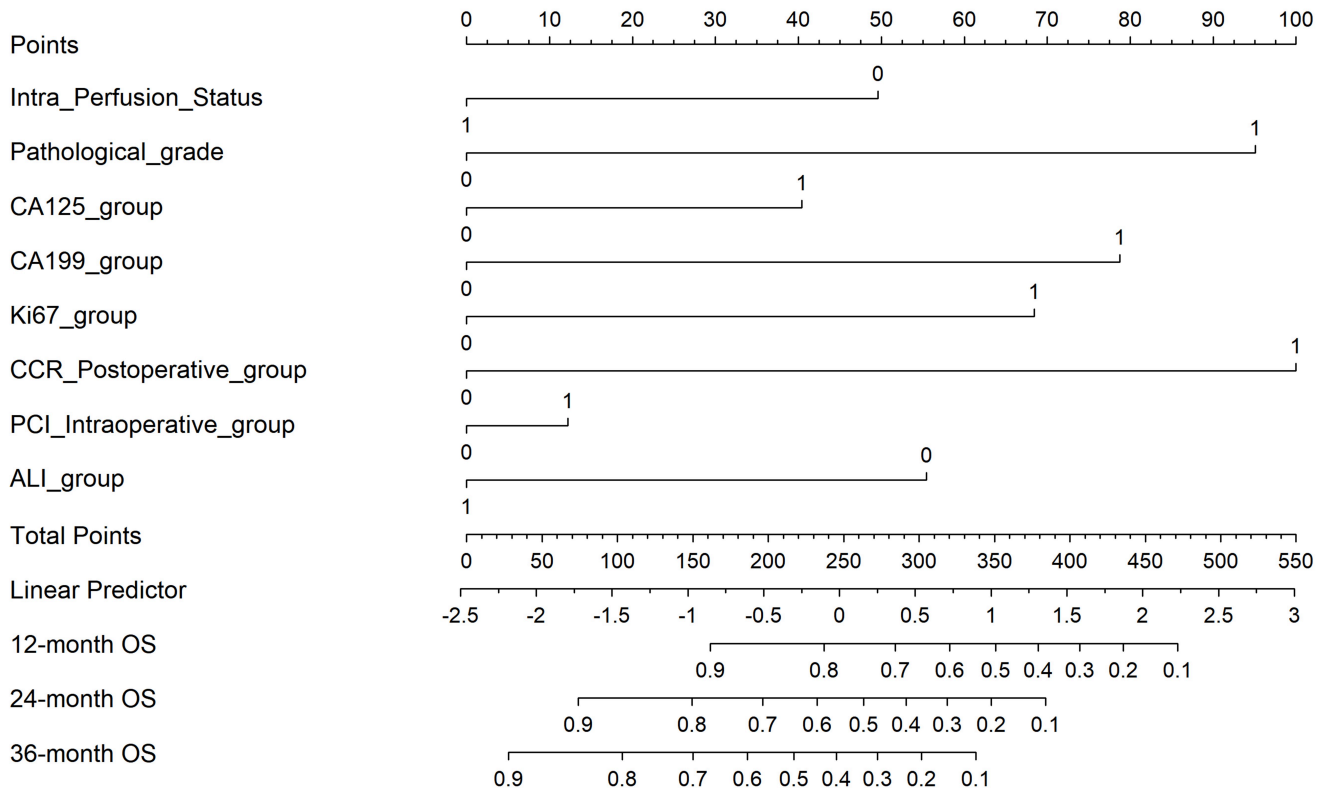

Figure 4

Nomogram for predicting 1-, 2-, and 3-year overall survival (OS)

Variables were coded as binary (0 = reference; 1 = risk) as follows:

CCR (postoperative), 0 = CCR0 (no visible disease), 1 = CCR1–3 (residual disease); PCI, 0 = low (study cutoff), 1 = high; ALI, 0 = high, 1 = low; Intraoperative HIPEC, 0 = yes, 1 = no; Pathological grade, 0 = high-grade (no signet-ring cells), 1 = high-grade with signet-ring cells; CA125, 0 = low, 1 = high; CA19-9 category, 0 = low, 1 = high; Ki-67, 0 = low, 1 = high.

