Research Square

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Perirenal Fat Thickness Is Associated With Pathological Grade of Clear Cell Renal Cell Carcinoma in a Retrospective Cohort Study

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Research Article

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Abstract

Objective

To investigate the association between perirenal fat thickness (PRFT) and pathological grade in patients with clear cell renal cell carcinoma (ccRCC), and to evaluate the preoperative predictive value of PRFT combined with systemic inflammatory biomarkers for identifying high-grade ccRCC.

Methods

We retrospectively reviewed 142 consecutive patients with pathologically confirmed ccRCC who underwent surgical treatment at our institution between January 2022 and December 2025. According to the World Health Organization/International Society of Urological Pathology (WHO/ISUP) grading system, patients were classified into a low-grade group (grades 1–2) and a high-grade group (grades 3–4). Clinical characteristics, laboratory parameters, and preoperative computed tomography (CT) images were collected. PRFT was measured on CT scans, while the neutrophil-to-lymphocyte ratio (NLR) and systemic immune-inflammation index (SII) were calculated from routine blood tests. Univariate and multivariable logistic regression analyses were performed to identify factors associated with high-grade pathology. Receiver operating characteristic (ROC) curve analysis was used to assess the predictive performance of each variable.

Results

A total of 142 ccRCC patients were included in the study, comprising 101 patients (71.1%) with low-grade tumors and 41 patients (28.9%) with high-grade tumors. Compared with the low-grade group, patients with high-grade ccRCC were older and had larger tumors, higher PRFT, elevated NLR, and increased SII levels (all $P < 0.05$). Multivariable logistic regression analysis identified tumor size (OR = 1.373, 95% CI: 1.048–1.799, $P = 0.022$), PRFT (OR = 1.149, 95% CI: 1.052–1.255, $P = 0.002$), and SII (OR = 1.002, 95% CI: 1.000–1.004, $P = 0.018$) as independent predictors of high-grade ccRCC. ROC analysis demonstrated that the area under the curve (AUC) was 0.663 for PRFT and 0.616 for SII. The combined model incorporating tumor size, PRFT, and SII achieved an improved AUC of 0.750, with a sensitivity of 75.6% and a specificity of 63.4%. In the subgroup of patients with small renal masses (tumor diameter ≤ 4 cm), PRFT remained significantly higher in the high-grade group than in the low-grade group ($P = 0.028$).

Conclusions

PRFT and SII are both associated with high-grade ccRCC. Incorporating PRFT with systemic inflammatory biomarkers and tumor size improves the preoperative identification of high-grade ccRCC.

Notably, PRFT retained its predictive value even among patients with small renal masses, suggesting a potential role for PRFT in preoperative risk stratification.

Introduction

Renal cell carcinoma (RCC) is one of the most common malignancy arising from the renal tubular epithelium. Its incidence has steadily increased worldwide over recent decades, posing a substantial public health burden due to its morbidity and mortality[1]. Clear cell renal cell carcinoma (ccRCC) represents the predominant histological subtype, accounting for approximately 70–80% of all RCC[2]. Despite sharing a common histological origin, ccRCC exhibits considerable biological heterogeneity, with marked differences in tumor aggressiveness, metastatic potential, and clinical outcomes according to different pathological grades. Consequently, tumor grade is a key determinant of disease behavior and plays an important role in therapeutic decision-making and prognostic assessment.

At present, pathological grade is usually determined after surgery, and accurate preoperative prediction remains challenging in routine clinical practice. However, insufficient risk stratification may lead to overtreatment of low-grade tumors or underestimation of potentially aggressive tumors. Thus, the demand for reliable preoperative risk assessment has become increasingly important. Several approaches have been investigated for preoperative prediction of ccRCC, including radiomics-based models, contrast-enhanced computed tomography (CT) characteristics, magnetic resonance imaging (MRI) parameters, and renal tumor biopsy[3, 4]. Although these methods have improved preoperative evaluation to some extent, each has inherent limitations. Radiomics and artificial intelligence-based models often require complex computational workflows, specialized software, and extensive data processing, which may limit their routine clinical implementation. Renal tumor biopsy, while informative, is invasive and may be affected by sampling error and intratumoral heterogeneity[5, 6]. In that case, there remains a need for simple, cost-effective, and broadly applicable biomarkers that can facilitate preoperative risk stratification.

