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Preoperative prediction of lymph node metastasis in ovarian cancer: Development and validation of a nomogram incorporating CT imaging features and clinical risk factors

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Abstract

Objective: To develop and validate a preoperative nomogram that integrates CT imaging features and clinical indicators for predicting Lymph Node Metastasis (LNM) in ovarian cancer, thereby facilitating individualized risk assessment.

Subjects and methods: This retrospective study enrolled 71 ovarian cancer patients who were treated at our institution between January 2020 and July 2025, and conducted an analysis of 142 lymph nodes that were radiologically suspicious for metastasis. Statistical analyses were performed using SPSS 26.0. Univariate and multivariate logistic regression analyses were used to identify independent risk factors for metastasis.

Results: Univariate analysis demonstrated significant associations between Lymph Node Metastasis (LNM) in ovarian cancer and the following parameters: serum albumin level, D-dimer level, Fibrinogen-to-Albumin Ratio (FAR), short-axis diameter of lymph nodes, and CT attenuation across all phases (non-contrast, arterial, venous, and delayed) (all $P<0.05$). Regarding clinical characteristics, significantly higher LNM rates were observed in patients with bilateral lesions, serous adenocarcinoma, advanced FIGO stage, or lymphovascular invasion (all $P<0.05$). Multivariate analysis established short-axis diameter, non-contrast CT attenuation value, and FIGO stage III as independent preoperative risk factors for LNM (all $P<0.05$). ROC analysis revealed that non-contrast CT attenuation exhibited the best predictive performance (AUC=0.789, specificity=89%), while attenuation values from other phases also demonstrated significant predictive value. The nomogram developed from these predictors showed excellent discriminatory power, good calibration, and promising clinical utility.

Conclusion: This study demonstrates that CT attenuation serves as reliable imaging biomarkers for predicting Lymph Node Metastasis (LNM) in ovarian cancer. The developed nomogram, which integrates CT imaging features with clinical parameters, provides an intuitive and effective tool for preoperative evaluation of lymph nodal status.

Keywords: Ovarian cancer; CT; Imaging; Lymph nodes; Nomogram; Predictive modeling.

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Introduction

Ovarian cancer is a highly malignant neoplasm of the female reproductive system that poses a substantial threat to women's health, demonstrating the highest mortality rate among all gynecological malignancies. The principal metastatic pathways include direct extension, peritoneal implantation, hematogenous dissemination, and lymphatic spread, with lymph node metastasis (LNM) representing one of the most critical dissemination routes [1]. Lymph node metastasis status constitutes a fundamental determinant in the International Federation of Gynecology and Obstetrics (FIGO) staging system, marking isolated retroperitoneal lymph node metastasis as stage IIIA1 [2,3]. The presence of lymph node metastasis not only determines surgical staging but also demonstrates significant correlations with recurrence risk and overall survival [4,5]. Preoperative evaluation of lymph node status in ovarian cancer predominantly utilizes imaging modalities, including Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography-Computed Tomography (PET-CT). The current radiological criterion for suspected metastatic lymph nodes is a short-axis diameter ≥10 mm [6]. Studies indicate that PET-CT, CT, and MRI demonstrate sensitivities of 73%, 43%, and 55%, respectively, and specificities of 97%, 95%, and 88%, respectively, for detecting lymph node metastasis in ovarian cancer. Despite its high specificity, PET-CT's clinical application is constrained by substantial financial costs and considerable radiation exposure. While MRI offers improved soft tissue characterization, its diagnostic specificity remains suboptimal. Consequently, CT persists as the foremost imaging modality for lymph node assessment in ovarian cancer [7]. CT attenuation, measured in Hounsfield Units (HU), objectively quantify tissue radiodensity by representing the relative absorption of X-rays [8]. This quantitative parameter has been widely employed across various medical specialties for preoperative prediction of lymph node status [9-13].