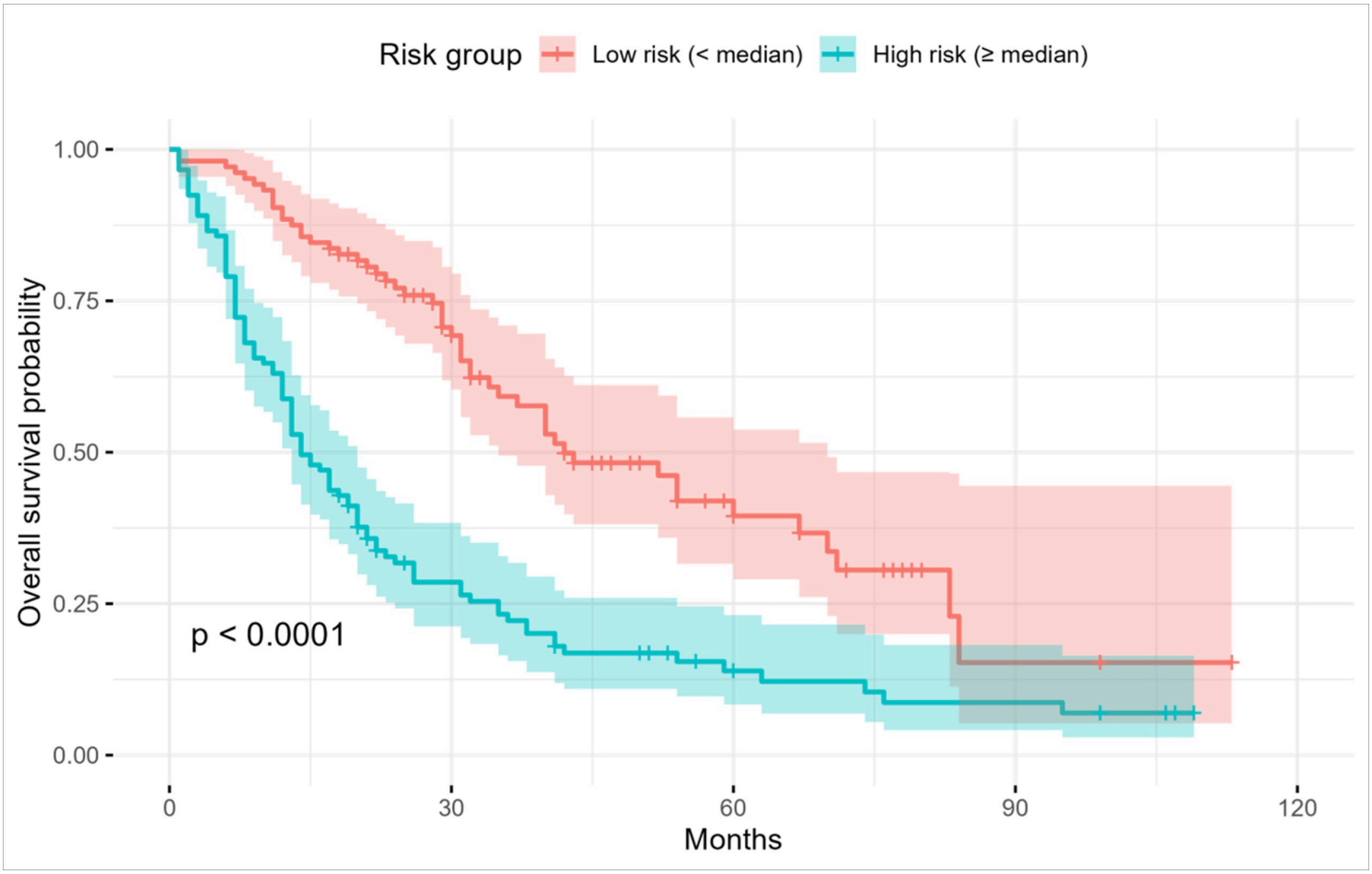

Figure 5

Figure 5A. Kaplan–Meier survival curves for groups stratified by the median of the nomogram-derived total score. The high-prediction (high-risk) group is shown in blue, and the low-prediction (low-risk) group in red.

