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NEUTROPHIL-TO-LYMPHOCYTE RATIO FOR PREDICTING POSTOPERATIVE RECURRENCE IN COMBINED HEPATOCELLULAR–CHOLANGIOCARCINOMA: A SECONDARY ANALYSIS OF A PUBLIC DATASET

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ABSTRACT

Background: Combined hepatocellular–cholangiocarcinoma (cHCC-CCA) is a rare primary liver cancer with a high rate of postoperative recurrence. The neutrophil-to-lymphocyte ratio (NLR) is a simple, routinely available marker of systemic inflammation. We aimed to identify predictors of postoperative recurrence—focusing on NLR—by framing recurrence as a binary outcome, an approach distinct from prior survival-based analyses of the same tumor. **Methods:** This was a secondary analysis of a publicly available dataset of 42 patients who underwent hepatectomy for cHCC-CCA (Chiu et al., 2020). Recurrence (present/absent) was the primary outcome. Each clinicopathological variable was assessed by univariable logistic regression; the discriminative performance of NLR was evaluated by receiver operating characteristic (ROC) analysis with an optimal cut-off determined by the Youden index. Patients were dichotomized by this cut-off, and disease-free survival was compared by the Kaplan–Meier method and log-rank test. A parsimonious multivariable logistic model was built from univariable-significant variables. **Results:** Recurrence occurred in 23 of 42 patients (54.8%). NLR was the strongest predictor of recurrence (univariable odds ratio [OR] 1.60 per unit; 95% confidence interval [CI] 1.15–2.22; p=0.005). NLR discriminated recurrent from non-recurrent patients with an area under the ROC curve of 0.80 (95% CI 0.64–0.94); the Youden-optimal cut-off was 2.78 (sensitivity 78%, specificity 79%). Patients with high NLR (≥2.78) had markedly worse disease-free survival than those with low NLR (median 5.1 months versus not reached; log-rank p<0.0001). NLR remained independently associated with recurrence after adjustment for the surgical margin (OR 1.42; 95% CI 1.00–2.01; p=0.049) and, separately, for AJCC tumor stage (OR 1.60; 95% CI 1.15–2.23; p=0.005). **Conclusions:** A higher NLR was independently associated with postoperative recurrence in cHCC-CCA, with a data-derived optimal cut-off (2.78) closely matching the conventional threshold of 3. By modeling recurrence as a binary outcome with logistic regression and ROC analysis, this study complements earlier survival-based findings and supports NLR as a simple, accessible candidate marker of recurrence risk. Validation in larger, prospective, externally validated cohorts is warranted.

KEYWORDS: combined hepatocellular–cholangiocarcinoma; neutrophil-to-lymphocyte ratio; recurrence; logistic regression; ROC curve; systemic inflammation; hepatectomy; prognosis.

INTRODUCTION

Combined hepatocellular–cholangiocarcinoma (cHCC-CCA) is a rare primary liver cancer that simultaneously exhibits hepatocytic and cholangiocytic differentiation within the same tumor.[1] It accounts for only approximately 0.4–14.2% of primary liver carcinomas, and because of this rarity its biological behavior and optimal management remain incompletely defined, with treatment strategies frequently extrapolated from hepatocellular carcinoma (HCC) or cholangiocarcinoma.[2] Surgical resection is the principal curative option; however, long-term outcomes are unsatisfactory, as pooled data indicate a median post-hepatectomy recurrence rate of roughly 65% and a 5-year overall survival below 30%.[3] Early recurrence is

particularly common, occurring in about half of patients within the first 1.5 years after resection.[4]

Because recurrence largely drives the poor prognosis of cHCC-CCA, the ability to identify patients at high risk of recurrence using accessible preoperative information would be clinically valuable, informing surveillance intensity, patient counseling, and potential adjuvant strategies. Yet most reported prognostic factors derive from small single-center series, and readily available blood-based predictors of recurrence remain limited.[5]

