

Five-year Survival Analyses on Non-Pathological Complete Response Esophageal Squamous Cell Carcinoma Patients after Neoadjuvant Regimens plus Surgery: a Propensity Score Matching, Real-World Cohort Study

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Research Article

Keywords: esophageal squamous cell carcinoma, non-pathological complete response, neoadjuvant immunochemotherapy, perineural invasion, Ki-67

Posted Date: January 29th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-8484860/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Non-pathological complete response (non-pCR) is common in esophageal squamous cell carcinoma (ESCC) patients after neoadjuvant therapy, yet evidence guiding long-term outcome and postoperative risk stratification in the immunotherapy era remains limited.

Methods

We retrospectively enrolled consecutive ESCC patients treated with neoadjuvant immunochemotherapy (nICT) or chemotherapy alone (nCT) followed by esophagectomy and restricted analyses to non-pCR cases. Primary endpoints were five-year overall survival (OS) and event-free survival (EFS). Propensity score matching analysis and 60-month censoring were used to reduce differences between groups. Cox proportional hazards model was used for analysis.

Results

Among 366 non-pCR patients, 164 matched pairs were generated. After matching, nICT demonstrated a higher major pathological response (MPR) rate (19.5% vs 6.1%), a lower ypT4 proportion (3.7% vs 22.0%) and fewer recurrence/metastasis rate (40.2% vs 58.5%) (all $p < 0.001$). Five-year OS rate (50.6% vs 37.2%, $p = 0.014$) and EFS rate (50.0% vs 31.1%, $p < 0.001$) were higher in nICT group. In matched multivariable Cox model, nICT was independently associated with improved EFS ($P = 0.005$) but not OS ($P = 0.707$). Adverse EFS was independently associated with open esophagectomy (OE) ($p = 0.003$), ypN2-3 ($p < 0.001$) and perineural invasion (PNI) ($p = 0.003$), while lower Ki-67 ($p = 0.035$) and postoperative adjuvant treatment ($p = 0.012$) were associated with improved EFS. For OS, PNI was an adverse factor ($p = 0.004$), whereas postoperative adjuvant treatment was a protective one ($p < 0.001$).

Conclusion

Among non-pCR ESCC patients after neoadjuvant therapy and surgery, nICT was associated with lower recurrence risk and improved five-year EFS compared with nCT, whereas a significant OS advantage was not observed. Pathological factors (PNI, high Ki-67, and residual nodal burden) and postoperative treatment were important correlates of long-term outcomes and may inform postoperative risk stratification and management.

Introduction

Esophageal squamous cell carcinoma (ESCC) remains a major cause of cancer-related mortality worldwide, particularly in Northern Europe, China and East Asia^{1,2}. Currently, neoadjuvant

chemoradiotherapy (nCRT) or neoadjuvant chemotherapy (nCT) combined with surgery remains the standard treatment for locally advanced esophageal cancer (EC)^{3–5}. With the advent and wide application of immune checkpoint blockades, such as PD-1/PD-L1 inhibitors, neoadjuvant immunochemotherapy (nICT) has turned out an important part of the multimodal treatment of ESCC⁶. Phase II-III trials and real-world cohort studies had consistently shown that nICT improves pathological complete response (pCR) rates and may probably translate into survival benefits compared with chemotherapy alone^{7–10}.

Although pCR is a well-recognized favorable surrogate endpoint, a majority of patients would inevitably have residual disease (non-pCR) after neoadjuvant therapy¹¹. In clinical practice, non-pCR patients represent a biologically heterogeneous and clinically prevalent population with substantial risk of recurrence in tumor site or distant metastasis, for whom optimal postoperative risk stratification, surveillance intensity, and adjuvant strategy remain uncertain^{12,13}. Moreover, while pathological response metrics are increasingly used to benchmark neoadjuvant regimens, the extent to which pathologic response fully captures long-term benefit remains debated^{14,15}.

Our current study therefore focused on the clinically prevalent non-pCR population, aiming to determine whether neoadjuvant regimen choice (nICT or nCT) remains prognostically relevant after resection. We compared long-term outcomes using propensity score matching and standardized follow-up windows, and we explored clinicopathological predictors that could support pathology-anchored postoperative risk stratification.

Methods

2.1. Study design and patients

This was a single-center retrospective cohort study conducted at Fujian Medical University Cancer Hospital. Consecutive patients with histologically confirmed as ESCC who received neoadjuvant therapy followed by esophagectomy with lymphadenectomy between January 2017 and December 2023 were screened (Fig. 1). The inclusion criteria were: (1) histologically confirmed as ESCC; (2) underwent preoperative nICT or nCT; and (3) underwent esophagectomy and lymphadenectomy. The exclusion criteria were: (1) cervical or esophagogastric junction ESCC; (2) esophageal adenocarcinoma, small cell carcinoma, or other histology; (3) Non-regional lymph node metastasis and/or distant organ metastasis, except supraclavicular lymph node metastasis; (4) received preoperative other antitumor therapies; (5) simultaneously combined with other malignant tumors; (6) incomplete medical records; and (7) patients with pCR.