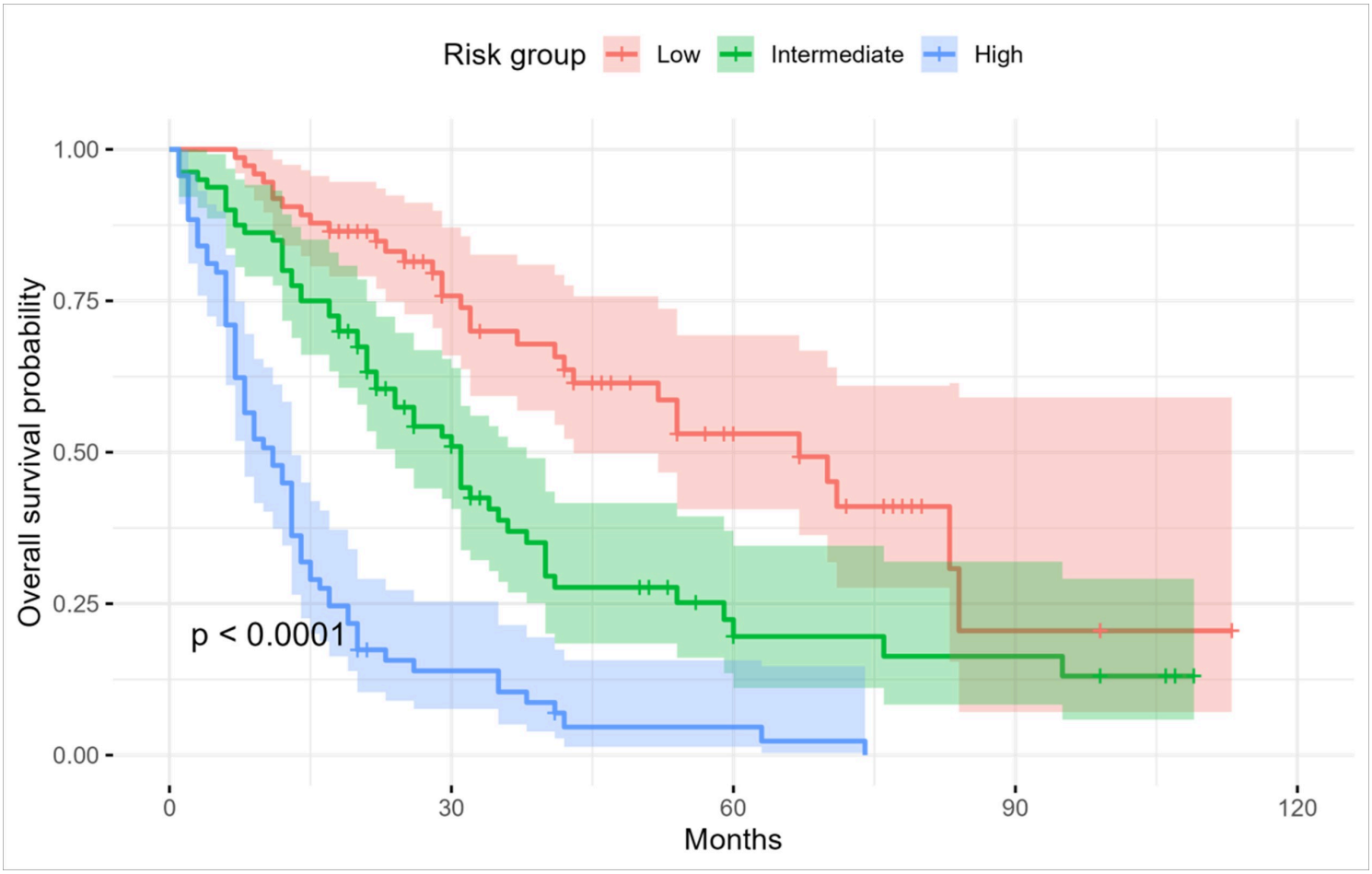

Figure 6

Figure 5B. Kaplan–Meier survival curves for tertiles of the nomogram-derived total score (high-risk group, blue; intermediate-risk group, green; low-risk group, red).