Increasing evidence suggests that obesity and adipose tissue biology play important roles in the development and progression of RCC[7]. Traditional measures of obesity, such as body mass index (BMI), provide limited information regarding regional fat distribution and metabolic activity. In contrast, visceral adiposity appears to have a closer relationship with tumor progression[8]. Perirenal fat is a unique visceral adipose tissue compartment located within Gerota’s fascia and in direct anatomical proximity to the kidney. Through paracrine interactions with adjacent tissues, perirenal fat may actively contribute to the local tumor microenvironment. Experimental and clinical studies have shown that perirenal adipose tissue can secrete a variety of inflammatory and metabolic mediators, including interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and leptin, which may influence tumor proliferation, angiogenesis, immune evasion, and metastatic behavior[9, 10]. These findings suggest that perirenal fat thickness (PRFT) may reflect not only anatomical characteristics but also underlying biological processes associated with tumor aggressiveness.

Beyond the local tumor microenvironment, systemic inflammation has emerged as another important contributor to RCC progression. Several inflammatory biomarkers derived from routine blood tests, including the neutrophil-to-lymphocyte ratio (NLR) and the systemic immune-inflammation index (SII), have been widely investigated as indicators of host inflammatory and immune status[11, 12]. Due to their accessibility and low cost, these markers have attracted increasing attention and have been associated with adverse outcomes in a variety of malignancies, including RCC.

Although previous studies have separately explored the relationship between perirenal adiposity or systemic inflammatory markers and RCC aggressiveness, their combined value for preoperative pathological prediction remains limited. Therefore, the present study aimed to investigate the association between PRFT and pathological grade in patients with ccRCC and to evaluate the incremental value of combining PRFT with systemic inflammatory biomarkers for preoperative prediction of high-grade disease.

Materials and Methods

Study Design and Patient Selection

We retrospectively reviewed the medical records of patients who underwent partial nephrectomy or radical nephrectomy at the Department of Urology, Nanjing First Hospital, between January 2022 and December 2025.

A total of 167 patients with renal tumors were initially included. After applying the predefined exclusion criteria, including non-clear cell histology, metastatic disease, incomplete clinical data, poor-quality imaging, and active inflammatory conditions, 142 patients with pathologically confirmed clear cell renal cell carcinoma (ccRCC) were ultimately included in the analysis.

According to the 2016 World Health Organization/International Society of Urological Pathology (WHO/ISUP) grading system, patients were categorized into a low-grade group (grades 1–2) and a high-grade group (grades 3–4).

Inclusion and Exclusion Criteria

Inclusion criteria

Patients meeting all of the following criteria were included:

1. age ≥ 18 years;
2. pathologically confirmed clear cell renal cell carcinoma;
3. available preoperative contrast-enhanced computed tomography (CT) within 1 month before surgery;
4. complete clinical, laboratory, and imaging data.

Exclusion criteria

Patients were excluded if they had any of the following conditions:

1. metastatic RCC at diagnosis;
2. bilateral renal tumors;
3. previous systemic therapy before surgery;
4. active infection or inflammatory disease;
5. hematological disease or autoimmune disease;
6. poor-quality CT images unsuitable for measurement;
7. incomplete medical records.

Clinical and Laboratory Data Collection

Clinical variables collected from the electronic medical records included age, sex, body mass index (BMI), hypertension, diabetes mellitus, surgical procedure, tumor size, and pathological grade.

Preoperative laboratory parameters obtained within one week before surgery included neutrophil count, lymphocyte count, platelet count, and serum albumin level.

The neutrophil-to-lymphocyte ratio (NLR) was calculated as follows:

$$\mathrm{NLR}=\frac{\mathrm{Neutrophil}}{\mathrm{Lymphocyte}}$$

The systemic immune-inflammation index (SII) was calculated using the following formula:
$\mathrm{SII}=\frac{\mathrm{Platelet}\times\mathrm{Neutrophil}}{\mathrm{Lymphocyte}}$

CT Imaging and Measurement of Perirenal Fat Thickness

All patients underwent contrast-enhanced CT examination before surgery.

Perirenal fat thickness (PRFT) was measured on axial CT images obtained at the level of the renal vein. PRFT was defined as the maximum distance between the posterior surface of the renal capsule and the posterior abdominal wall.The measurement method is illustrated in Fig. 1.

Measurements were independently performed by two experienced urologists who were blinded to the pathological results. The average value of the two measurements was used for subsequent analyses.

Tumor size was determined according to the maximum diameter of the surgical specimen reported in the final pathological assessment.

Pathological Evaluation

All surgical specimens were reviewed by dedicated genitourinary pathologists.

