ORIGINAL ARTICLE UDK: 616.24-007.63-073.756.8:004

www.doi.org/10.67214/mk4e4641

CT-BASED ANALYSIS OF PULMONARY NEOPLASTIC LESIONS IN PATIENTS WITH EMPHYSEMA: PREVALENCE AND IMAGING CORRELATES — A RETROSPECTIVE STUDY

Dimitrijevikj K., Pejkovska S., Karkinski D., Angelovska I., Momchilovikj S.

[1]*University Clinic of Pulmonology and Allergology, Faculty of Medicine, Skopje, North Macedonia*

Abstract

Objective: Computed tomography (CT) plays a central role in the early detection and characterization of lung neoplasms and allows simultaneous assessment of structural lung diseases such as emphysema. The aim is to determine the prevalence of emphysema in patients with CT-detected pulmonary neoplastic lesions and to evaluate its association with tumor size, morphology, and anatomical distribution.

Materials and Methods: This retrospective observational study was conducted at the University Clinic of Pulmonology and Allergology. A total of 1045 thoracic CT examinations performed between August 2025 and January 2026 using a PHILIPS Incisive CT scanner protocol optimized for thoracic imaging were reviewed. One hundred patients with CT-detected lung neoplasms were included.

Demographic characteristics, emphysema subtype, tumor features, and associated CT findings were analyzed. Emphysema was assessed visually and classified by subtype. Statistical analysis included chi-square testing, t-tests, Mann–Whitney U tests, ANOVA, and multivariable logistic regression.

Results: Lung neoplasms were identified in 9.6% of CT examinations. Emphysema was detected in 48% of patients, predominantly of the centrilobular type. The mean tumor size was 52.4 ± 22.1 mm, with a predominance of the upper lobe and central segment. No statistically significant associations were observed between emphysema and tumor size, morphology, lobar distribution, or segmental localization. Male sex was associated with increased odds of emphysema (OR ≈ 2.4), although the association did not reach statistical significance. The regression model showed limited explanatory power (Pseudo $R^2 = 0.066$).

Conclusion: Emphysema frequently coexists with lung neoplasms in tertiary clinical practice. However, within the limitations of this retrospective imaging-based study, emphysema was not associated with measurable differences in CT tumor phenotype. Emphysema should be regarded primarily as a background risk substrate rather than a determinant of tumor imaging characteristics.

Keywords: *CT; emphysema; prevalence; neoplastic lesions; lungs.*

Introduction

Lung cancer remains the leading cause of cancer-related mortality worldwide, largely due to late diagnosis and advanced disease at presentation. Computed tomography (CT) plays a central role in early detection, characterization, and staging of lung neoplasms and has

demonstrated a significant impact on mortality reduction in high-risk populations through screening programs such as the National Lung Screening Trial and the NELSON trial.

Emphysema, a smoking-related structural lung disease, has been independently associated with increased lung cancer risk even after adjustment for smoking exposure.

Chronic inflammation, altered extracellular matrix, and regional hypoxia in emphysematous lungs may theoretically influence tumor development and growth patterns. However, whether emphysema modifies the radiologic phenotype of established tumors remains uncertain (1-3). This study was designed to evaluate this relationship in a real-world tertiary-care population.

In addition to tumor detection, CT provides a detailed evaluation of structural lung abnormalities, including emphysema. Emphysema represents a chronic smoking-related parenchymal disorder characterized by permanent enlargement of airspaces and destruction of alveolar walls. Several studies have demonstrated that CT-detected emphysema is independently associated with increased risk of lung cancer development, even after adjustment for smoking exposure and airflow limitation (4–6). This association has led to growing interest in understanding whether emphysema merely reflects shared risk factors or influences tumor behavior and radiologic phenotype.

Previous studies have suggested potential relationships between emphysema and tumor location, morphology, and aggressiveness; however, results remain inconsistent, and data derived from real-world clinical populations remain limited. Furthermore, the influence of different emphysema subtypes on tumor characteristics has not been fully clarified.

Given the increasing role of CT as an integrated diagnostic tool that simultaneously evaluates malignant lesions and structural lung disease, further investigation of the relationship between emphysema and lung carcinoma imaging characteristics is warranted.

Objective of the Study

To determine the prevalence of emphysema in patients with CT-detected pulmonary neoplastic lesions and to evaluate whether emphysema is associated with tumor size, morphology, or anatomical distribution.

Specific objectives were:

1. To determine the prevalence of emphysema among patients with CT-detected pulmonary neoplastic lesions.
2. To analyze the distribution of emphysema subtypes.
3. To evaluate tumor anatomical distribution according to lobar and segmental localization.
4. To compare tumor morphology and dimensions between patients with and without emphysema.
5. To assess associations between emphysema and additional CT findings, including nodules, lymph nodes, pleural effusion, and distant metastasis.
6. To identify independent predictors of emphysema using multivariable statistical analysis.