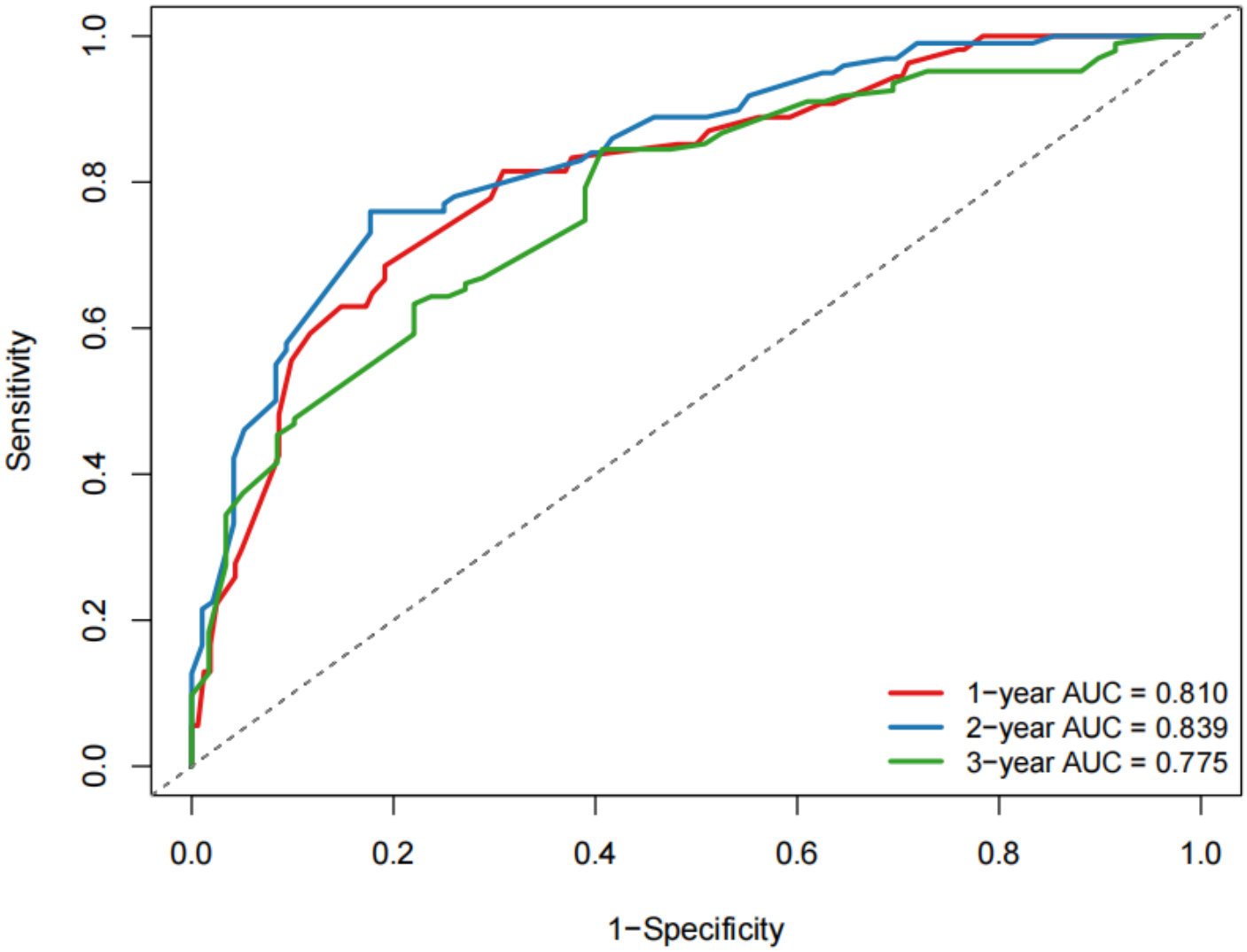

Figure 7

Figure 6. Receiver operating characteristic (ROC) curves for predicting 1-, 2-, and 3-year overall survival (OS) based on the final multivariable nomogram model.