Histological subtype and pathological grade were determined according to the 2016 WHO/ISUP classification system. High-grade ccRCC was defined as WHO/ISUP grade 3 or 4, whereas grades 1 and 2 were classified as low-grade tumors.

Statistical Analysis

Continuous variables were presented as mean ± standard deviation (SD) for normally distributed data or as median with interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using Student's t-test or the Mann–Whitney U test for continuous variables, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test.

Univariate logistic regression analysis was performed to identify factors associated with high-grade pathology. Variables with a P value < 0.10 in the univariate analysis were subsequently entered into a multivariable logistic regression model to identify independent predictors.

Receiver operating characteristic (ROC) curve analysis was used to evaluate the predictive performance of PRFT and inflammatory biomarkers. The area under the ROC curve (AUC) was calculated to assess discriminative ability.

All statistical tests were two-sided, and a P value < 0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 26.0.

Results

Patient Characteristics

A total of 167 patients who underwent surgical treatment for RCC between January 2022 and December 2025 were initially included. After excluding patients with non-clear cell histology, metastatic disease, incomplete laboratory data, active inflammatory conditions, or inadequate imaging quality, 142 patients with pathologically confirmed clear cell renal cell carcinoma (ccRCC) were included in the final analysis.

According to the WHO/ISUP grading system, 101 patients (71.1%) were classified as having low-grade tumors (grades 1–2), whereas 41 patients (28.9%) had high-grade tumors (grades 3–4).

The mean age of the entire cohort was 58.6 ± 9.8 years. There were 79 men (55.6%) and 63 women (44.4%). Partial nephrectomy was performed in 117 patients (82.4%), while 25 patients (17.6%)

underwent radical nephrectomy. Baseline demographic and clinical characteristics are summarized in Table 1.

Table 1
Baseline characteristics of patients according to pathological grade

Variable	Low-grade (n = 101)	High-grade (n = 41)	P value
Age (years)	57.6 ± 9.7	61.1 ± 9.4	0.045
Sex Male Female	55 46	24 17	0.472
BMI (kg/m²)	24.8 ± 3.1	25.3 ± 3.4	0.391
Hypertension, n (%)	39 (38.6)	18 (43.9)	0.556
Diabetes mellitus, n (%)	16 (15.8)	8 (19.5)	0.593
Tumor size (cm)	4.04 ± 1.39	4.71 ± 1.60	0.022
PRFT (mm)	13.42 ± 4.36	16.40 ± 5.79	0.004
NLR	2.56 ± 0.87	3.02 ± 1.09	0.018
SII	625 ± 197	727 ± 233	0.016

Compared with the low-grade group, patients with high-grade ccRCC were significantly older (61.1 ± 9.4 vs. 57.6 ± 9.7 years, $P = 0.045$) and had larger tumors (4.71 ± 1.60 vs. 4.04 ± 1.39 cm, $P = 0.022$).

PRFT was significantly greater in patients with high-grade tumors than in those with low-grade tumors (16.40 ± 5.79 vs. 13.42 ± 4.36 mm, $P = 0.004$). Markers of systemic inflammation were also elevated in the high-grade group. Specifically, the NLR was significantly higher in patients with high-grade disease (3.02 ± 1.09 vs. 2.56 ± 0.87, $P = 0.018$), and SII values were likewise increased (727 ± 233 vs. 625 ± 197, $P = 0.016$).

No significant differences were observed between the two groups regarding sex distribution, body mass index (BMI), hypertension, or diabetes mellitus.

Logistic Regression Analysis

To identify factors associated with high-grade pathology, univariate logistic regression analysis was initially performed, and the results are summarized in Table 2.

Table 2
Univariate logistic regression analysis for predicting high-grade ccRCC

Variable	OR	95% CI	P value
Age	1.039	1.002–1.078	0.041
Male sex	1.334	0.619–2.873	0.462
BMI	1.048	0.935–1.174	0.421
Hypertension	1.247	0.609–2.553	0.546
Diabetes mellitus	1.291	0.507–3.289	0.592
Tumor size	1.372	1.059–1.777	0.017
PRFT	1.137	1.048–1.233	0.002
NLR	1.688	1.129–2.524	0.011
SII	1.002	1.001–1.004	0.011

Age, tumor size, PRFT, NLR, and SII were all significantly associated with high-grade ccRCC. Among these variables, tumor size demonstrated a significant association with high-grade pathology (OR = 1.372, 95% CI: 1.059–1.777, *P* = 0.017). PRFT was also significantly associated with an increased possibility of high-grade disease (OR = 1.137, 95% CI: 1.048–1.233, *P* = 0.002). Elevated inflammatory biomarkers were similarly associated with a higher probability of high-grade tumors, including NLR (OR = 1.688, 95% CI: 1.129–2.524, *P* = 0.011) and SII (OR = 1.002, 95% CI: 1.001–1.004, *P* = 0.011).