In addition to imaging indicators, existing evidence has identified multiple clinical parameters associated with Lymph Node Metastasis (LNM) in ovarian cancer, including tumor markers (CA125, HE4, CA199), serous histology, high tumor grade, BMI ≥23.23 kg/m², ascites, and abnormalities in neutrophil, lymphocyte, and monocyte counts [14,15]. Nevertheless, the diagnostic utility of preoperative CT attenuation in predicting LNM remains inadequately investigated. Nomograms, as visually interpretable predictive instruments, have gained widespread application in oncology [16-19]. This study seeks to integrate CT attenuation with clinical features to identify risk factors for LNM and to develop and validate a noninvasive, precise preoperative nomogram for visual guidance in individualized therapeutic decision-making.

Subjects and methods

Subjects

This study enrolled 71 ovarian cancer patients with radiologically identified retroperitoneal lymphadenopathy treated at our institution between January 2020 and July 2025. A total of 142 enlarged and radiologically suspicious metastatic lymph nodes were included.

Inclusion criteria:

1. Patients who underwent ovarian cancer staging surgery or cytoreductive surgery at our hospital;
2. Completion of contrast-enhanced CT within two weeks prior to surgery;
3. Postoperative pathological confirmation of ovarian cancer with the presence of metastatic lymph nodes corresponding to imaging findings.

Exclusion criteria:

1. Incomplete clinicopathological data;
2. History of other malignant tumors.

Methods

Data collection

Preoperative clinical and laboratory data were systematically collected, including demographic characteristics (height, weight), serum biomarkers (CA125, HE4, CA199, AFP, CEA), albumin levels, complete blood count parameters, D-dimer levels, coagulation profiles, tumor location, short-axis diameter of radiologically suspicious lymph nodes, and CT attenuation. Pathological features including tumor histotype, FIGO stage, lymphovascular invasion, perineural invasion, and lymph node metastasis status were comprehensively documented.

CT imaging evaluation

Two senior gynecologic oncologists independently evaluated CT images (acquired at 5 mm slice thickness) for Lymph Node Metastasis (LNM) assessment. Following a standardized protocol, suspicious lymph nodes in the para-aortic and pelvic regions were identified and delineated as Regions Of Interest (ROIs). The maximum short-axis diameter and mean CT attenuation were measured in non-contrast, arterial, venous, and delayed phases (Figure 1). All images were interpreted under synchronous double-blinded conditions to minimize interpretive bias. All ROIs were subsequently reviewed and adjusted by a second physician. CT examinations were performed using standardized parameters (slice thickness ≤5 mm). Lymph nodes were considered suspicious for metastasis if they exhibited: short-axis diameter >1 cm, marked or heterogeneous enhancement, or irregular morphological features. All radiologically suspicious nodes were surgically excised and subjected to histopathological examination to establish precise imaging-pathological correlation.

Nomogram development and validation

The 142 enlarged lymph nodes were randomly allocated to a training cohort (n=99) and validation cohort (n=43) in a 7:3 ratio for model development and internal validation, respectively. In the training cohort, univariate analysis was conducted to identify potential risk factors for Lymph Node Metastasis (LNM). Receiver Operating Characteristic (ROC) curve analysis was employed to determine optimal cutoff values for CT attenuation parameters. Significant variables in univariate analysis were subsequently included in multivariate logistic regression to identify independent predictors. A nomogram was developed using R software (version 4.5.0). The model's performance was assessed through discrimination (ROC analysis), calibration (calibration curves with Hosmer-Lemeshow test), and clinical utility (decision curve analysis, DCA). Internal validation was performed using the validation cohort.

Statistical analysis

All statistical analyses were performed using SPSS (version 26.0). Normality of continuous variables was assessed using the Shapiro-Wilk test. Normally distributed variables were expressed as mean±standard deviation and compared using Student's t-test. Non-normally distributed variables were presented as median with Interquartile Range (IQR) and compared using the Mann-Whitney U test. Categorical variables were expressed as frequencies (percentages) and analyzed using chi-square or Fisher's exact tests as appropriate. Multivariate analysis was performed using binary logistic regression, with results expressed as Odds Ratios (OR) and 95% Confidence Intervals (CI).