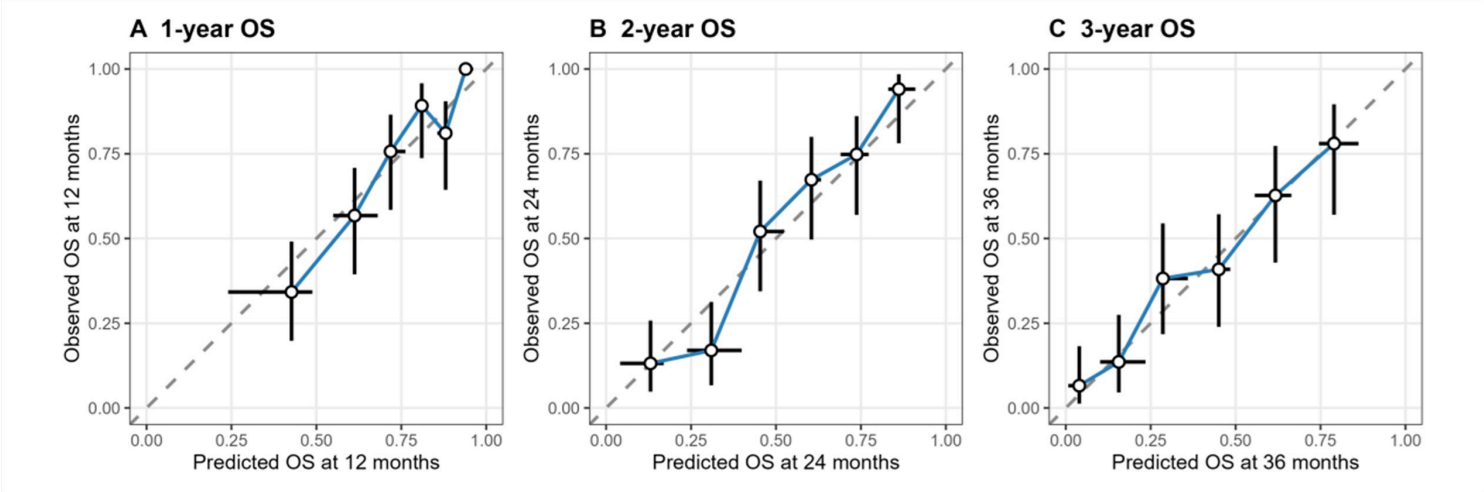

Figure 8

Figure 7. Calibration plots for predicting 1-, 2-, and 3-year overall survival (OS) using the final nomogram

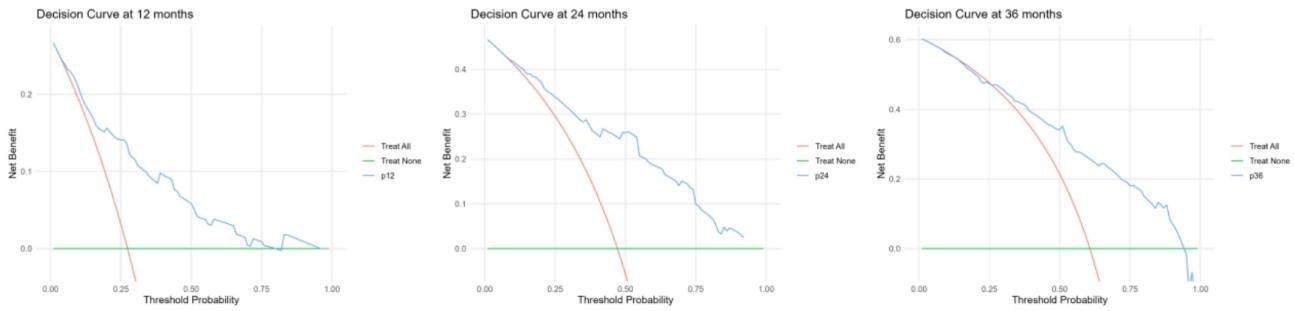

Figure 9

Figure 8. Decision-curve analysis (DCA) curves for 1-, 2-, and 3-year overall survival (OS). The *treat-all* and *treat-none*strategies are shown as reference lines.

Supplementary Files

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- Appendix.docx