Materials and Methods

Study Design and Population

This retrospective observational study included 100 patients with CT-detected pulmonary neoplastic lesions identified among 1045 thoracic CT examinations performed over a six-month period (August 2025 to January 2026) at the University Clinic of Pulmonology and Allergology in Skopje, N. Macedonia. Thoracic CT examinations were imaged on a PHILIPS INCISIVE CT Scanner with a 1 mm thin section protocol and a spatial reconstruction algorithm optimized for thoracic imaging.

Variables recorded included age, sex, presence and subtype of emphysema (centrilobular, paraseptal, combined), tumor size, morphology, lobar and segmental location, lymph node involvement, pleural effusion, and distant metastasis.

Emphysema was assessed visually according to established radiologic criteria. Quantitative densitometric analysis was not available due to constraints imposed by the retrospective design.

Smoking exposure data were not consistently available in medical records and could not therefore be included in regression modeling, representing an important limitation.

Statistical analysis included chi-square testing, t-tests, Mann–Whitney U tests, ANOVA, and multivariable logistic regression. Confidence intervals were calculated for odds ratios. No formal power calculation was performed. All examinations were performed using standard thoracic CT protocols. Images were evaluated by radiologists experienced in thoracic imaging.

Statistical Analysis

Statistical analysis was performed using standard comparative and multivariable methods. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages.

Comparisons between categorical variables were performed using the Chi-square test or Fisher's exact test as appropriate. Continuous variables were compared using the Welch t-test or the Mann–Whitney U test depending on data distribution. Comparisons among multiple emphysema subtypes were performed using one-way ANOVA or the Kruskal–Wallis test. Multivariable logistic regression analysis was conducted with emphysema presence as the dependent variable, including demographic and tumor-related imaging variables as predictors. A p-value less than 0.05 was considered statistically significant, and values between 0.05 and 0.10 were interpreted as borderline trends.

Results

During the six-month study period (August 2025–January 2026), a total of 1045 thoracic CT examinations were performed at the University Clinic of Pulmonology and Allergology. Among these, CT findings consistent with pulmonary neoplastic lesions were identified in100 patients, corresponding to a prevalence of 9.6%. The mean patient age was approximately 69 years, and the study population was predominately male (72% male, 28% female).

TABLE 1 — Study Population and Demographics

Variable	Value
Total CT examinations	1045
Patients with pulmonary neoplastic lesions	100
Prevalence	9.6%
Mean age (years)	69
Male	72 (72%)
Female	28 (28%)

Emphysematous changes were identified in 48% of patients, whereas 52% had no CT evidence of emphysema. Subtype analysis revealed a predominance of centrilobular emphysema (25%), followed by combined emphysema patterns (14%) and paraseptal emphysema (9%). Male patients were more prevalent in the emphysema group (39 males and 9 females) than in the non-emphysema group (33 males and 19 females). Statistical analysis yielded an odds ratio of 2.49 for male sex, with $\chi^2 = 3.09$ ($p = 0.079$) and Fisher's exact $p = 0.074$, indicating a borderline association and suggesting a clinically relevant trend toward a higher prevalence of emphysema among male patients.

TABLE 2 — Emphysema Prevalence and Subtypes		
Emphysema status/subtype.	**n**	**%**
No emphysema	52	52%
Any emphysema	48	48%
Centrilobular	25	25%
Combined (both)	14	14%
Paraseptal	9	9%