2.2. Neoadjuvant therapy and surgery

All patients completed at least one cycle of neoadjuvant therapy before surgery, administered every 3 weeks. nCT consists of a taxane (paclitaxel, albumin-bound paclitaxel, or docetaxel) plus a platinum

agent (cisplatin, carboplatin, lobaplatin, or nedaplatin). nICT includes the addition of a PD-1 inhibitor (pembrolizumab, camrelizumab, tislelizumab, toripalimab, serplulimab or sintilimab) to the nCT base regimen. All patients underwent esophagectomy and lymphadenectomy after neoadjuvant therapy. Surgeries included open esophagectomy (OE) or minimally invasive esophagectomy (MIE), mainly McKeown or Ivor-Lewis procedure. Resected tumor and lymph node specimens were evaluated by two independent pathologists. pCR was defined as the absence of any viable cancer cells at both the primary tumor site and the regional lymph nodes and major pathological response (MPR) was defined as < 10% viable tumor cells in the primary tumor bed¹⁶. All patients except pCR were classified as non-pCR.

2.3. Collection of clinicopathological data

Data were collected from the hospital's medical record, including: age, gender, body mass index (BMI), personal medical history, esophageal tumor location, neoadjuvant treatment regimen, surgical data, pathological data, clinical TNM staging (cT, cN and cM), and auxiliary examination data. The pathological data include TNM staging (ypT, ypN and ypM), perineural invasion (PNI), lymphovascular invasion (LVI), tumor pathological response, Ki-67, histologic grade and margin status, etc. TNM staging was based on the AJCC 8th edition¹⁷. Ki-67 was divided into high (> 0.65) and low (< = 0.65) groups according to the median. Postoperative treatment (post_treatment) information is postoperative adjuvant therapy, excluding treatment after recurrence and/or metastasis.

2.4. Endpoints and Follow-up

The study endpoints were five-year OS and five-year EFS. OS was defined as the time from initiation of neoadjuvant therapy to death from any cause. EFS was defined as the time from initiation of neoadjuvant therapy to the first occurrence of recurrence/metastasis or death, whichever occurred first. To mitigate bias from unequal follow-up between regimens, survival time was administratively censored at 60 months for both endpoints. Patients without an event were censored at the last follow-up date or 60 months, whichever came first. Follow-up was conducted through outpatient reviews, inpatient records, and telephone inquiry. Recurrence/metastasis was confirmed by imaging and/or pathological examination.

2.5. Statistical analysis

Continuous variables were described with the use of medians (Q1, Q3) and categorical variables with the use of counts (percentages). Differences between groups were compared using the chi-square test or Fisher's exact test for categorical variables and the Wilcoxon rank-sum test for continuous variables as appropriate. Propensity scores were estimated using logistic regression including the covariates listed in Table 1, followed by 1:1 optimal pair matching without replacement (MatchIt package, R). Covariate balance was assessed using standardized mean differences. OS and EFS were estimated using the Kaplan-Meier method and compared using the log-rank test. Cox proportional hazards models were used for univariable and multivariable analyses in both the overall cohort and the matched cohort; robust standard errors clustered by matched pair were used for analyses after propensity score matching

(PSM). All tests were two-sided and $p < 0.05$ was considered statistically significant. Analyses were conducted using R software (Version 4.2.2).

Table 1
Baseline characteristics before and after propensity score matching.

Characteristics	Unmatched			Matched		
	nICT	nCT	p-value	nICT	nCT	p-value
	N = 202	N = 164		N = 164	N = 164	
Age , Median (Q1, Q3)	62 (56, 68)	60 (55, 66)	0.045 ¹	62 (55, 67)	60 (55, 66)	0.155 ¹
Sex , n (%)			0.195 ²			0.286 ²
Female	38 (19%)	40 (24%)		32 (20%)	40 (24%)	
Male	164 (81%)	124 (76%)		132 (80%)	124 (76%)	
BMI , Median (Q1, Q3)	21.48 (19.37, 23.42)	21.55 (20.01, 23.82)	0.199 ¹	21.62 (19.51, 23.58)	21.55 (20.01, 23.82)	0.551 ¹
Smoker , n (%)	82 (41%)	66 (40%)	0.946 ²	66 (40%)	66 (40%)	> 0.999 ²
Drinker , n (%)	38 (19%)	32 (20%)	0.865 ²	33 (20%)	32 (20%)	0.890 ²
cT , n (%)			0.387 ²			0.517 ²
T1-2	31 (15%)	20 (12%)		24 (15%)	20 (12%)	
T3-4	171 (85%)	144 (88%)		140 (85%)	144 (88%)	
cN , n (%)			0.719 ²			0.721 ²
N0	30 (15%)	26 (16%)		22 (13%)	26 (16%)	
N1-2	161 (80%)	126 (77%)		132 (80%)	126 (77%)	
N3	11 (5%)	12 (7%)		10 (6%)	12 (7%)	
cM , n (%)			0.079 ³			> 0.999 ³
M0	195 (97%)	163 (99%)		164 (100%)	163 (99%)	
M1 (lymph nodes)	7 (3%)	1 (1%)		0 (0%)	1 (1%)	
¹ Wilcoxon rank sum test; ² Pearson's Chi-squared test; ³ Fisher's exact test. Abbreviations: nICT, neoadjuvant immunochemotherapy; nCT, neoadjuvant chemotherapy; MIE, Minimally Invasive Esophagectomy; OE, Open Esophagectomy; Post_treatment, postoperative adjuvant therapy.						
Legends: Table 1 presents the basic clinical characteristic data of the two groups (nICT vs nCT) before and after PSM.						