Systemic inflammation is now recognized as a hallmark of cancer, a link first suggested by Virchow in the 19th century.[6] The neutrophil-to-lymphocyte ratio (NLR), calculated from a routine complete blood count, is a simple, inexpensive, and reproducible index of this inflammatory state; it reflects the balance between pro-tumor innate immunity (neutrophils) and anti-tumor adaptive immunity (lymphocytes).[6] An elevated NLR has been associated with an immunosuppressive tumor microenvironment characterized by reduced CD8+ tumor-infiltrating lymphocytes.[7] Across many solid tumors, and specifically in cholangiocarcinoma, meta-analyses have confirmed that a high pretreatment NLR predicts poorer overall survival (pooled hazard ratio ≈ 1.28–1.45) and disease-free survival (pooled hazard ratio ≈ 1.39).[8,9] Its low cost and near-universal availability make NLR an attractive candidate biomarker.[6]

In cHCC-CCA specifically, however, evidence for NLR is scarce. The publicly available dataset analyzed here was originally reported by Chiu et al., who evaluated NLR predominantly through survival analysis (Kaplan–Meier and Cox regression) using a fixed cut-off of NLR ≥ 3.[5] Whether NLR predicts the binary event of postoperative recurrence—and whether a cut-off derived directly from the data performs well for that specific classification task—has been less thoroughly examined. Modeling recurrence as a dichotomous outcome with logistic regression addresses a distinct and clinically intuitive question ("will this patient recur?") and yields directly interpretable discrimination metrics such as the area under the ROC curve.

Therefore, in this secondary analysis of the open-access cHCC-CCA dataset, we aimed to (i) assess NLR and other clinicopathological variables as predictors of postoperative recurrence using univariable and multivariable logistic regression, (ii) determine an optimal, data-derived NLR cut-off for recurrence by ROC analysis, and (iii) compare disease-free survival between the resulting NLR groups.

MATERIALS AND METHODS

Study design and data source

This was a retrospective study based on a secondary analysis of a publicly available dataset. The data were obtained from the supporting information file of the open-access study by Chiu et al., which investigated the prognostic value of the neutrophil-to-lymphocyte ratio (NLR) in patients with combined hepatocellular–cholangiocarcinoma (CHCC-CC) (Chiu et al., PLoS One 2020; DOI: 10.1371/journal.pone.0240791). The original study evaluated outcomes primarily using survival analysis (Kaplan–Meier and Cox regression). In contrast, the present study addressed a different research question: the presence of postoperative recurrence was defined as a binary outcome and modeled using logistic regression.

Patients and Variables

The dataset comprised 42 patients with CHCC-CC who underwent hepatectomy. The variables analyzed included demographic data (age, sex), preoperative hematologic parameters (white blood cell count, platelet count, monocyte percentage, and NLR), tumor markers (CEA, CA19-9, AFP), comorbidities (hepatitis B, hepatitis C, liver cirrhosis, gallstone, diabetes mellitus), and pathological features (histological grade, tumor necrosis percentage, surgical margin, lymphovascular invasion, perineural invasion, pathological T stage, regional lymph node metastasis, AJCC tumor stage, and the proportion of the cholangiocarcinoma component within the tumor). The primary outcome was disease recurrence (present/absent).

Statistical analysis

Continuous variables were summarized as median (interquartile range, IQR) and categorical variables as counts and percentages; the median was chosen as the measure of central tendency because of the small sample size and the marked right-skewness of the tumor markers. The association of each independent variable with recurrence was assessed separately using univariable logistic regression, with effect sizes reported as odds ratios (OR) and 95% confidence intervals (CI). For continuous variables, ORs were scaled per clinically meaningful increments to improve interpretability. The discriminative performance of NLR for recurrence was evaluated by receiver operating characteristic (ROC) analysis; the area under the curve (AUC) and its 95% CI were estimated using 2000-replicate bootstrapping. The optimal cut-off value was determined by the Youden index, and the corresponding sensitivity, specificity, positive and negative predictive values (PPV, NPV), and accuracy were reported. Patients were then dichotomized into low- and high-NLR groups according to this cut-off; time to recurrence (disease-free survival) was estimated by the Kaplan–Meier method, and groups were compared with the log-rank test. A multivariable logistic regression model was constructed using variables significant in the univariable analysis, limited to at most two variables in accordance with the events-per-variable (EPV) constraint. A two-sided $p<0.05$ was considered statistically significant. Analyses were performed in Python (statsmodels, scikit-learn, and lifelines libraries).