Figure-1

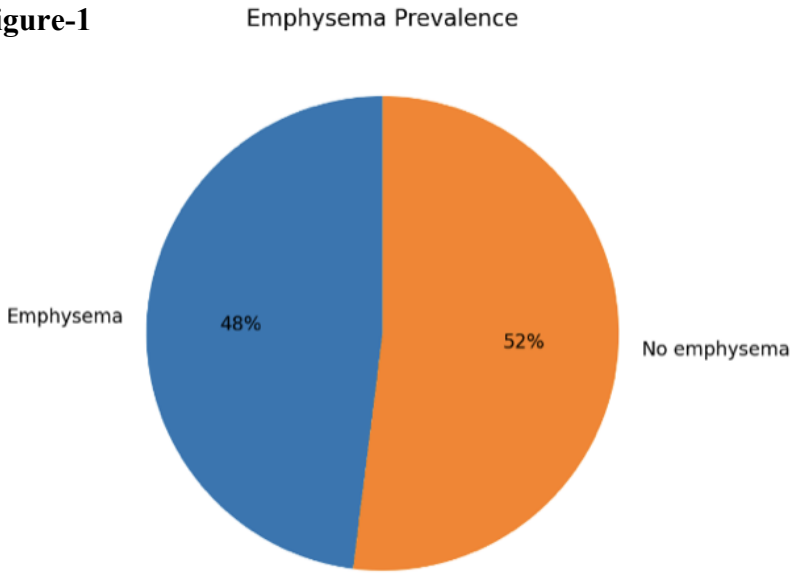


Figure-2

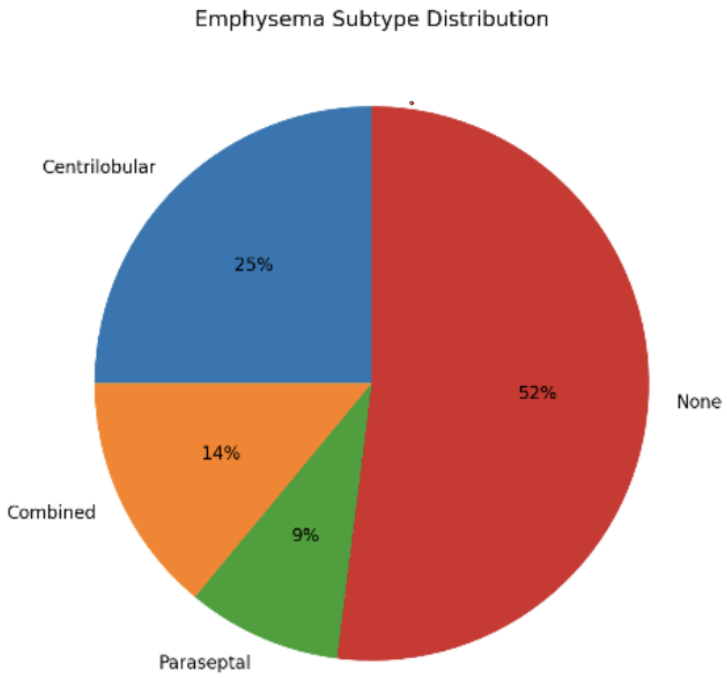


TABLE 3 — Sex Distribution According to the Presence of Emphysema		
Sex	**Emphysema**	**No emphysema**
Male	39	33
Female	9	19

Statistics: OR = 2.49; $\chi^2 = 3.09$; p = 0.079; Fisher p = 0.074

The mean lesion dimension for the entire cohort was 52.4 ± 22.1 mm (median 48 mm; range 13–100 mm). When analyzed by morphology, polylobular lesions had larger mean dimensions (60.5 mm) than spiculated (40.1 mm) or irregular lesions (39.2 mm), indicating variability in growth characteristics across morphologic types.

Figure-3

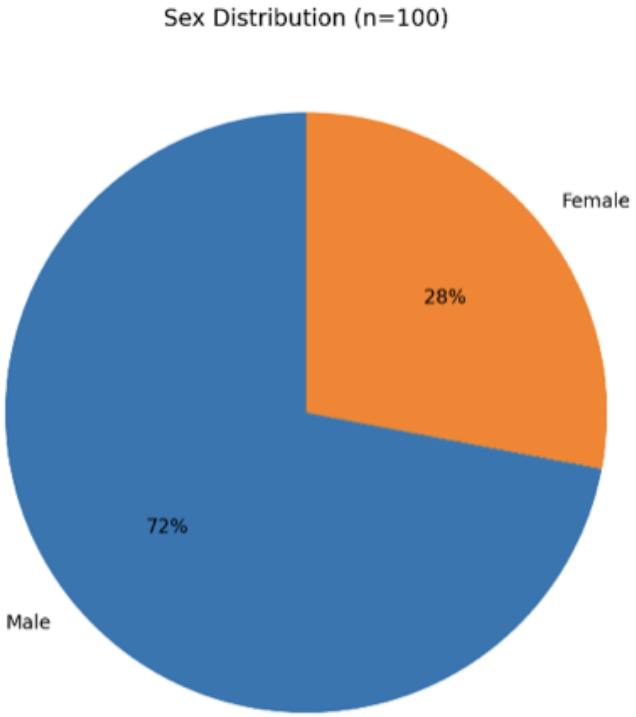


TABLE 4 — Lesion Size by Morphology	
Morphology	**Mean size (mm)**
Polylobular	60.5
Spiculated	40.1
Irregular	39.2

An upper-lobe predominance was observed in the conducted anatomical distribution, with the right upper lobe representing the most frequently involved location (34%), followed by the right lower lobe (22%), left upper lobe (21%), left lower lobe (17%), and right middle lobe (6%). Segmental analysis showed the highest frequency in the hilar region (26%),

followed by the superior segment (12%), the apicoanterior segment (9%), the posterobasal segment (7%), and the lateral segment (6%), reflecting a predominance of central and upper segment involvement.

TABLE 5 — Lobar Distribution of Pulmonary Neoplastic Lesions

Lobe	**n**	**%**
Right upper lobe	34	34%
Right lower lobe	22	22%
Left upper lobe	21	21%
Left lower lobe	17	17%
Right middle lobe	6	6%