Characteristics	Unmatched			Matched		
	nICT	nCT	p-value	nICT	nCT	p-value
	N = 202	N = 164		N = 164	N = 164	
Neoadjuvant treatment cycles, n (%)			< 0.001 ²			0.604 ²
1	21 (10%)	18 (11%)		19 (12%)	18 (11%)	
2	145 (72%)	139 (85%)		134 (82%)	139 (85%)	
≥3	36 (18%)	7 (4%)		11 (7%)	7 (4%)	
Surgical type, n (%)			0.001 ²			0.024 ²
MIE	167 (83%)	112 (68%)		130 (79%)	112 (68%)	
OE	35 (17%)	52 (32%)		34 (21%)	52 (32%)	
Resection degree, n (%)			0.057 ²			0.170 ²
Non-R0	41 (20%)	21 (13%)		30 (18%)	21 (13%)	
R0	161 (80%)	143 (87%)		134 (82%)	143 (87%)	
Post_treatment, n (%)			0.467 ²			0.629 ²
No	65 (32%)	47 (29%)		51 (31%)	47 (29%)	
Yes	137 (68%)	117 (71%)		113 (69%)	117 (71%)	
¹ Wilcoxon rank sum test; ² Pearson's Chi-squared test; ³ Fisher's exact test. Abbreviations: nICT, neoadjuvant immunochemotherapy; nCT, neoadjuvant chemotherapy; MIE, Minimally Invasive Esophagectomy; OE, Open Esophagectomy; Post_treatment, postoperative adjuvant therapy.						
Legends: Table 1 presents the basic clinical characteristic data of the two groups (nICT vs nCT) before and after PSM.						

Results

3.1. Patient base characteristics

A total of 366 non-pCR patients were included (nICT = 202; nCT = 164). Before matching, several characteristics differed between groups, including age, neoadjuvant cycle distribution, and surgical approach. PSM yielded 164 well-matched pairs and improved comparability between treatment groups (Table 1).

3.2. Pathological findings

Post-treatment pathological staging, tumor response, pathological risk features and are summarized in Table 2. After matching, patients receiving nICT had a higher rate of MPR (19.5% vs 6.1%) and a lower proportion of ypT4 (3.7% vs 22.0%) compared with nCT, suggesting deeper tumor regression. The five-year OS rate and five-year EFS rate of the nICT group were both higher than those of the nCT group (five-year OS rate, 50.6% vs 37.2%; $p = 0.014$; five-year EFS rate, 50.0% vs 31.1%; $p < 0.001$). The incidence of recurrence/metastasis during follow-up was also lower in the nICT group (40.2% vs 58.5%, $p < 0.001$).

Table 2

Post-treatment pathological characteristics and postoperative outcomes before and after propensity score matching.

Characteristic	Unmatched			Matched		
	nICT N = 202	nCT N = 164	p-value	nICT N = 164	nCT N = 164	p-value ¹
Ki-67 , Median (Q1, Q3)	0.60 (0.50, 0.80)	0.70 (0.50, 0.80)	0.946 ¹	0.65 (0.50, 0.80)	0.70 (0.50, 0.80)	0.801 ¹
Ki-67 Group , n (%)			0.744 ²			0.878 ²
High	65 (48.9%)	47 (51.1%)		54 (50.0%)	47 (51.1%)	
Low	68 (51.1%)	45 (48.9%)		54 (50.0%)	45 (48.9%)	
Histologic Grade , n (%)			0.117 ³			0.113 ³
G1	36 (19.3%)	18 (11.4%)		30 (19.9%)	18 (11.4%)	
G2	147 (78.6%)	135 (85.4%)		117 (77.5%)	135 (85.4%)	
G3	4 (2.1%)	5 (3.2%)		4 (2.6%)	5 (3.2%)	
PNI , n (%)	76 (37.6%)	40 (24.4%)	0.007 ²	58 (35.4%)	40 (24.4%)	0.030 ²
LVI , n (%)	107 (53.0%)	80 (48.8%)	0.425 ²	88 (53.7%)	80 (48.8%)	0.377 ²
Tumor response , n (%)			< 0.001 ²			< 0.001 ²
MPR	41 (20.3%)	10 (6.1%)		32 (19.5%)	10 (6.1%)	
PR	161 (79.7%)	154 (93.9%)		132 (80.5%)	154 (93.9%)	
ypT , n (%)			< 0.001 ²			< 0.001 ²

¹Wilcoxon rank sum test, ²Pearson's Chi-squared test, ³Fisher's exact test. Abbreviations: nICT, neoadjuvant immunochemotherapy; nCT, neoadjuvant chemotherapy; PNI, perineural invasion; LVI, lymphovascular invasion; MPR, major pathological response; OS, overall survival; EFS, event-free survival.