Variables with a *P* value < 0.10 in the univariate analysis were subsequently entered into a multivariable logistic regression model.

After adjustment for potential confounding factors, tumor size (OR = 1.373, 95% CI: 1.048–1.799, *P* = 0.022), PRFT (OR = 1.149, 95% CI: 1.052–1.255, *P* = 0.002), and SII (OR = 1.002, 95% CI: 1.000–1.004, *P* = 0.018) remained independent predictors of high-grade ccRCC (Table 3).

Table 3
Multivariable logistic regression analysis for predicting high-grade ccRCC

Variable	OR	95% CI	P value
Age	1.027	0.988–1.068	0.181
Tumor size	1.373	1.048–1.799	0.022
PRFT	1.149	1.052–1.255	0.002
NLR	1.241	0.774–1.991	0.370
SII	1.002	1.000–1.004	0.018

ROC Curve Analysis

Receiver operating characteristic (ROC) curve analysis was performed to evaluate the predictive performance of PRFT and inflammatory biomarkers for identifying high-grade ccRCC.

The AUC of PRFT alone was 0.663, whereas the AUC of SII alone was 0.616, indicating modest discriminatory ability for both variables.

A combined model incorporating tumor size, PRFT, and SII demonstrated improved predictive performance, showing an AUC of 0.750. At the optimal cutoff value, the model achieved a sensitivity of 75.6% and a specificity of 63.4% (Fig. 2).

These findings suggest that integrating PRFT with systemic inflammatory status and tumor size provides superior preoperative predicting ability of high-grade ccRCC compared with individual biomarkers alone.

Subgroup Analysis of Small Renal Masses

Because preoperative assessment of tumor aggressiveness is particularly challenging in patients with small renal masses, a subgroup analysis was performed in patients with tumors measuring ≤ 4 cm in maximum diameter.

Within this subgroup, PRFT remained significantly higher in patients with high-grade tumors than in those with low-grade tumors (15.9 ± 4.6 mm vs. 12.8 ± 3.9 mm, $P = 0.028$) (Fig. 3).

In contrast, the associations between systemic inflammatory biomarkers and pathological grade became less pronounced in this subgroup.

These findings indicate that PRFT may retain its predictive value even among patients with clinically localized small renal masses and may therefore serve as a useful imaging biomarker for preoperative risk stratification.

Discussion

The present study demonstrated that perirenal fat thickness (PRFT) is an independent predictor of high-grade pathological features in patients with clear cell renal cell carcinoma (ccRCC). ROC analysis further showed that combining PRFT, SII, and tumor size improved the preoperative discrimination of high-grade ccRCC. Notably, the association between PRFT and pathological grade remained significant in patients with tumors ≤ 4 cm, suggesting a potential role for PRFT in risk stratification of small renal masses.

Increasing evidence indicates that perirenal fat is not merely a passive fat depot but rather a metabolically active component of the tumor microenvironment[9, 13]. Compared with traditional obesity-related indicators such as body mass index (BMI), PRFT provides a more direct assessment of local adipose tissue surrounding the kidney. Previous studies have shown that perirenal adipose tissue secretes a variety of inflammatory and metabolic mediators, including interleukin-6, tumor necrosis factor-α, and leptin, which may promote angiogenesis, immune evasion, and tumor progression[10, 14]. Given its close anatomical proximity to the kidney, perirenal fat may exert direct paracrine effects on adjacent tumor tissue. This biological interaction may partly explain the observed association between increased PRFT and higher pathological grade in ccRCC.

Beyond the local adipose microenvironment, systemic inflammation is increasingly recognized as a key contributor to cancer progression[15]. In the present study, SII remained an independent predictor of high-grade disease after multivariable adjustment. As a composite marker incorporating neutrophil, lymphocyte, and platelet counts, SII reflects the balance between tumor-promoting inflammation and antitumor immune responses. Previous studies have linked elevated SII to adverse oncological outcomes in RCC[16], and our findings further support its value in identifying biologically aggressive tumors.

A notable aspect of this study is the combined evaluation of PRFT and systemic inflammatory biomarkers, whereas few previous studies have assessed their integrated predictive value. Our results suggest that local adipose tissue and systemic inflammatory status may contribute to tumor aggressiveness together. Incorporating both factors provided better discrimination of high-grade ccRCC than either marker alone.