Figure-4

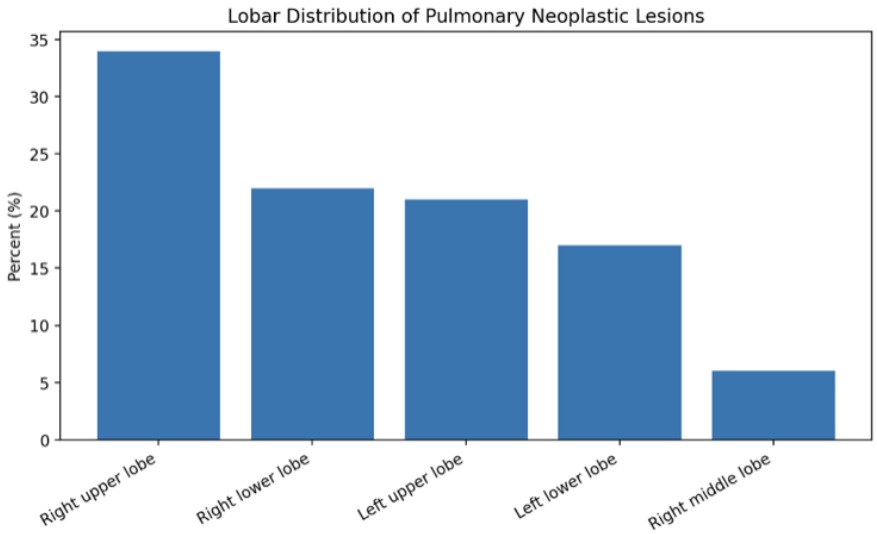
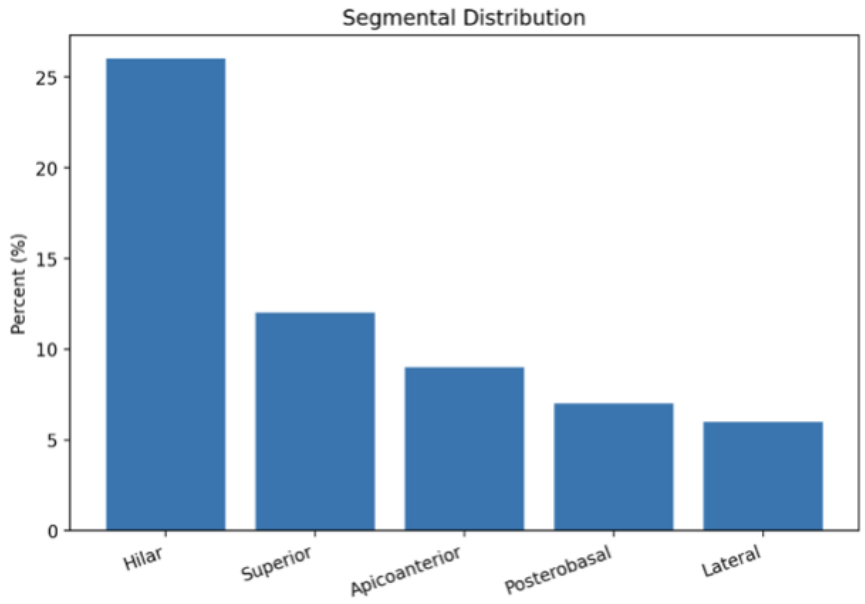


TABLE 6 — Segmental Distribution		
Segment	**n**	**%**
Hilar	26	26%
Superior	12	12%
Apicoanterior	9	9%
Posterobasal	7	7%
Lateral	6	6%

Figure-5



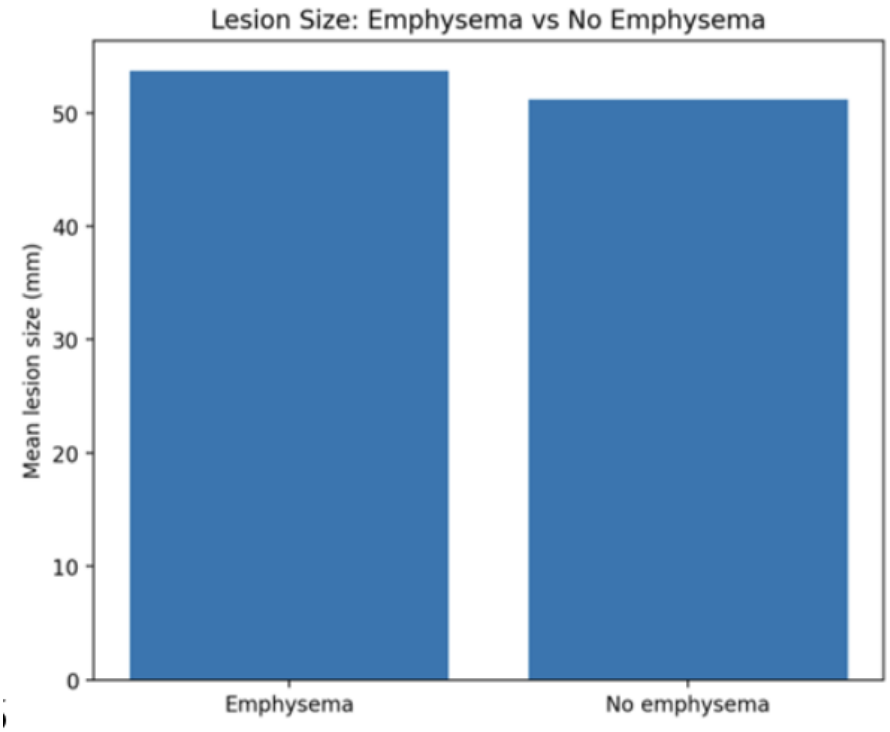
A comparative analysis between patients with concomitant emphysema (n = 48) and those without emphysema (n = 52) showed no statistically significant difference in lesion size.