Results

Comparison of clinical characteristics between training and validation cohorts

The lymph node metastasis rates were 70.7% in the training cohort and 79.1% in the validation cohort, respectively. No significant differences were observed in CT attenuation across all phases or clinicopathological characteristics between the two cohorts (all P>0.05; Table 1). Pathological examination confirmed lymph node metastasis in 70 cases (70.7%) and non-metastasis in 29 cases (29.3%) within the training cohort. Univariate analysis revealed significant differences in serum albumin levels, D-dimer levels, Fibrinogen-to-Albumin Ratio (FAR), short-axis diameter of lymph nodes, and CT attenuation across all phases between metastatic and non-metastatic groups (all P<0.05; Table 2).

ROC Analysis of CT attenuation for preoperative prediction of lymph node metastasis

Receiver Operating Characteristic (ROC) curves were generated to assess the predictive performance of CT attenuation during non-contrast, arterial, venous, and delayed phases for detecting lymph node metastasis (Table 3, Figure 2). The optimal cutoff values were determined to be 24.08 HU, 27.87 HU, 35.43 HU, and 41.10 HU for each phase, respectively. The corresponding sensitivities were 59%, 82%, 81%, and 71%, with specificities of 89%, 71%, 53%, and 78%. The Areas Under the Curve (AUC) were 0.789, 0.795, 0.690, and 0.779, indicating that CT attenuation provide moderate to high diagnostic accuracy for the preoperative prediction of lymph node metastasis.

Nomogram for preoperative prediction of lymph node metastasis

Multicollinearity diagnostics were performed on CT attenuation from all enhancement phases based on clinical relevance, which demonstrated no significant collinearity; all variables were therefore eligible for inclusion in multivariate analysis. Multivariate logistic regression analysis (Table 4) identified maximum short-axis diameter of lymph nodes, non-contrast CT attenuation, and FIGO stage III as independent predictive factors significantly associated with lymph node metastasis. Based on these independent predictors, a nomogram was constructed (Figure 3) that calculates a total risk score through summation of assigned points for each variable, thereby enabling individualized estimation of lymph node metastasis probability.

Nomogram validation (discrimination, calibration, and clinical utility)

Receiver Operating Characteristic (ROC) curves were constructed for both the training and validation cohorts (Figure 4). The Area Under the Curve (AUC) was 0.908 (95% CI: 0.847–0.969) for the training cohort and 0.876 (95% CI: 0.772–0.980) for the validation cohort, demonstrating excellent discriminatory ability of the nomogram. Calibration curves (Figure 5) assessed the agreement between predicted probabilities and observed outcomes. The close approximation of the calibration curve to the ideal reference line, supported by non-significant Hosmer-Lemeshow goodness-of-fit test results (P=0.197 for training; P=0.769 for validation), indicated good model calibration without significant deviation between predictions and observations. Decision curve analysis (Figure 6) revealed that within the threshold probability range of 0.6 to 0.9, using this nomogram for clinical decision-making yielded higher net benefit than both "treat all" and "treat none" strategies. These findings confirm the model's clinical applicability and utility in guiding lymph node dissection decisions.

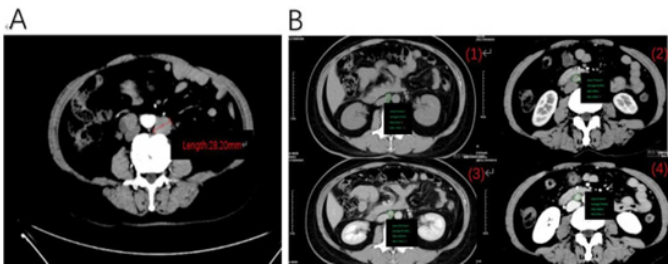

Figure 1: Comparison of clinicopathological data between the training and validation cohorts.