RESULTS

Patient characteristics

The 42 patients had a median age of 58 years (IQR 52–64); 29 (69%) were male and 13 (31%) were female. The median NLR was 3.01 (IQR 1.64–5.62). During follow-up, recurrence developed in 23 of 42 patients (54.8%).

For the whole cohort, the Kaplan–Meier–estimated median disease-free survival was 13.3 months, and the 1- and 2-year disease-free survival rates were 52% and 49%, respectively. Baseline characteristics of the cohort are presented in Table 1.

Table 1. Patient characteristics (n=42).

Variable	Value (n=42)
Age, years — median (IQR)	58 (52–64)
Male sex — n (%)	29 (69%)
WBC, /µL — median (IQR)	5400 (4100–7175)
Platelets — median (IQR)	140 (101–196)
Monocyte, % — median (IQR)	6.7 (5.4–9.7)
NLR — median (IQR)	3.01 (1.64–5.62)
CEA — median (IQR)	1.58 (0.70–2.56)
CA19-9 — median (IQR)	15.6 (5.0–38.6)
AFP — median (IQR)	18.7 (6.1–60.2)
Cholangiocarcinoma cell ratio, % — median (IQR)	50 (20–70)
Tumor necrosis, % — median (IQR)	0 (0–19)
Surgical margin — median (IQR)	10 (4–15)
Hepatitis B — n (%)	30 (71%)
Hepatitis C — n (%)	12 (29%)
Liver cirrhosis — n (%)	31 (74%)
Gallstone — n (%)	3 (7%)
Diabetes mellitus — n (%)	9 (22%)
Lymphovascular invasion — n (%)	16 (38%)
Perineural invasion — n (%)	3 (7%)
Regional lymph node metastasis — n (%)	3 (7%)
Histological grade 3 — n (%)	7 (17%)
Advanced T stage (T3–T4) — n (%)	6 (14%)
Advanced AJCC stage (III–IV) — n (%)	8 (19%)
Recurrence — n (%)	23 (55%)

IQR: interquartile range; NLR: neutrophil-to-lymphocyte ratio.

Continuous variables are given as median (IQR) and categorical variables as n (%).

Univariable logistic regression

In the univariable logistic regression analysis for recurrence, NLR and surgical margin were significant. Each one-unit increase in NLR was associated with an approximately 1.6-fold increase in the odds of recurrence (OR 1.60; 95% CI 1.15–2.22; p=0.005). Pathological T stage (OR 2.41; p=0.074) and the cholangiocarcinoma cell ratio (per 10 units, OR 1.24; p=0.083) approached statistical significance. Age, sex, tumor markers (CEA, CA19-9, AFP), comorbidities, and other pathological variables showed no significant association. Results for all variables are presented in Table 2.

Table 2. Univariable logistic regression for recurrence (n=42).

Variable	OR (95% CI)	p
Age (per year)	0.98 (0.93–1.04)	0.587
Sex (female vs male)	0.38 (0.10–1.47)	0.161
WBC (per 1000/µL)	1.20 (0.89–1.63)	0.233
Platelets (per 10 units)	1.04 (0.94–1.14)	0.449
Monocyte %	1.02 (0.83–1.26)	0.851
NLR	**1.60 (1.15–2.22)**	**0.005**
Hepatitis B	1.31 (0.34–5.01)	0.695
Hepatitis C	0.76 (0.20–2.93)	0.695
Liver cirrhosis	1.66 (0.42–6.64)	0.472
Gallstone	1.71 (0.14–20.50) [a]	0.670
Diabetes mellitus	0.62 (0.14–2.76)	0.532
CEA	0.87 (0.64–1.20)	0.405