Legends: Table 2 presents the postoperative pathological characteristics and five-year survival data of the two groups before and after PSM.

Characteristic	Unmatched			Matched		
	nICT N = 202	nCT N = 164	p-value	nICT N = 164	nCT N = 164	p-value ¹
T0-2	79 (39.1%)	36 (22.0%)		64 (39.0%)	36 (22.0%)	
T3	115 (56.9%)	92 (56.1%)		94 (57.3%)	92 (56.1%)	
T4	8 (4.0%)	36 (22.0%)		6 (3.7%)	36 (22.0%)	
ypN, n (%)			0.178 ²			0.119 ²
N0	99 (49.0%)	78 (47.6%)		77 (47.0%)	78 (47.6%)	
N1	64 (31.7%)	42 (25.6%)		56 (34.1%)	42 (25.6%)	
N2-3	39 (19.3%)	44 (26.8%)		31 (18.9%)	44 (26.8%)	
ypM, n (%)			0.865 ²			> 0.999 ²
M0	185 (91.6%)	151 (92.1%)		151 (92.1%)	151 (92.1%)	
M1(lymph nodes)	17 (8.4%)	13 (7.9%)		13 (7.9%)	13 (7.9%)	
OS, Median (Q1, Q3)	859 (631, 1,213)	1,075 (508, 2,129)	< 0.001 ¹	860 (680, 1,224)	1,075 (508, 2,129)	0.004 ¹
EFS, Median (Q1, Q3)	747 (341, 1,091)	645 (261, 2,041)	0.178 ¹	774 (357, 1,115)	645 (261, 2,041)	0.270 ¹
Five-year OS rate, n(%)	99 (49.0%)	61 (37.2%)	0.023 ²	83 (50.6%)	61 (37.2%)	0.014 ²
Five-year EFS rate, n(%)	98 (48.5%)	51 (31.1%)	< 0.001 ²	82 (50.0%)	51 (31.1%)	< 0.001 ²
¹ Wilcoxon rank sum test, ² Pearson's Chi-squared test, ³ Fisher's exact test. Abbreviations: nICT, neoadjuvant immunochemotherapy; nCT, neoadjuvant chemotherapy; PNI, perineural invasion; LVI, lymphovascular invasion; MPR, major pathological response; OS, overall survival; EFS, event-free survival.						
Legends: Table 2 presents the postoperative pathological characteristics and five-year survival data of the two groups before and after PSM.						

Characteristic	Unmatched			Matched		
	nICT N = 202	nCT N = 164	p-value	nICT N = 164	nCT N = 164	p-value ¹
Recurrence/Metastasis, n (%)	83 (41.1%)	96 (58.5%)	< 0.001 ²	66 (40.2%)	96 (58.5%)	< 0.001 ²
¹ Wilcoxon rank sum test, ² Pearson's Chi-squared test, ³ Fisher's exact test. Abbreviations: nICT, neoadjuvant immunochemotherapy; nCT, neoadjuvant chemotherapy; PNI, perineural invasion; LVI, lymphovascular invasion; MPR, major pathological response; OS, overall survival; EFS, event-free survival.						
Legends: Table 2 presents the postoperative pathological characteristics and five-year survival data of the two groups before and after PSM.						

3.3. Univariate and multivariate regression analyses of the five-year OS and EFS.

Cox regression results for five-year OS and five-year EFS are presented in **Supplementary table 1–2**. After matching, nICT was associated with a significantly lower risk of EFS events (HR 0.55, 95% CI 0.36–0.84; P = 0.005). In contrast, five-year OS did not differ significantly between treatment groups (HR 0.94, 95% CI 0.70–1.27; P = 0.707). In the matched multivariable model for EFS, OE (HR 1.87, 95% CI 1.24–2.83; p = 0.003), ypN2-3 (HR 2.82, 95% CI 1.55–5.11; p < 0.001), and PNI (HR 1.93, 95% CI 1.24-3.00; p = 0.003) were independently associated with worse EFS. In addition, lower Ki-67 (HR 0.65, 95% CI 0.44–0.97; p = 0.035) and postoperative adjuvant treatment (HR 0.57, 95% CI 0.36–0.88; p = 0.012) are protective factors for EFS. For OS, PNI was an adverse factor (HR 1.66, 95% CI 1.17–2.36; p = 0.004), whereas postoperative adjuvant treatment was protective (HR 0.54, 95% CI 0.39–0.77; p < 0.001). The main influencing factors associated with 5-year OS and 5-year EFS are shown in Fig. 2 forest plots and Fig. 3 survival curves.