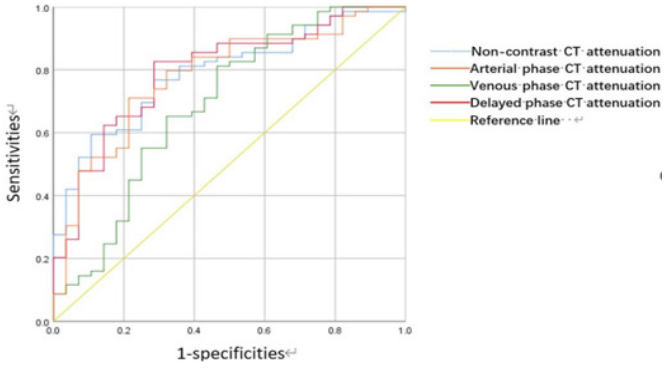

Figure 2: ROC curve of CT attenuation values in the training cohort.

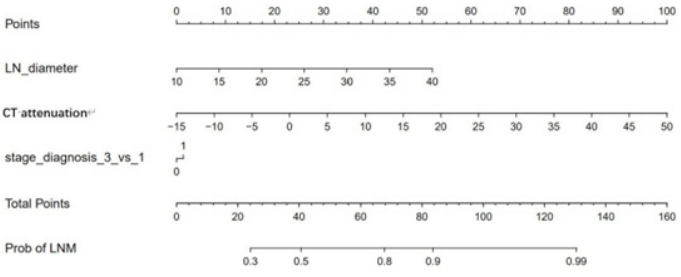

Figure 3: Preoperative nomogram for predicting the risk of LNM in the training cohort.

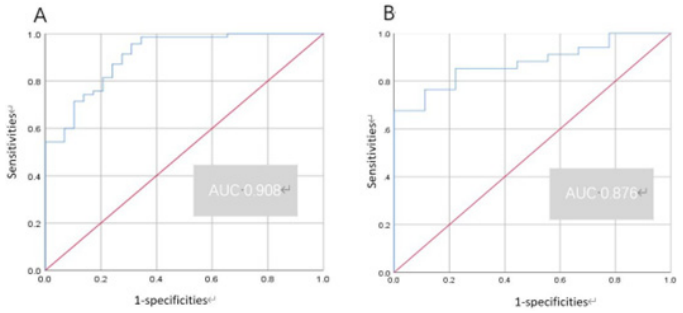

Figure 4: Preoperative ROC curve for predicting LNM risk. **(A)** the training cohort. **(B)** the validation cohort.

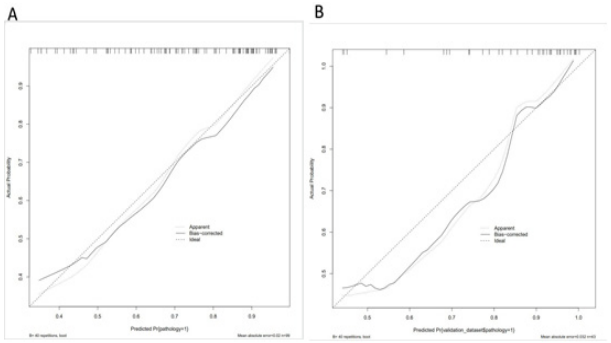

Figure 5: Calibration curve of the preoperative nomogram. **(A)** the training cohort. **(B)** the validation cohort.

Table 1: Comparison of clinicopathological data between the training and validation cohorts.