CA19-9 (per 10 units)	1.06 (0.92–1.22)	0.423
AFP (per 100 units)	1.01 (0.98–1.04)	0.555
Cholangiocarcinoma cell ratio (per 10%)	1.24 (0.97–1.58)	0.083
Histological grade	1.13 (0.29–4.43)	0.856
Tumor necrosis %	1.03 (0.99–1.07)	0.192
Surgical margin	**1.19 (1.06–1.33)**	**0.002**
Lymphovascular invasion	2.57 (0.69–9.50)	0.158
Perineural invasion	1.71 (0.14–20.50) [a]	0.670
Pathological T stage	2.41 (0.92–6.33)	0.074
Regional lymph node metastasis	1.71 (0.14–20.50) [a]	0.670
AJCC stage	1.80 (0.85–3.84)	0.126

OR: odds ratio; CI: confidence interval. Bold rows indicate p<0.05. For continuous variables, ORs are per the increment indicated. [a] Estimate unstable owing to few events (wide confidence interval).

ROC analysis of NLR

NLR showed strong discriminative performance for recurrence (AUC 0.80; 95% CI 0.64–0.94; Figure 1). Because the confidence interval did not include 0.50, the discrimination was statistically significant. The optimal cut-off determined by the Youden index was NLR = 2.78. At this cut-off, sensitivity was 78%, specificity 79%, PPV 82%, NPV 75%, and overall accuracy 79%; 33 of 42 patients were correctly classified (18 true positives, 15 true negatives, 4 false positives, 5 false negatives).

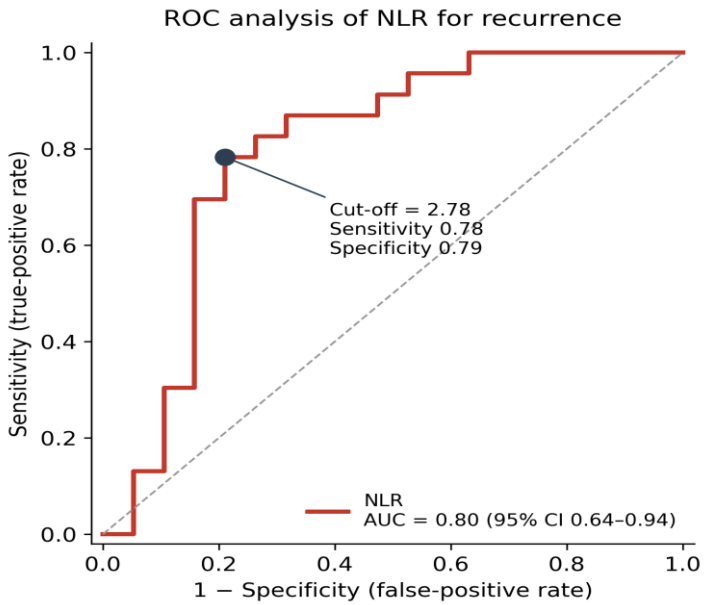

Figure 1. ROC curve of NLR for predicting recurrence. AUC = 0.80 (95% CI 0.64–0.94). The optimal cut-off by the Youden index was 2.78 (sensitivity 78%, specificity 79%).

Disease-free survival by NLR group

According to the determined cut-off, 20 patients were classified as low NLR (<2.78) and 22 as high NLR (≥2.78). In the low-NLR group, only 5 of 20 patients developed recurrence, whereas in the high-NLR group 18 of 22 patients recurred. The median disease-free survival was 5.1 months in the high-NLR group, whereas the median was not reached in the low-NLR group, as most patients remained recurrence-free during follow-up. The difference between the two groups was highly significant (log-rank p<0.0001; Figure 2).