Subgroup analysis demonstrated that PRFT remained significantly associated with pathological grade in tumors measuring ≤ 4 cm. In contrast, the predictive value of inflammatory biomarkers appeared less pronounced. This finding may be clinically relevant because treatment decisions for small renal masses often rely on preoperative estimation of tumor aggressiveness. A simple imaging marker such as PRFT may therefore provide additional information to support individualized treatment planning.

Several limitations should be acknowledged. First, this was a retrospective single-center study with a relatively limited sample size, which may induce selection bias. Second, only PRFT was evaluated, whereas other adiposity-related imaging parameters were not included. Third, external validation was not performed. Future multicenter prospective studies with larger cohorts are warranted to confirm these

findings and further clarify the biological relationship between perirenal adiposity and ccRCC aggressiveness.

Conclusion

In conclusion, PRFT is independently associated with high-grade pathological features in ccRCC. A predictive model incorporating PRFT, SII, and tumor size improves the preoperative identification of high-grade tumor. As a simple and readily available parameter derived from routine CT imaging, PRFT may serve as a useful adjunct for preoperative risk stratification and clinical decision-making in patients with ccRCC.

Declarations

Author Contributions

Yifan Zhang: Conceptualization, Data curation, Formal analysis, Writing—original draft.

Jijie Shen: Data curation, Investigation, Methodology, Writing—review and editing.

Kai Wang: Data collection, Statistical analysis, Validation.

Shengli Zhang: Supervision, Project administration, Writing—review and editing.

Hongbin Sun: Conceptualization, Supervision, Funding acquisition, Final approval of manuscript.

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The authors declare no conflicts of interest.

Ethical Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Nanjing First Hospital.The requirement for informed consent was waived due to the retrospective nature of the study.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Clinical trial number: not applicable.

This was a retrospective observational study using existing anonymized clinical, imaging, and pathological data; it was not a clinical trial and therefore was not registered.

Consent to publish

Not applicable. This study was a retrospective analysis of de-identified clinical, laboratory, and imaging data. No individual patient's identifiable personal information, identifiable clinical details, or identifiable images are included in this manuscript. The computed tomography images used for perirenal fat thickness measurement were anonymized before analysis, and any imaging information presented in the manuscript does not contain patient identifiers. The results are reported at the group level. Therefore, specific consent for publication was not required. All authors have read and approved the final manuscript and agree to its publication in Discover Oncology.

References

1. Rose TL, Kim WY. Renal cell carcinoma: a review. JAMA. 2024;332:1001–10. https://doi.org/10.1001/jama.2024.12848.
2. Schiavoni V, Campagna R, Pozzi V, Cecati M, Milanese G, Sartini D, Salvolini E, Galosi AB, Emanuelli M. Recent advances in the management of clear cell renal cell carcinoma: novel biomarkers and targeted therapies. Cancers (Basel). 2023;15:3207. https://doi.org/10.3390/cancers15123207.
3. Choi JW, Hu R, Zhao Y, Purkayastha S, Wu J, McGirr AJ, Stavropoulos SW, Silva AC, Soulen MC, Palmer MB, Zhang PJL, Zhu C, Ahn SH, Bai HX. Preoperative prediction of the stage, size, grade, and necrosis score in clear cell renal cell carcinoma using MRI-based radiomics. Abdom Radiol (NY). 2021;46:2656–64. https://doi.org/10.1007/s00261-020-02876-x.
4. Shen J, Zou Y. Diagnostic value of contrast-enhanced CT in clear cell renal cell carcinoma: a systematic review and meta-analysis. BMC Urol. 2024;24:189. https://doi.org/10.1186/s12894-024-01574-w.
5. Xu Y, Li Y, Wang F, Zhang Y, Huang D. Addressing the current challenges in the clinical application of AI-based radiomics for cancer imaging. Front Med (Lausanne). 2025;12:1674397. https://doi.org/10.3389/fmed.2025.1674397.
6. Suarez-Ibarrola R, Basulto-Martinez M, Heinze A, Gratzke C, Miernik A. Radiomics applications in renal tumor assessment: a comprehensive review of the literature. Cancers (Basel). 2020;12:1387. https://doi.org/10.3390/cancers12061387.
7. Gluba-Brzózka A, Rysz J, Ławiński J, Franczyk B. Renal cell cancer and obesity. Int J Mol Sci. 2022;23:3404. https://doi.org/10.3390/ijms23063404.
8. Crudele L, Piccinin E, Moschetta A. Visceral adiposity and cancer: role in pathogenesis and prognosis. Nutrients. 2021;13:2101. https://doi.org/10.3390/nu13062101.
9. Kashiwagi E. Perirenal fat in disease progression: from inflammatory mediator to therapeutic target. Int J Urol. 2025;32:1314–20. https://doi.org/10.1111/iju.70158.

