Machine learning-based survival prediction using a pretreatment metabolic–inflammatory score in locally advanced oesophageal squamous cell carcinoma

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The present study aims to establish a novel prognostic model by using baseline clinical laboratory tests to predict outcomes in patients with locally advanced oesophageal squamous cell carcinoma (LA-ESCC). A total dataset of 106 LA-ESCC patients was retrospectively analysed who underwent neoadjuvant chemoradiotherapy (nCRT) followed by surgery. An internal validation cohort ($n = 53$) was randomly selected from the training cohort. A predictive model was constructed by integrating baseline clinical laboratory variables using Least Absolute Shrinkage and Selection Operator (LASSO) regression analysis. The integrative metabolic and inflammatory score (IMIS) was constructed based on 16 metabolic and inflammatory indicators, which demonstrated high areas under the curve (AUCs) for predicting survival at 1, 3, and 5 years (0.867, 0.879, and 0.879, respectively) within the training cohort. Multivariate Cox Proportional Hazards (PH) regression analysis confirmed the IMIS as an independent prognostic factor (Hazard Ratio [HR]: 33.39, $P < 0.0001$), alongside the lymphocyte-to-monocyte ratio (LMR) and post-neoadjuvant therapy pathological nodal stage (ypN). A prognostic nomogram integrating IMIS, LMR, and ypN exhibited robust predictive capability for overall survival (OS), achieving a concordance index (C-index) of 0.85 and a 5-year AUC of 0.895 in the training cohort. These findings were consistently reproduced within the internal validation cohort. The preoperative IMIS serves as a highly accurate predictor of overall survival in patients with LA-ESCC. Furthermore, the newly developed nomogram integrating IMIS, LMR, and ypN holds clear clinical utility for calculating individualised survival predictions and guiding therapeutic strategies for LA-ESCC patients undergoing nCRT and surgical resection.

Keywords: Inflammatory score, locally advanced oesophageal squamous cell carcinoma, machine learning, metabolic score, overall survival.

OESOPHAGEAL cancer (OC) ranks as the eleventh most common prevalent cancer globally and is the seventh leading cause of cancer-related mortality, with an estimated 510,716 new cases and 445,129 deaths reported in 2022 (ref. 1). Particularly in China, approximately 324,422 new cases of oesophageal squamous cell carcinoma (ESCC) and 301,135 deaths were documented in 2020 (refs 2,3). Squamous cell carcinoma (SCC) accounts for approximately 90% of all OC cases[4]. Despite progress in screening and therapeutic approaches, including chemoradiotherapy and immunotherapy[5], the 5-year survival rate for patients with locally advanced disease remains a mere 21%, which is largely attributable to tumour heterogeneity and treatment resistance[6]. Neoadjuvant chemoradiotherapy (nCRT) followed by oesophagectomy is considered the standard treatment protocol for patients with resectable locally advanced ESCC (LA-ESCC; T1, N1–3, M0; or T2–4a, N0–3, M0)

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