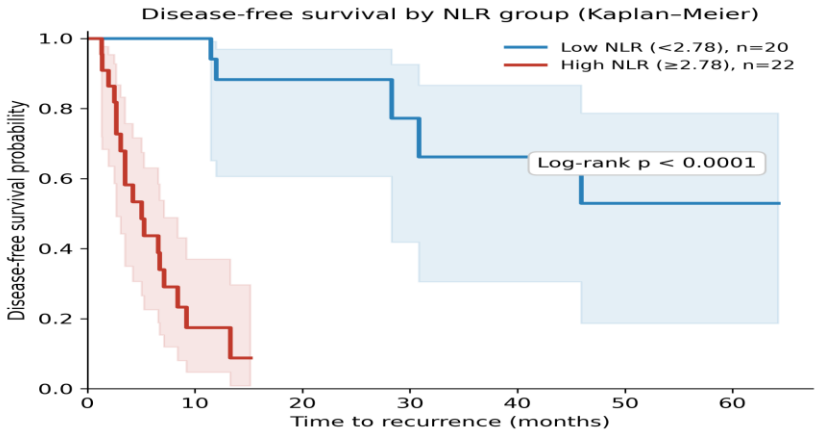

Figure 2. Disease-free survival by NLR group (Kaplan–Meier). Event: recurrence; time: disease-free survival. Log-rank p<0.0001.

Multivariable logistic regression

In the multivariable model built with the variables significant in the univariable analysis (NLR and surgical margin; events per variable = 11.5), both variables remained independently associated with recurrence: NLR, OR 1.42 (95% CI 1.00–2.01; p=0.049); surgical margin, OR 1.17 (95% CI 1.03–1.31; p=0.012). The model was significant overall (p=0.0001; pseudo-R^2=0.315). In a sensitivity analysis adjusting for AJCC tumor stage, the independent association of NLR was preserved (OR 1.60; 95% CI 1.15–2.23; p=0.005). Results of the multivariable models are presented in Table 3.

Table 3. Multivariable Logistic Regression for Recurrence.

Model / Variable	aOR (95% CI)	p
Model A — NLR + Surgical margin		
NLR	**1.42 (1.00–2.01)**	**0.049**
Surgical margin	**1.17 (1.03–1.31)**	**0.012**
Model B — NLR + AJCC stage (sensitivity)		
NLR	**1.60 (1.15–2.23)**	**0.005**
AJCC stage	1.92 (0.82–4.52)	0.133

aOR: adjusted odds ratio; CI: confidence interval. Model A includes variables significant in the univariable analysis. Model B is a sensitivity analysis testing the independence of NLR from AJCC stage. Events per variable = 11.5 in both models.

DISCUSSION

In this secondary analysis of a publicly available combined hepatocellular–cholangiocarcinoma (cHCC-CCA) dataset, our aim was to identify the factors that influence postoperative recurrence, treating recurrence as a binary outcome rather than a time-to-event endpoint. The neutrophil-to-lymphocyte ratio (NLR) was the strongest predictor: each one-unit increase raised the odds of recurrence approximately 1.6-fold, and NLR discriminated recurrent from non-recurrent patients with an area under the ROC curve of 0.80. A data-derived cut-off of 2.78 (sensitivity 78%, specificity 79%) separated patients into groups with markedly different disease-free survival (median 5.1 months versus not reached; log-rank p<0.0001), and NLR remained independently associated with recurrence after adjustment for the surgical margin and, in a separate model, for AJCC tumor stage.

These findings align with and extend the original report by Chiu et al., from which this dataset originates.[5] Using survival analysis (Kaplan–Meier and Cox regression) with a prespecified threshold of NLR ≥ 3, that study identified NLR as the only independent predictor of recurrence and poorer survival, together with a contribution of intrahepatic cholangiocarcinoma predominance. Our study addressed a related but distinct question—whether NLR predicts the binary occurrence of recurrence—and approached it with logistic regression and ROC analysis rather than time-to-event modeling. This shift in outcome definition yields directly interpretable classification metrics (odds ratios, AUC, sensitivity, and specificity). Reassuringly, the two approaches converge: our data-derived optimal cut-off (2.78) is close to their literature-based threshold of 3, and NLR was again the dominant independent factor, supporting the robustness of the association across different analytic choices.