Discussion

In this real-world cohort restricted to the clinically prevalent non-pCR ESCC population, nICT was associated with a meaningful reduction in relapse risk and improvement in long-term EFS compared with nCT after rigorous adjustment, including propensity score matching and administrative censoring at 60 months. Specifically, the nICT group demonstrated higher 5-year OS and 5-year EFS rates than the nCT group, and in the matched cohort nICT was linked to a significantly lower risk of EFS events, whereas the difference in 5-year OS was not statistically significant. These research results indicate that even if a patient does not achieve pCR, nICT can still show clinically benefits.

Beyond regimen selection, we identified a set of post-treatment pathological aggressiveness markers that independently stratified risk. In the matched multivariable model, ypN2-3 was among the strongest predictors of adverse EFS, underscoring the dominant prognostic role of residual nodal burden after

neoadjuvant therapy. This is consistent with contemporary evidence showing that post-neoadjuvant nodal status (ypN) remains a major determinant of recurrence and survival after induction therapy and surgery in esophageal cancer, and that nodal downstaging is associated with superior outcomes^{18,19}. We further identified post-treatment pathological aggressiveness markers, including PNI, LVI, high Ki-67, and margin status (non-R0 resection), as independent predictors of adverse outcomes. The prognostic impact of PNI and LVI in our cohort aligns with prior evidence that these histopathologic features indicate aggressive invasion patterns and a higher propensity for dissemination²⁰. A recent study incorporating PNI and LVI demonstrated their utility for recurrence risk modeling after neoadjuvant chemoradiotherapy and esophagectomy in ESCC²¹. Evidence also continues to support the prognostic relevance of margin involvement definitions (e.g., circumferential resection margin) for recurrence and survival, providing a rationale for incorporating margin status into postoperative risk assessment²². In addition, high Ki-67 expression indicates higher proliferative activity and is associated with poorer survival rates in patients with esophageal squamous cell carcinoma, which is consistent with previous study^{23,24}. These variables are readily available in routine pathology and may support practical, pathology-anchored risk stratification to guide surveillance intensity and adjuvant decision-making.

The protective association of postoperative adjuvant treatment across both OS and EFS in our matched cohort suggested that postoperative systemic therapy may partially mitigate residual micrometastatic risk in high-risk non-pCR patients. This interpretation is consistent with the evolving paradigm that adjuvant systemic therapy can translate residual pathological risk into improved disease control after multimodality management, supported by the emerging overall survival analysis from CheckMate 577 and corroborated by contemporary real-world matched comparisons of adjuvant nivolumab following neoadjuvant chemoradiotherapy and resection^{25,26}. In addition, retrospective evidence further suggests that postoperative adjuvant therapy after neoadjuvant immunochemotherapy can benefit patients in pathological high-risk subgroups¹³. However, different regimens of postoperative adjuvant therapy and patient compliance may affect the readability of related outcomes. Prospective trials are still needed in the non-pCR population after neoadjuvant therapy to determine the best drug and patient selection criteria.

The association between open esophagectomy and worse OS/EFS should be interpreted cautiously. Randomized trials comparing minimally invasive and open approaches reported reduced pulmonary complications with minimally invasive or hybrid techniques, with broadly comparable long-term oncologic survival²⁷. Surgical approach may partially capture tumor extent, technical complexity, or perioperative complication burden, any of which could influence survival outcomes.

The association between OE and worse OS/EFS should be interpreted cautiously, because operative approach may reflect confounding by indication (tumor extent, technical complexity), center/surgeon factors, and postoperative complication burden rather than a direct causal effect. Recent large systematic review indicate that MIE was superior to OE treatment in terms of blood loss, pulmonary complications, and length of hospital stay, but showed a balance in mortality, survival, and oncologic

outcomes²⁸. Notably, other high-quality studies have shown improved survival with MIE compared with OE^{29,30}. At present, MIE should be recommended as a preferred surgical procedure.

Several limitations should be mentioned: (1) As a single-center retrospective cohort study, selection bias and information bias were inevitable, and in the future a multicenter retrospective study would be conducted to further validate the current findings; (2) Different specific drugs within the neoadjuvant categories, despite sharing similar mechanisms, might have potential inter-drug differences affecting the outcomes; (3) Missingness in key variables such as Ki-67 and histologic grade was non-negligible; (4) Imaging modalities like CT have inherent false positives and negatives in assessing lymph node metastasis, potentially affecting accuracy in recurrence evaluation. Despite these limitations, the findings suggest that neoadjuvant regimen choice and post-treatment pathology provide effective prognostic information in non-pCR ESCC patients.