Variates	Training Set (n=99)	Validation Set (n=43)	t/Z/χ2 value	*P*-value
BMI	23.62±3.35	23.50±3.37	0.203[a]	0.839
CA125	352.50(104.90,1382.93)	352.50(241.40,1382.93)	0.486[b]	0.486
HE4	188.70(92.92,628.10)	263.10(110.40,661.30)	0.219[b]	0.64
CA199	18.33(10.09,30.22)	23.67(7.82,42.53)	0.945[b]	0.331
AFP	1.79(1.12,2.46)	1.90(1.12,2.86)	0.005[b]	0.994
CEA	0.97(0.48,1.53)	0.55(0.45,1.16)	2.932[b]	0.087
Albumin	43.63(39.22,45.45)	43.15(40.02,45.45)	0.078[b]	0.78
Fibrinogen	3.71(3.47,4.17)	3.69(3.27,4.54)	0.193[b]	0.66
D-dimer	1.35(0.68,1.98)	1.46(0.74,2.50)	0.114[b]	0.736
Monocytes	0.42±0.12	0.41±0.13	0.448[a]	0.655
Neutrophils	4.08±1.39	4.35±1.37	-1.068[a]	0.287
WBC	6.22±1.76	6.27±1.50	-0.140[a]	0.888
PLR	192.64(152.94,237.11)	207.32(149.57,207.32)	2.521[b]	0.112
FAR	0.09(0.08,0.10)	0.09(0.07,0.12)	0172[b]	0.679
Lesion location n (%)			0.690[c]	0.406
Unilateral	32(32.3)	17(39.5)		
Bilateral	67(67.7)	26(60.5)		
Pathological type n (%)			0.230[c]	0.632
Serous adenocarcinoma	88(88.9)	37(86.0)		
Non-serous adenocarcinoma	11(11.1)	6(14.0)		
Diagnostic stage n (%)			0.949[c]	0.814
Stage I	3(3.0)	1(2.3)		
Stage II	8(8.1)	2(4.7)		
Stage III	51(51.5)	21(48.8)		
Stage IV	37(37.4)	19(44.2)		
Vascular tumor thrombus n (%)			0.300[c]	0.584
No	20(20.2)	7(16.3)		
Yes	79(79.8)	36(83.7)		
Perineural invasion n (%)			3.268[c]	0.071
No	85(85.9)	42(97.7)		
Yes	14(14.1)	1(2.3)		
Maximum short axis of LN (mm)	12.39(10.74,15.97)	12.65 (10.94,17.65)	0.924[b]	0.336
Non-contrast CT attenuation (HU)	20.83±12.20	22.47±10.77	-0.762[a]	0.448
Arterial phase CT attenuation (HU)	36.24±17.17	38.09±13.71	-0.623[a]	0.534
Venous phase CT attenuation (HU)	45.81±17.29	44.38±14.77	0.471[a]	0.638
Delayed phase CT attenuation (HU)	42.66±17.29	42.85±14.10	-0.064[a]	0.949

[a]Indicates T test. [b]Indicates Mann–Whitney U test. [c]Indicates χ2 test.

Table 2: Univariate analysis of LNM in the training cohort.