In the emphysema group, the mean lesion dimension was 53.7 ± 22.0 mm (median 50 mm) and 51.2 ± 22.4 mm (median 46 mm) in the non-emphysema group (Welch t-test p = 0.681; Mann–Whitney U p = 0.609), indicating no significant association to lesion size at the time of CT detection.

TABLE 7 — Lesion Size: Emphysema vs No Emphysema

Group	Mean size (mm)	SD	Median
Emphysema	53.7	22.0	50
No emphysema	51.2	22.4	46

Figure-6



Lesion morphology showed no statistically significant association with emphysema presence ($\chi^2 = 9.59$, p = 0.088), although a borderline trend toward differing morphology distribution

was observed. Similarly, no significant associations were identified between emphysema and lobar tumor distribution ($\chi^2 = 5.94$, $p = 0.312$) or segmental localization ($\chi^2 = 1.65$, $p = 0.895$), indicating that emphysema does not determine macroscopic or segmental anatomical localization.

Further analysis of lesion dimensions in relation to associated CT findings showed that lesions accompanied by nodules were larger (54.4 mm vs 46.5 mm), with borderline statistical significance (t-test, $p = 0.084$; Mann–Whitney, $p = 0.077$). An identical borderline trend was observed in lesions with lymph node involvement (54.4 mm vs 46.5 mm; $p \approx 0.08$), reflecting substantial overlap between nodules and lymph node findings within the dataset. No significant differences in lesion size were observed according to the presence of pleural effusion (50.8 mm vs 49.5 mm; $p = 0.760$) or distant metastasis (50.0 mm vs 49.9 mm; $p = 0.988$).

TABLE 8 — Lesion Size vs Associated CT Findings

Finding	**Mean size YES (mm)**	**Mean size NO (mm)**	**p-value**
Nodules	54.4	46.5	0.084
Lymph nodes	54.4	46.5	0.084
Pleural effusion	50.8	49	0.760
Far metastasis	50.0	49	0.988

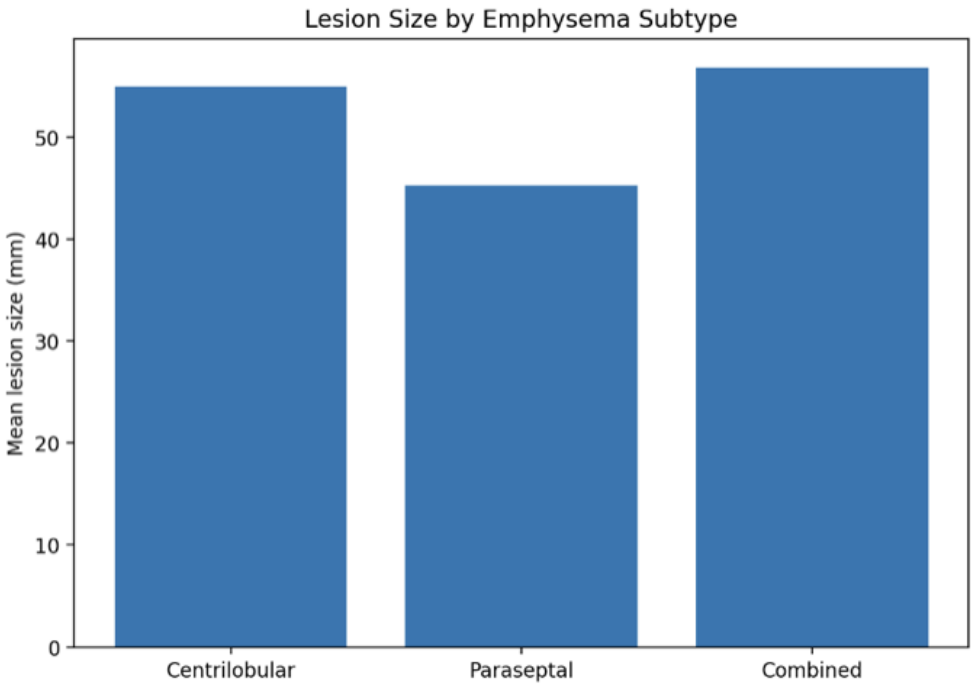
Subtype-specific analysis of emphysema found no significant differences in lesion dimensions (ANOVA $p = 0.209$; Kruskal–Wallis $p = 0.190$), with mean lesion sizes of 55.0

mm in centrilobular emphysema, 45.3 mm in paraseptal emphysema, and 56.8 mm in combined patterns. The identical p-values reflect substantial overlap between patients presenting with pulmonary nodules and lymph node involvement within the study cohort.