Recurrence is the central problem after resection of cHCC-CCA, a tumor that carries a higher recurrence risk than pure hepatocellular carcinoma and a poorer overall prognosis.[10] Reported 3-year recurrence rates reach roughly 59%, with a mean time to recurrence of only about seven months,[10] and approximately half of patients recur early after resection.[4] Previous series have identified several determinants of recurrence in this malignancy, including tumor number and vascular invasion,[11] elevated alpha-fetoprotein and/or CA19-9,[12] and microvascular and lymph-node involvement.[13]

Our results complement these by highlighting an inexpensive, routinely available blood marker—NLR—as an additional predictor of recurrence, one that is measurable before surgery and does not depend on the resected specimen.

The prognostic value of NLR is well established across solid tumors and, specifically, in cholangiocarcinoma, where meta-analyses report that an elevated pretreatment NLR predicts poorer overall and disease-free survival.[8,9]

Mechanistically, a high NLR reflects a pro-tumor inflammatory milieu: relative neutrophilia can promote angiogenesis, tumor proliferation, and an immunosuppressive microenvironment, whereas relative lymphopenia signals weakened anti-tumor immunity.[6] Consistent with this, an elevated NLR has been linked to reduced CD8+ tumor-infiltrating lymphocytes in intrahepatic cholangiocarcinoma.[7] That NLR predicts recurrence in cHCC-CCA fits this framework and suggests that, with respect to inflammation-related prognosis, the biphenotypic tumor behaves much like its cholangiocarcinoma component.

Clinically, an NLR threshold near 2.8–3.0 could help flag patients at higher risk of recurrence for more intensive postoperative surveillance—particularly valuable in a rare tumor that lacks robust, disease-specific prognostic tools.[2] Whether such patients benefit from adjuvant therapy remains uncertain: adjuvant transarterial chemoembolization did not improve recurrence-free or overall survival after resection of cHCC-CCA,[14] and the role of postoperative systemic chemotherapy is still undefined,[15] although adjuvant chemotherapy combined with immunotherapy has shown promise in cholangiocarcinoma more broadly.[16] In this context, a simple preoperative marker that identifies high-risk patients could help target closer follow-up and support enrollment into trials of adjuvant strategies.

Our study has important limitations. The sample was small (n=42) and analyzed retrospectively as secondary, single-institution data, which limits statistical power and generalizability. Most importantly, the NLR cut-off was both derived and tested within the same dataset without external or cross-validation, so the reported AUC and classification metrics are likely optimistic. Multiple variables were screened in the univariable analysis without correction for multiple comparisons, and the events-per-variable constraint limited the multivariable models to two covariates, leaving residual confounding possible. Finally, the surgical-margin variable was recorded as a continuous value whose exact definition we could not confirm, so that particular association should be interpreted with caution. Our findings are therefore hypothesis-generating and require confirmation in larger, prospective, and externally validated cohorts.

In conclusion, in this secondary analysis of a public cHCC-CCA dataset, a higher NLR was independently associated with postoperative recurrence and discriminated recurrent from non-recurrent patients with good accuracy, with an optimal cut-off (2.78) closely matching the conventional threshold of 3. By framing recurrence as a binary outcome and applying logistic regression and ROC analysis, our study complements the survival-based findings of the original report and reinforces NLR as a simple, accessible candidate marker of recurrence risk in this rare malignancy—pending validation in larger cohorts.