Variates	LNM (n=70)	Non-LNM (n=29)	t/Z/χ2 值	*P*-value
BMI	23.73±3.55	23.36±2.84	-0.501[a]	0.617
CA125	372.71(165.55,1418.19)	268.02(40.49,1915.96)	1.946[b]	0.163
HE4	267.20(101.57,628.10)	115.75(70.18,690.87)	0.463[b]	0.496
CA199	20.62(14.20,30.22)	15.44(7.32,31.28)	2.616[b]	0.106
AFP	2.86±6.01	2.03±0.79	-0.691[a]	0.492
CEA	0.90(0.29,1.69)	1.01 (0.45,1.53)	0.181[b]	0.67
Albumin	42.91±4.21	40.68±4.42	-2.359[a]	0.020*
Fibrinogen	3.73 (3.54,4.13)	3.49 (3.14,4.23)	3.062[b]	0.08
D-dimer	1.44 (0.80,2.18)	0.84 (0.53,1.80)	4.432[b]	0.035*
Monocytes	0.43±0.13	0.42±0.11	-0.071[a]	0.943
Neutrophils	3.98±1.44	4.33±1.25	1.163[a]	0.248
WBC	6.12±1.82	6.48±1.58	0.932[a]	0.354
PLR	193.88(165.08,232.99)	176.47(134.44,247.12)	0.337[b]	0.561
FAR	0.09(0.08,0.10)	0.08(0.07,0.10)	4.020[b]	0.045*
Lesion location n (%)			7.057[c]	0.008*
Unilateral	17 (24.3)	15 (51.7)		
Bilateral	53 (75.7)	14 (48.3)		
Pathological type n (%)			13.754[c]	<0.001*
Serous adenocarcinoma	68(97.1)	20(69.0)		
Non-serous adenocarcinoma	2(2.9)	9(31.0)		
Diagnostic stage n (%)			31.356[c]	<0.001*
Stage I	0(0.0)	3(10.3)		
Stage II	0(0.0)	8(27.6)		
Stage III	38(54.3)	13(44.8)		
Stage IV	32(45.7)	5(17.2)		
Vascular tumor thrombus n (%)			20.052[c]	<0.001*
No	6(8.6)	14(48.3)		
Yes	64(91.4)	15(51.7)		
Perineural invasion n (%)			2.717[c]	0.099
No	57(81.4)	28(96.6)		
Yes	13(18.6)	1(3.4)		
Maximum short axis of LN (mm)	13.36(10.85,17.76)	11.04(10.36,12.57)	8.717[b]	0.003*
Non-contrast CT attenuation (HU)	24.18±11.48	12.75±10.03	-4.670[a]	<0.001*
Arterial phase CT attenuation (HU)	41.22±15.58	24.23±14.90	-4.999[a]	<0.001*
Venous phase CT attenuation (HU)	49.67±14.30	36.30±20.39	-3.169[a]	0.003*
Delayed phase CT attenuation (HU)	47.34±15.79	31.37±15.69	-4.588[a]	<0.001*

[a]Indicates T test. [b]Indicates Mann–Whitney U test. [c]Indicates χ^2 test.
*Indicates that the difference was statistically significant (P<0.05). LNM: Lymph Node Metastasis.

Table 3: Diagnostic value of CT attenuation at each phase for LNM in the training cohort.

Variate	Cutoff value (HU)	Sensitivity (%)	Specificity (%)	AUC	95%CI
Non-contrast CT attenuation	24.08	59	89	0.789	0.697-0.881
Arterial phase CT attenuation	27.87	82	71	0.795	0.698-0.891
Venous phase CT attenuation	35.43	81	53	0.690	0.565-0.816
Delayed phase CT attenuation	41.10	71	78	0.779	0.678-0.880

NM: Lymph Node Metastasis.

Table 4: Multivariate logistic regression analysis of LNM in the training Cohort.

Variate	B	Wald	*P*	OR (95%CI)
Intercept	-9.486	4.814	0.028	——
Maximum short axis of LN (mm)	0.674	4.209	0.040*	1.031-3.733
Non-contrast CT attenuation (HU)	0.178	3.865	0.049*	1.001-1.426
Arterial phase CT attenuation (HU)	0.101	2.92	0.087	0.985-1.241
Venous phase CT attenuation (HU)	-0.019	0.119	0.73	0.879-1.095
Delayed phase CT attenuation (HU)	-0.055	0.778	0.378	0.837-1.070
FIGO stage Ⅲ	-3.796	7.031	0.008*	0.001-0.372

*Indicates statistical significance P<0.05). LNM: Lymph Node Metastasis.