10. Campo-Verde-Arbocco F, López-Laur JD, Romeo LR, Giorlando N, Bruna FA, Contador DE, López-Fontana G, Santiano FE, Sasso CV, Zyla LE, López-Fontana CM, Calvo JC, Carón RW, Pistone Creydt V. Human renal adipose tissue induces the invasion and progression of renal cell carcinoma. Oncotarget. 2017;8:94223–34. https://doi.org/10.18632/oncotarget.21666.
11. Liu K, Yang L, Liu Y, Zhang Y, Zhu J, Zhang H, He Z. Systemic immune-inflammation index (SII) and neutrophil-to-lymphocyte ratio (NLR): a strong predictor of disease severity in large-artery atherosclerosis (LAA) stroke patients. J Inflamm Res. 2025;18:195–202. https://doi.org/10.2147/JIR.S500474.
12. Li Z, An W, Wang B, Yan Z, Gao L, Wang J, Yu H, Wen S. Prognostic significance of peripheral blood inflammatory biomarkers (SII, PLR, NLR, LMR, SIRI, PIV, PNI) in lip cancer: NLR as an independent biomarker for survival outcomes. Front Oncol. 2025;15:1676824. https://doi.org/10.3389/fonc.2025.1676824.
13. Grigoraș A, Balan RA, Căruntu ID, Giușcă SE, Lozneanu L, Avadanei RE, Rusu A, Riscanu LA, Amalinei C. Perirenal adipose tissue-current knowledge and future opportunities. J Clin Med. 2021;10:1291. https://doi.org/10.3390/jcm10061291.
14. Qiu X, Lan X, Li L, Chen H, Zhang N, Zheng X, Xie X. The role of perirenal adipose tissue deposition in chronic kidney disease progression: mechanisms and therapeutic implications. Life Sci. 2024;352:122866. https://doi.org/10.1016/j.lfs.2024.122866.
15. Zhao H, Wu L, Yan G, Chen Y, Zhou M, Wu Y, Li Y. Inflammation and tumor progression: signaling pathways and targeted intervention. Signal Transduct Target Ther. 2021;6:263. https://doi.org/10.1038/s41392-021-00658-5.
16. Jin M, Yuan S, Yuan Y, Yi L. Prognostic and clinicopathological significance of the systemic immune-inflammation index in patients with renal cell carcinoma: a meta-analysis. Front Oncol. 2021;11:735803. https://doi.org/10.3389/fonc.2021.735803.