TABLE 9 — Lesion Size by Emphysema Subtype

Emphysema subtype	**Mean size (mm)**
Centrilobular	55.0
Paraseptal	45.3
Combined	56.8

Figure-7



Multivariable logistic regression analysis was performed to identify independent predictors of emphysema. Variables included sex, age, lesion size, upper-lobe location, and

morphology. Male sex showed the strongest association with emphysema (OR ≈ 2.4), although the association did not reach statistical significance. Age, lesion size, morphology, and upper-lobe location were not independently associated with emphysema presence. The model demonstrated modest explanatory power (Pseudo R^2 = 0.066), indicating that emphysema occurrence is likely influenced by factors beyond the analyzed imaging characteristics.

TABLE 10 — Multivariable Logistic Regression (Predictors of Emphysema)

Variable	**Association**
Male sex	OR ≈ 2.4 (borderline)
Age	Not significant
Lesion size	Not significant
Morphology	Not significant
Upper-lobe location	Not significant
Model Pseudo R^2	0.066

Overall, across multiple comparative analyses, no statistically significant differences were identified in lesion size, morphology, or anatomical distribution between patients with and without emphysema.

The only variable demonstrating a borderline association was male sex, suggesting that demographic characteristics may exert a greater influence on emphysema prevalence than

imaging characteristics of pulmonary neoplastic lesions. The consistency of findings across independent statistical analyses supports the interpretation that emphysema primarily functions as a patient-level risk substrate and background risk condition, rather than a determinant or modifier of CT imaging phenotype.

Image-1 and Image-2 Axial HRCT image (lung window setting) showing a right side pulmonary neoplasm in the presence of mild paraseptal emphysema in a patient

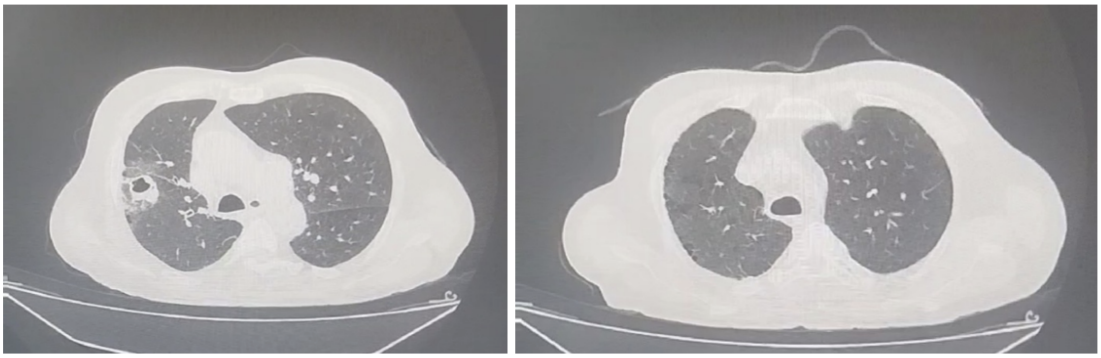


Image-3 and Image-4 Axial HRCT image (lung window setting) showing a dense pulmonary neoplasm in the left lower lobe in the presence of mild centrilobular and paraseptal emphysematous changes.

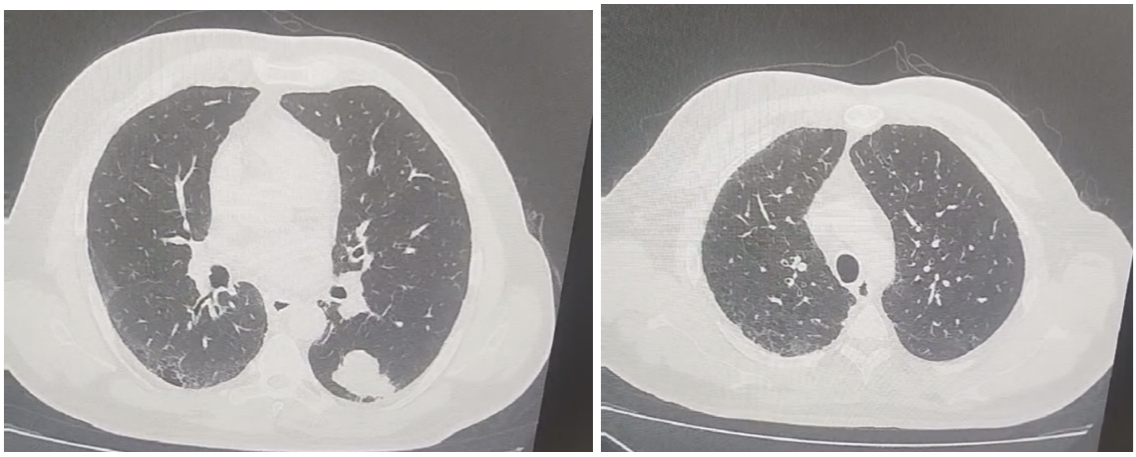
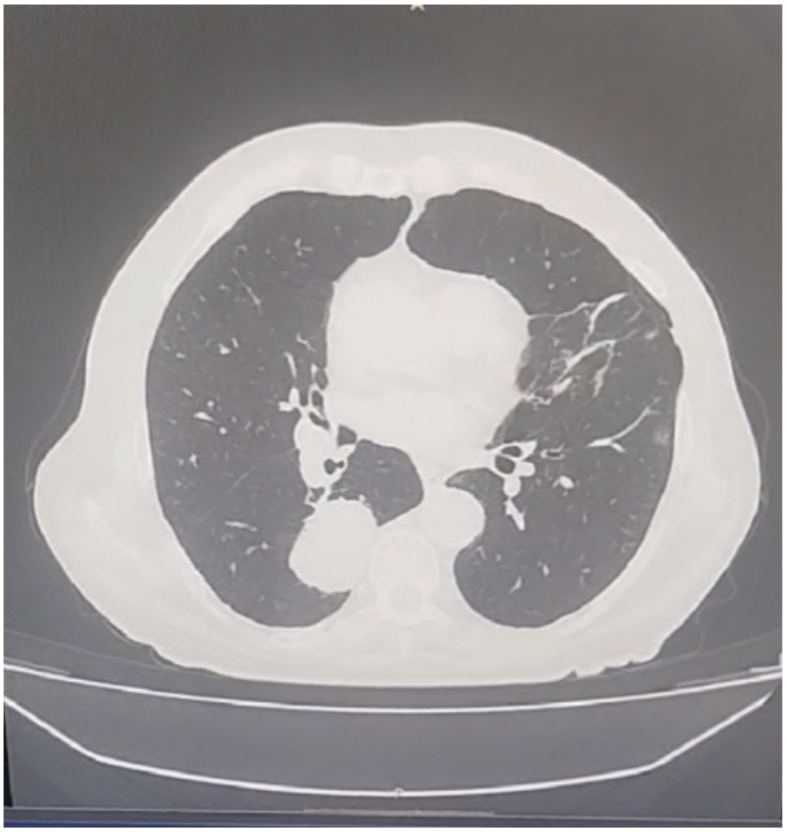