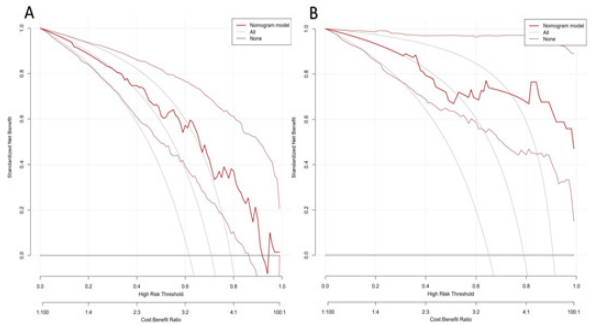

Figure 6: Clinical decision curve for preoperative prediction. **(A)** the training cohort. **(B)** the validation cohort.

Discussion

Ovarian cancer remains the most lethal gynecologic malignancy worldwide, with lymph node metastasis representing a critical prognostic factor. Lymphadenectomy serves as an essential procedure for surgical staging in early-stage disease and plays a significant therapeutic role in advanced ovarian cancer management [5,20]. Although lymph node dissection may reduce recurrence rates in advanced-stage patients [21], it has not been shown to significantly improve Overall Survival (OS) [22] and may conversely increase surgical morbidity. Therefore, clinicians must carefully weigh the risks and benefits of lymphadenectomy, highlighting the crucial need for accurate preoperative assessment of lymph node status.

The tumor marker CA125 is widely utilized for the preoperative evaluation of lymph node status in ovarian cancer. Kim et al. reported that CA125 ≥535 U/mL served as a significant predictor of lymph node metastasis [23]. In contrast, our study found no significant association between CA125 levels and lymph node metastasis. This discrepancy may be explained by differences in study populations: whereas Kim et al. enrolled patients who underwent Primary Debulking Surgery (PDS) followed by adjuvant chemotherapy, our cohort consisted of patients receiving neoadjuvant chemotherapy followed by Interval Debulking Surgery (IDS). The potential modulation of lymph node characteristics by chemotherapy may account for the lack of statistical significance of CA125 in both univariate and multivariate analyses in our investigation (P>0.05).

Noninvasive preoperative evaluation of lymph node status has become an important research focus, with Computed Tomography (CT) being a widely used imaging technique. Meng Xiao et al. first demonstrated in cervical cancer that non-contrast CT attenuation could predict lymph node metastasis; this parameter was established as an independent risk factor and was subsequently integrated into a predictive model [24]. Building upon this work, our study represents the first investigation into the diagnostic value of CT attenuation for predicting lymph node metastasis in ovarian cancer. Retrospective analysis of the training cohort yielded AUC values of 0.789, 0.795, 0.690, and 0.779 for the non-contrast, arterial, venous, and delayed phases, respectively, indicating that CT attenuation demonstrate substantial predictive accuracy for lymph node metastasis in ovarian cancer and may serve as a valuable diagnostic indicator.

A study by Jia Lina et al. identified preoperative arterial-phase CT attenuation as an independent risk factor for predicting lymph node metastasis in lung adenocarcinoma [10]. In contrast, our investigation revealed that non-contrast CT attenuation (cutoff: 24.08 HU) yielded optimal predictive performance for lymph node metastasis in ovarian cancer (AUC=0.789, specificity 89%, sensitivity 59%).

This discrepancy may be explained by the fact that non-contrast imaging primarily reflects inherent tissue density with minimal contrast agent interference, while iodinated contrast agents in enhanced phases may introduce artifacts that compromise accurate delineation of lymph node regions of interest and introduce measurement variability. Although the identified critical phase differs between studies, Jia et al. similarly reported higher CT attenuation in metastatic compared to non-metastatic lymph nodes, a trend consistent with our findings (Table 2). Furthermore, Zhang Zecai et al. demonstrated the predictive value of short-axis diameter for lymph node metastasis in gastric cancer (P<0.05), with significantly larger diameters in metastatic nodes [25], which aligns with our conclusions. The observed increase in short-axis diameter likely reflects morphological alterations resulting from intranodal tumor proliferation following lymphatic invasion.