REFERENCES

1. Brunt E, Aishima S, Clavien PA, Fowler K, Goodman Z, Gores G, et al. cHCC-CCA: Consensus terminology for primary liver carcinomas with both hepatocytic and cholangiocytic differentation. Hepatology. 2018; 68(1): 113-26.
2. Wu Y, Liu H, Zeng J, Chen Y, Fang G, Zhang J, et al. Development and validation of nomogram to predict very early recurrence of combined hepatocellular-cholangiocarcinoma after hepatic resection: a multi-institutional study. World journal of surgical oncology. 2022; 20(1): 60.
3. Li D-B, Si X-Y, Wang S-J, Zhou Y-M. Long-term outcomes of combined hepatocellular-cholangiocarcinoma after hepatectomy or liver transplantation: A systematic review and meta-analysis. Hepatobiliary & Pancreatic Diseases International. 2019; 18(1): 12-8.
4. Yamashita Yi, Aishima S, Nakao Y, Yoshizumi T, Nagano H, Kuroki T, et al. Clinicopathological characteristics of combined hepatocellular cholangiocarcinoma from the viewpoint of patient prognosis after hepatic resection: High rate of early recurrence and its predictors. Hepatology Research. 2020; 50(7): 863-70.
5. Chiu T-J, Chen Y-J, Kuo F-Y, Chen Y-Y. Elevated neutrophil-to-lymphocyte ratio and predominance of intrahepatic cholangiocarcinoma prediction of poor hepatectomy outcomes in patients with combined hepatocellular–cholangiocarcinoma. PLoS One. 2020; 15(12): e0240791.
6. Heshmat-Ghahdarijani K, Sarmadi V, Heidari A, Falahati Marvasti A, Neshat S, Raeisi S. The neutrophil-to-lymphocyte ratio as a new prognostic factor in cancers: a narrative review. Frontiers in Oncology. 2023; 13: 1228076.

7. Lin G, Liu Y, Li S, Mao Y, Wang J, Shuang Z, et al. Elevated neutrophil-to-lymphocyte ratio is an independent poor prognostic factor in patients with intrahepatic cholangiocarcinoma. Oncotarget. 2016; 7(32): 50963.
8. Tan D-W, Fu Y, Su Q, Guan M-J, Kong P, Wang S-Q, et al. Prognostic significance of neutrophil to lymphocyte ratio in oncologic outcomes of cholangiocarcinoma: a meta-analysis. Scientific reports. 2016; 6(1): 33789.
9. Liu D, Heij LR, Czigany Z, Dahl E, den Dulk M, Lang SA, et al. The prognostic value of neutrophil-to-lymphocyte ratio in cholangiocarcinoma: a systematic review and meta-analysis. Scientific reports. 2022; 12(1): 12691.
10. Wu C-H, Yong C-C, Liew E-H, Tsang L-C, Lazo M, Hsu H-W, et al., editors. Combined hepatocellular carcinoma and cholangiocarcinoma: diagnosis and prognosis after resection or transplantation. Transplantation Proceedings; 2016: Elsevier.
11. Song P, Midorikawa Y, Nakayama H, Higaki T, Moriguchi M, Aramaki O, et al. Patients' prognosis of intrahepatic cholangiocarcinoma and combined hepatocellular-cholangiocarcinoma after resection. Cancer medicine. 2019; 8(13): 5862-71.
12. Jiang X-X, Huang X-T, Huang C-S, Chen L-H, Liang L-J, Yin X-Y. Long-term outcome and prognostic factors of combined hepatocellular carcinoma and cholangiocarcinoma after curative resection. Gastroenterology report. 2020; 8(2): 134-42.
13. Tang Y, Wang L, Teng F, Zhang T, Zhao Y, Chen Z. The clinical characteristics and prognostic factors of combined Hepatocellular Carcinoma and Cholangiocarcinoma, Hepatocellular Carcinoma and Intrahepatic Cholangiocarcinoma after Surgical Resection: A propensity score matching analysis. International journal of medical sciences. 2021; 18(1): 187.
14. Liu W-R, Tian M-X, Tao C-Y, Tang Z, Zhou Y-F, Song S-S, et al. Adjuvant Transarterial chemoembolization does not influence recurrence-free or overall survival in patients with combined hepatocellular carcinoma and Cholangiocarcinoma after curative resection: a propensity score matching analysis. BMC cancer. 2020; 20(1): 642.
15. Lu Y, Zheng L, Mei H. Impact of postoperative chemotherapy on the prognosis of combined hepatocellular-cholangiocarcinoma: a retrospective study based on the SEER database. Journal of Gastrointestinal Oncology. 2025; 16(3): 1220.
16. Li Xh, Zhou El, Zhao Cy, Cui Bk, Dong Xy, Du H, et al. Adjuvant chemotherapy combined with immunotherapy in patients with cholangiocarcinoma after radical resection. Cancer Medicine. 2023; 12(24): 21742-50.