Figures

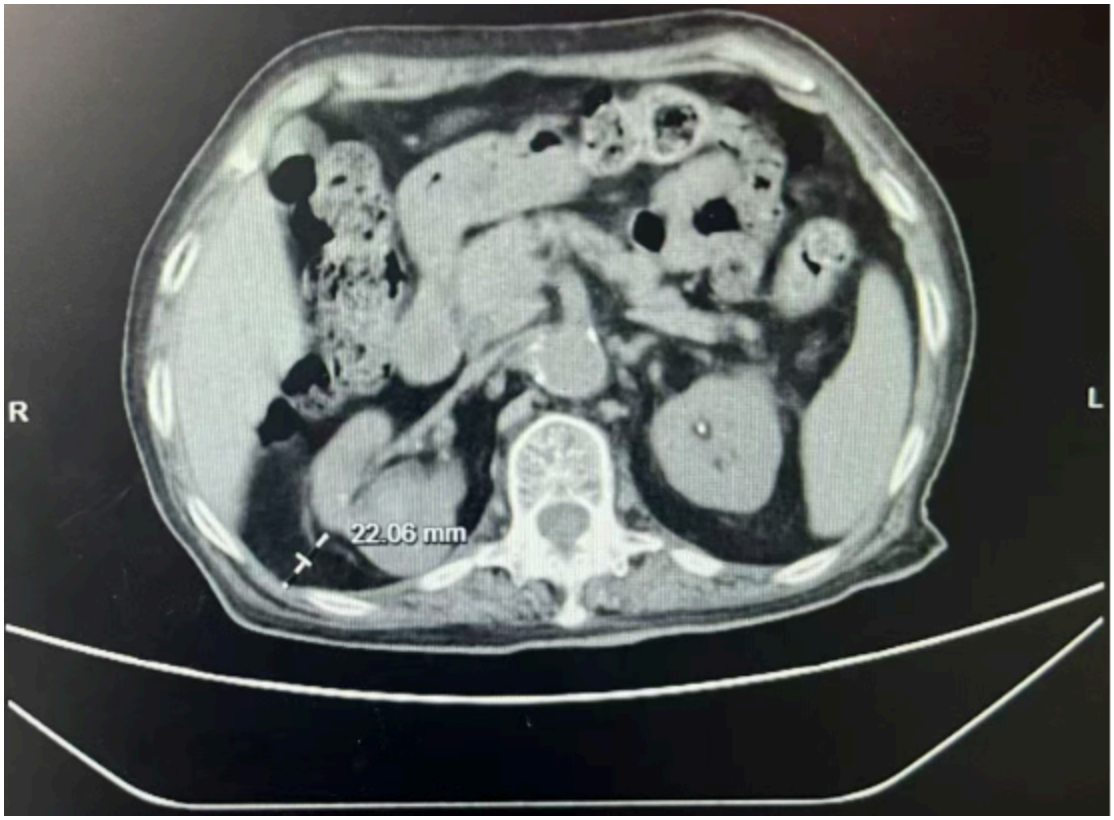


Figure 1

Measurement of perirenal fat thickness (PRFT)

PRFT was defined as the maximum distance between the posterior surface of the renal capsule and the posterior abdominal wall.

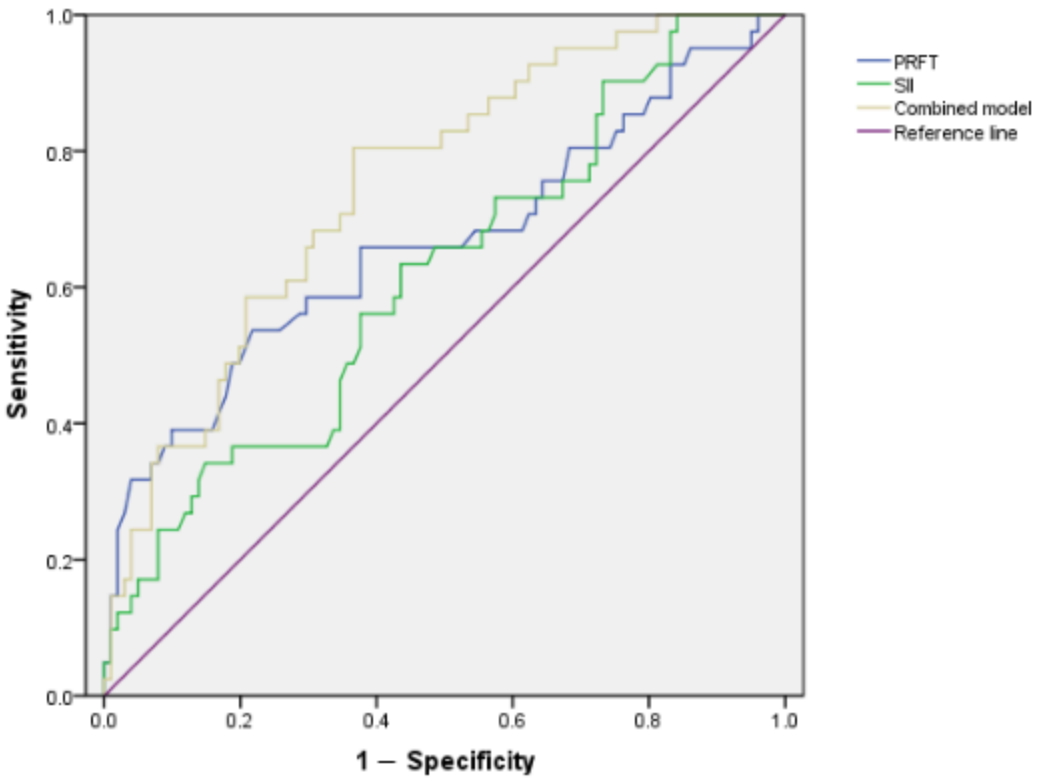


Figure 2

Receiver operating characteristic (ROC) curves for predicting high-grade ccRCC.
ROC curves comparing the predictive performance of perirenal fat thickness (PRFT), systemic immune-inflammation index (SII), and a combined model consisting of tumor size, PRFT, and SII. The combined model achieved the highest predictive accuracy (AUC = 0.750), outperforming PRFT alone (AUC = 0.663) and SII alone (AUC = 0.616).