Conclusions

Among non-pCR ESCC patients after neoadjuvant therapy and surgery, nICT was associated with lower recurrence risk and improved five-year EFS compared with nCT, whereas a significant OS advantage was not observed. Pathological factors (PNI, high Ki-67, and residual nodal burden) and postoperative treatment were important correlates of long-term outcomes and may inform postoperative risk stratification and management.

Abbreviations

ESCC, esophageal squamous cell carcinoma;

nICT, neoadjuvant immunochemotherapy;

nCT, neoadjuvant chemotherapy;

MIE, minimally invasive esophagectomy;

OE, open esophagectomy;

Post_treatment, postoperative adjuvant therapy;

PNI, perineural invasion;

LVI, lymphovascular invasion;

non-pCR, non-pathological complete response;

pCR, pathological complete response;

MPR, major pathological response;

OS, overall survival;

EFS, event-free survival;

PSM, propensity score matching.

Declarations

Ethics approval and consent to participate

The study was approved by the Human Ethics Review Committee of Fujian Medical University Cancer Hospital (Approval No.: K2025-340-01), and relevant informed consent was waived.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Availability of data and materials

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Funding

This study was supported in part by Fujian Research and Training Grants for Young and Middle-aged Leaders in Healthcare (to Chen X.), the Natural Science Foundation of Fujian Province (Grant No: 2025J011193 to Chen X.) and Special Scientific Research Project of the Fujian Provincial Finance Department Undertaken by Fuzhou Traditional Chinese Medicine Hospital. (to Deng Y.).

Author Contributions

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Acknowledgements

Not applicable

Conflict of Interest

The authors declared that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Figures