The LION trial [22] established that systematic lymphadenectomy can be omitted in advanced ovarian cancer patients without radiologically evident retroperitoneal lymph node involvement. However, current clinical decision-making predominantly depends on lymph node size as the diagnostic criterion, which demonstrates limited accuracy. This limitation creates a clinical dilemma: some patients with lymph node metastases remain undetected and consequently fail to achieve complete R0 resection, while others undergo unnecessary lymphadenectomy and face associated risks of surgical complications including lymphatic leakage, chylous ascites, and thromboembolic events. Consequently, precise preoperative assessment of lymph node status is of critical importance. Nomograms represent a widely utilized clinical tool for developing predictive models. Through multivariate analysis, our study identified maximum short-axis diameter, non-contrast CT attenuation, and FIGO stage III as independent predictors of lymph node metastasis in ovarian cancer, and subsequently developed a predictive nomogram based on these parameters. The model exhibited excellent discriminatory power and calibration, with Area Under the Curve (AUC) values of 0.908 and 0.876 in the training and validation cohorts, respectively.

In conclusion, CT imaging characteristics provide a valuable non-invasive method for the preoperative prediction of lymph node metastasis in ovarian cancer, demonstrating significant diagnostic utility. The developed model offers a more comprehensive framework for preoperative lymph node evaluation, allowing clinicians to combine CT parameters with clinical features for integrated assessment of nodal status. This methodology supports the formulation of individualized treatment plans and promotes the advancement of precision medicine in ovarian cancer management.

Conclusion

CT attenuation represents reliable imaging biomarkers for predicting lymph node metastasis in ovarian cancer. The nomogram prediction model, developed by integrating CT imaging features with clinical parameters, provides an intuitive and effective tool for preoperative evaluation of lymph node metastasis status.

This study has several limitations. First, the relatively small sample size and single-center nature of the data require validation through larger, multicenter investigations. Second, although the prediction model underwent internal validation, external validation using independent datasets is still lacking. Third, prospective studies are necessary to further assess the clinical utility and practical performance of the nomogram. Therefore, future well-designed multicenter studies with larger sample sizes are needed to verify the robustness and generalizability of the model.

Declarations

Ethics statement: Human-related procedures were reviewed and approved by the Ethics Committee of the Second Affiliated Hospital of Dalian Medical University and were carried out in full compliance with local laws and institutional policies; written informed consent was obtained from every participant (ethical approval number: KY2025-481-01).

Data availability statement: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of interest: The authors affirm that no commercial or financial connections exist that might be interpreted as a potential conflict of interest regarding this research.

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Author contributions:

Yajie Duan, Jiawei Wang, Jiayuan Zhong, Xin Li, Wenying Zhou, Siman Li: Formal Analysis, Investigation, Writing – original draft, Writing – review & editing. Xinyou Wang: Formal Analysis, Writing – original draft.

Jing Na, : Methodology, Project administration, Writing – original draft. Ya Li: Data curation, Formal Analysis, Investigation, Writing – original draft. Jun Wang: Formal Analysis, Software, Writing – review & editing. Jinming Zhu, Shichao Han: Writing – review & editing.

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Abbreviations: LNM: Lymph Node Metastasis FIGO Lymph Node; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; PET-CT: Positron Emission Tomography–Computed Tomography; HU: Hounsfield Units; FAR: Fibrinogen-to-Albumin Ratio; PLR: Platelet-to-Lymphocyte Ratio; ROIs: Regions of Interest; ROC: Receiver Operating Characteristic; IQR: Interquartile Range; DCA: Decision Curve Analysis; OR: Odds Ratios; CI: Confidence Intervals; AUC: Area Under Curve; OS: Overall Survival; PDS: Primary Debulking Surgery; IDS: Interval Debulking Surgery; WBC: White Blood Cell; HE4: Human Epididymis Protein 4.

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