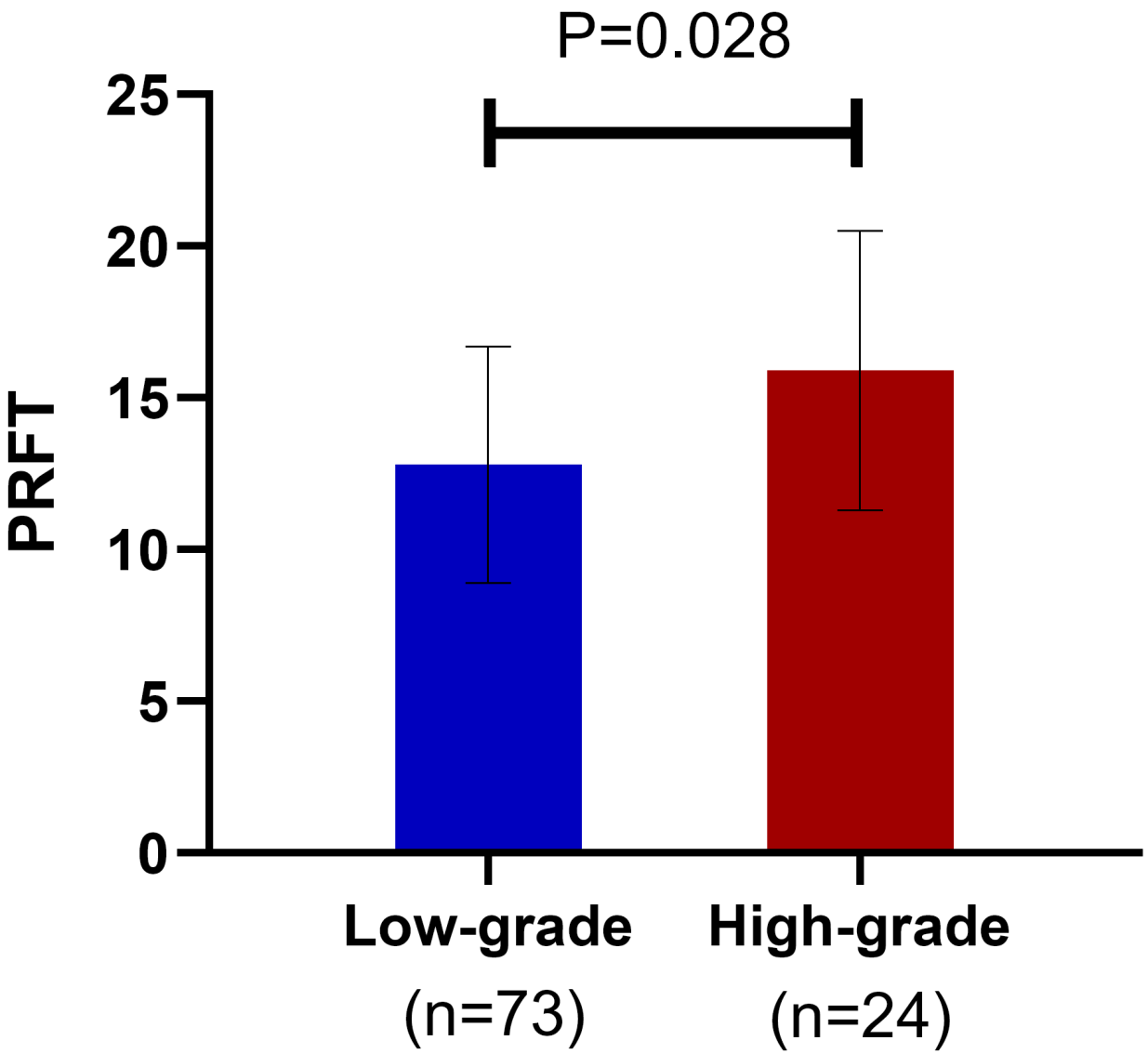


Figure 3

Comparison of perirenal fat thickness (PRFT) between low-grade and high-grade clear cell renal cell carcinoma (ccRCC) in patients with tumors ≤4 cm.
Patients with high-grade ccRCC exhibited significantly greater PRFT than those with low-grade tumors (15.9 ± 4.6 mm vs. 12.8 ± 3.9 mm, P = 0.028).