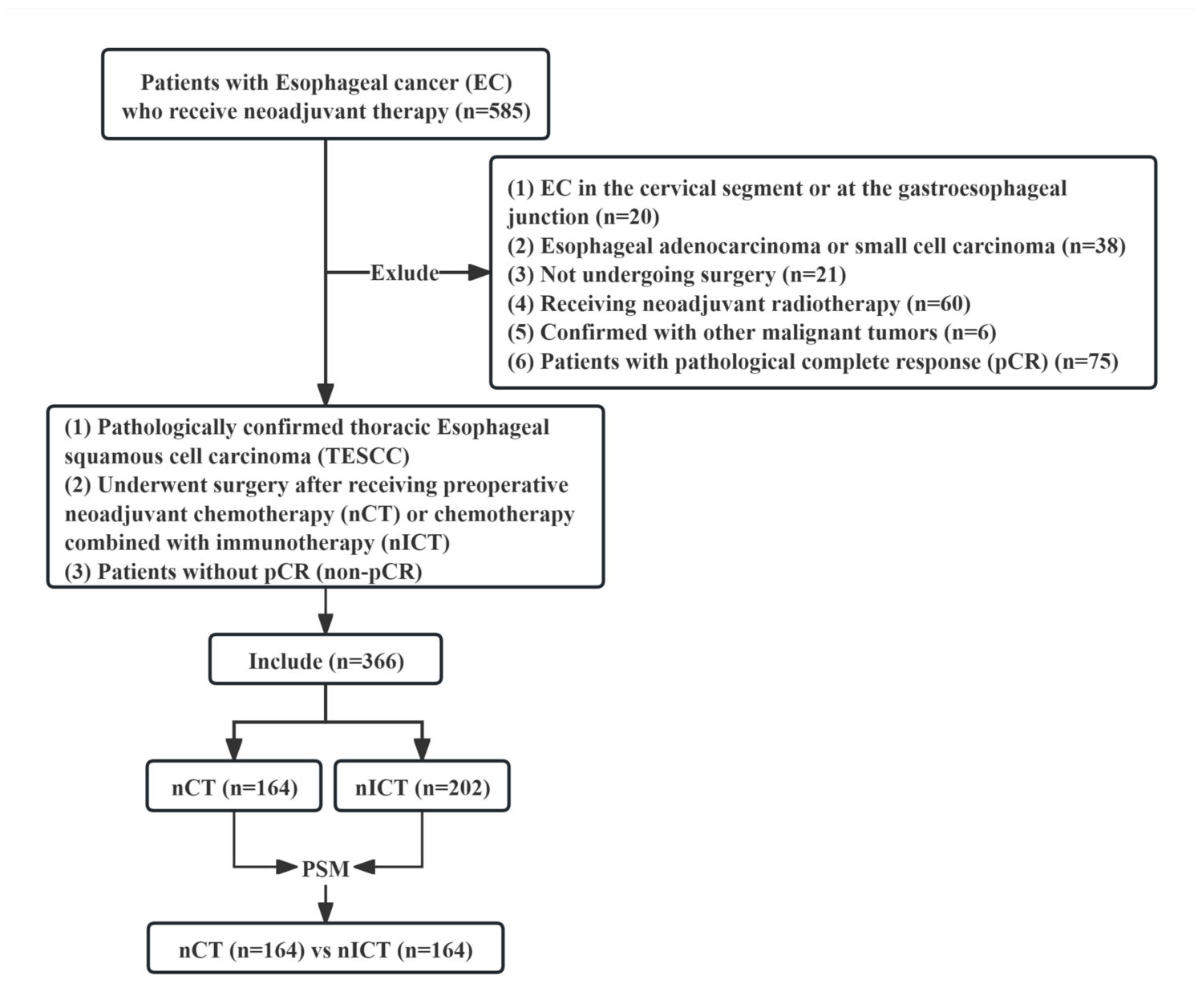


Figure 1

Patient inclusion flowchart (non-pCR cohort: N=366; after Propensity Score Matched: nICT=164, nCT=164).

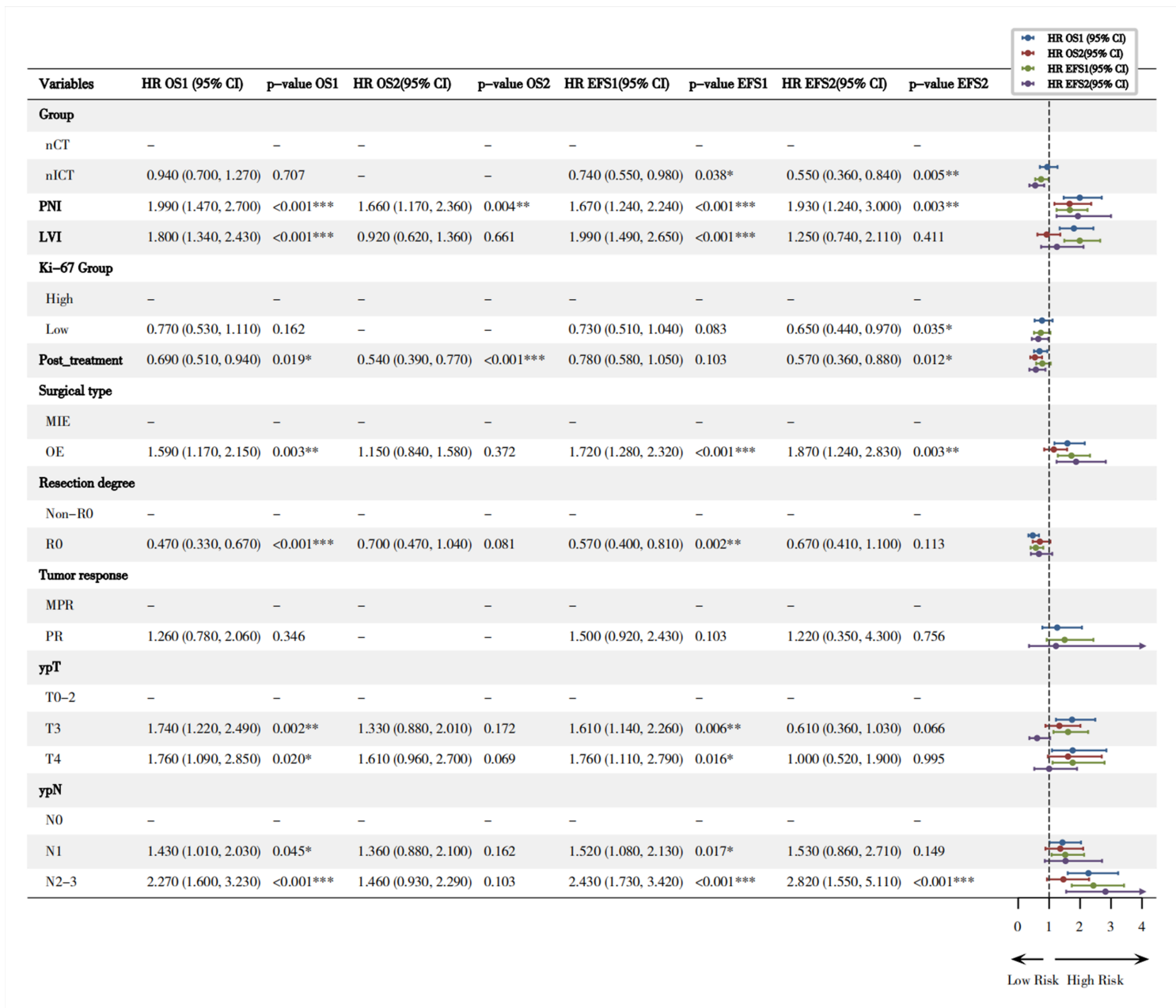


Figure 2

Forest plots of univariable and multivariable regression analyses for five-year OS and five-year EFS. Forest plots showing hazard ratios (HRs) with 95% confidence intervals (CIs) for factors associated with five-year overall survival (OS) and five-year event-free survival (EFS) after propensity score matching (PSM). OS1 and EFS1 denote univariable Cox proportional hazards models, whereas OS2 and EFS2 denote multivariable Cox proportional hazards models. HR >1 indicate increased risk of OS or EFS events, and HR <1 indicate decreased risk.