Image-5 Axial HRCT image (lung window setting) showing a pulmonary mass in a patient without radiological evidence of emphysema



Discussion

This study demonstrates a high coexistence of emphysema and lung neoplastic lesions, with emphysema identified in nearly half of patients undergoing CT evaluation for lung neoplasms. Although emphysema was highly prevalent, no statistically significant associations were observed between emphysema and tumor size, morphology, or anatomical distribution. These findings suggest that emphysema acts primarily as a background carcinogenic condition rather than a determinant of tumor phenotype.

The observed prevalence of emphysema among patients with lung carcinoma is consistent with findings from previous CT-based studies.

De Torres et al. reported that emphysema detected on low-dose CT was independently associated with an increased risk of lung, even after adjustment for smoking history (1).

Similarly, Wilson et al. showed that radiographic emphysema is associated with increased incidence of lung cancer independent of airflow obstruction (2).

Large screening trials, such as the National Lung Screening Trial (NLST) and the NELSON study, confirmed the central role of CT in early detection of lung malignancies and highlighted structural lung abnormalities as important risk markers (3–5). Our findings extend these observations into a real-world tertiary pulmonology population, where prevalence rates are higher than those seen in screening cohorts. The relatively high prevalence observed in our tertiary institution may be attributed to several contributing factors, including the socioeconomic status of the population, insufficient health education, the absence of a structured lung cancer screening program, and the high smoking prevalence in Europe.

Centrilobular emphysema was the predominant subtype in our cohort, consistent with the CT-based emphysema classification proposed by the Fleischner Society (6). This subtype predominance likely reflects smoking-related small-airway destruction, which has been repeatedly associated with increased carcinogenic susceptibility.

Despite the strong coexistence of emphysema and cancer, subtype analysis demonstrated no significant differences in tumor size or distribution, including patients with combined ("both") emphysema patterns. This supports previous imaging studies suggesting that emphysema subtype may influence risk but not tumor characteristics (7).

Upper-lobe predominance observed in this cohort aligns with prior reports showing smoking-related tumors occurring more frequently in upper lung regions (8).

Regional differences in ventilation, perfusion, and carcinogen deposition have been proposed as possible explanations.

However, statistical analysis revealed no association between emphysema and lobar or segmental tumor location. This finding suggests that although emphysema and tumors frequently coexist in similar anatomical regions, emphysema itself does not determine where tumors develop.

The mean tumor size in our cohort (52.4 mm) reflects typical lesion size encountered in symptomatic clinical populations rather than screening cohorts. Polylobular lesions had larger mean dimensions than spiculated tumors, likely reflecting different growth stages.

Importantly, tumor dimensions did not differ between patients with and without emphysema, nor between emphysema subtypes. These findings are consistent with studies indicating that emphysema increases cancer risk but does not alter tumor growth kinetics or imaging phenotype (9).

One of the most important findings of this study is that patient factors were more strongly associated with emphysema than tumor-related characteristics. Male sex was associated with approximately 2.5-fold increased odds of emphysema, although the significance was borderline. Similar demographic patterns have been reported in epidemiologic studies of smoking-related lung disease (10).