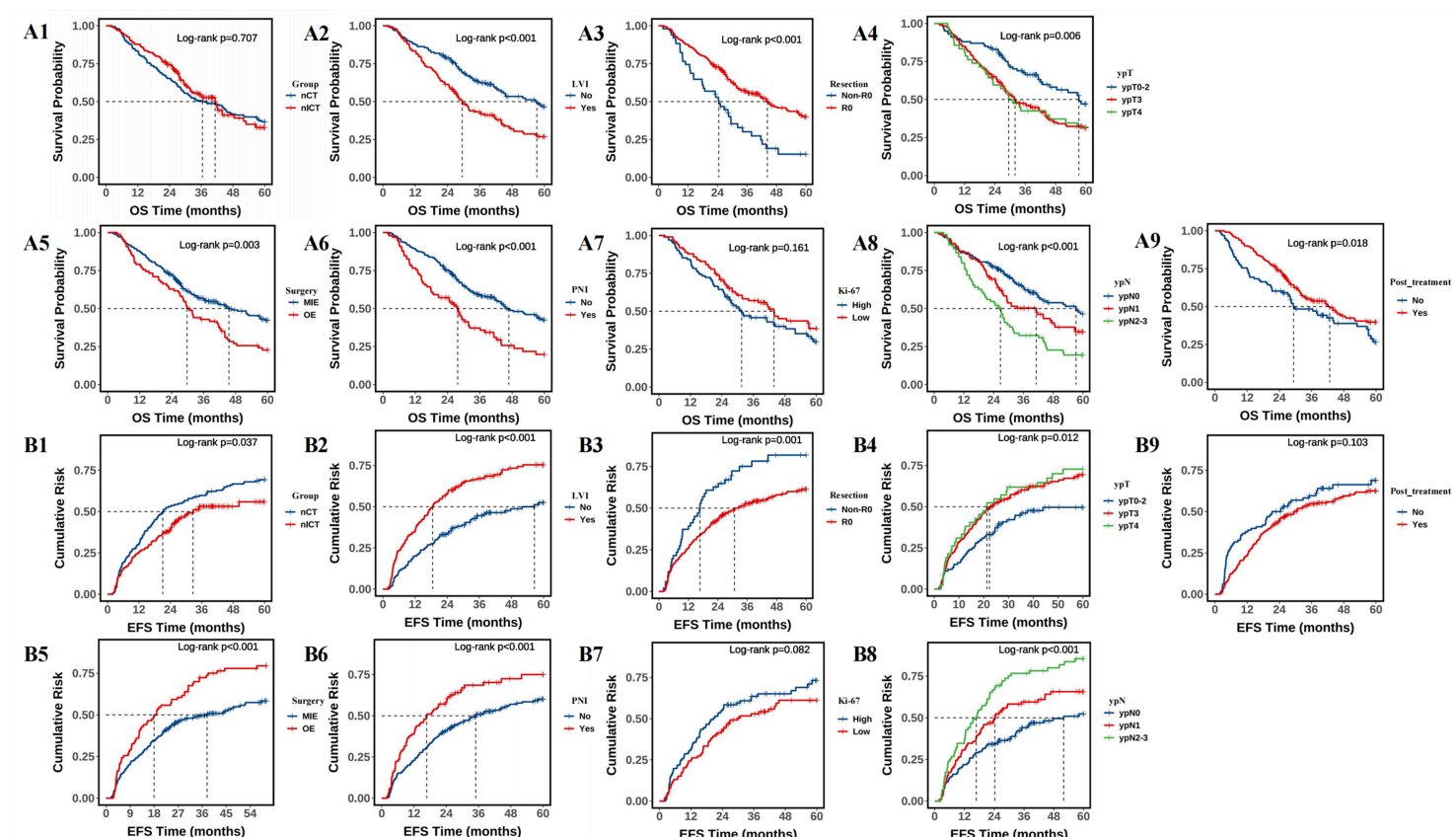


Figure 3

Kaplan–Meier survival curves and cumulative event curves for five-year OS and five-year EFS by key clinicopathological factors. Panels A1–A9 display OS according to each factor, and panels B1–B9 display the corresponding cumulative incidence of EFS events. A1/B1, group (nCT vs nCT); A2/B2, lymphovascular invasion (No vs Yes); A3/B3, resection degree (R0 vs non-R0); A4/B4, postoperative pathological T staging (ypT0-2 vs ypT3 vs ypT4); A5/B5, surgery (MIE vs OE); A6/B6, perineural invasion (No vs Yes); A7/B7, Ki-67 (Low vs High); A8/B8, postoperative pathological N staging (ypN0 vs ypN1 vs ypN2-3); A9/B9, post_treatment (No vs Yes).

Supplementary Files

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