Multivariable analysis confirmed that tumor morphology, size, and location were not independent predictors of emphysema. This supports the concept that emphysema primarily functions as a patient-level risk substrate.

Although statistically significant associations were not identified, the consistency of findings across multiple analyses suggests a stable biological pattern.

Rather than indicating absence of relevance, these results imply that emphysema contributes to carcinogenesis without modifying tumor behavior after malignant transformation.

This interpretation is increasingly supported by contemporary models of smoking-related lung injury, where chronic inflammation promotes cancer initiation but does not necessarily influence tumor phenotype (11-13).

From a radiologic perspective, emphysema should be regarded as an important contextual risk marker during CT interpretation. Radiologists should maintain increased vigilance in emphysematous lungs, yet apply identical morphologic criteria for malignancy evaluation regardless of emphysema subtype.

The high prevalence of emphysema observed in this cohort also has important implications for anesthesiologists involved in the perioperative management of patients undergoing thoracic surgery. Patients with emphysema are at increased risk of postoperative pulmonary complications, including respiratory failure, prolonged mechanical ventilation, persistent air leaks, and bronchopleural fistula formation following lung resection. Recognition of emphysema on preoperative CT, therefore, contributes not only to risk stratification but also to anesthetic planning. Protective intraoperative ventilation strategies, including lower tidal volumes, individualized positive end-expiratory pressure (PEEP), avoidance of dynamic hyperinflation and auto-PEEP, and careful monitoring for barotrauma, may be particularly important in this patient population. Consequently, CT assessment of emphysema provides clinically relevant information extending beyond oncologic characterization of pulmonary lesions.

Several limitations should be acknowledged: retrospective single-center design; moderate sample size; absence of quantitative smoking exposure data; segmental classification based on routine reporting terminology.

These factors may limit the detection of subtle associations.

This study confirms a high prevalence of emphysema among patients with lung neoplasms in a tertiary-care setting. However, emphysema was not associated with measurable differences in CT tumor phenotype.

The absence of smoking exposure data limits interpretation, as smoking represents the principal shared etiologic factor. Additionally, visual rather than quantitative assessment of emphysema may have reduced sensitivity for detecting subtle associations.

The study population consisted primarily of symptomatic patients with relatively large tumors, limiting generalizability to screening populations and early-stage disease. These findings suggest that while emphysema increases carcinogenic risk, it does not substantially modify established tumor morphology on CT within the constraints of this dataset. The consistency of findings across analyses supports a biologically coherent interpretation in which emphysema primarily acts as a background carcinogenic substrate rather than a modifier of tumor imaging phenotype (15).

Future prospective studies incorporating automated quantitative CT densitometry, including calculation of the percentage of lung volume below −950 HU, may provide a more precise assessment of emphysema burden and allow detection of subtle relationships between emphysema severity and tumor characteristics that could not be identified in the present study.

Conclusion

CT-based evaluation demonstrates a high prevalence of emphysema among patients with pulmonary neoplastic lesions, confirming the frequent coexistence of structural smoking-related lung disease and neoplastic imaging findings in routine clinical practice. Although

emphysema was common, it was not associated with differences in lesion size, morphology, or anatomical distribution, indicating that underlying emphysematous change does not substantially modify CT imaging phenotype. These findings support the role of CT as an integrated diagnostic tool capable of simultaneously characterizing pulmonary lesions and background parenchymal abnormalities, emphasizing the importance of recognizing emphysema primarily as a patient-level risk context rather than an imaging determinant of lesion behavior.

Emphysema frequently coexists with pulmonary neoplastic lesions in routine clinical practice. Within the methodological limitations of this retrospective imaging-based study, no significant association was observed between emphysema and CT tumor phenotype. Future prospective studies incorporating quantitative CT analysis and detailed smoking exposure data are warranted.

Given the high prevalence of emphysema among patients with pulmonary neoplasms, recognition of emphysematous changes on preoperative CT may also provide valuable information for perioperative risk assessment and anesthetic management.

Declarations

Ethics approval and consent to participate: Protocol number – 01/2026

Informed consent: Written informed consent was obtained from all participants included in the study.

Conflict of Interest: The first author and all co-authors declare that they have no conflicts of interest related to this study.

Funding information: The author declares that no funding was received for this study.

Availability of data and materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author contributions statement: The First Author, K. D. contributed to study conception and design, data collection, image analysis, statistical analysis, interpretation of results and manuscript drafting. Co-author S. P. contributed to clinical data acquisition and manuscript analysis. Co-author D. K. contributed to the acquisition of clinical data and the analysis of the manuscript. Co-author I. A. contributed to the acquisition of clinical data and the analysis of the manuscript. Co-author S. M. contributed to clinical data acquisition and manuscript analysis.

Acknowledgments: None

Artificial Intelligence (AI) Statement AI tools- Artificial intelligence (AI) tools, were not used in the preparation of this manuscript.

References:

1. Aberle DR, Adams AM, Berg CD, Black WC, Fagerstrom RM, et al. Reduced lung-cancer mortality with low-dose computed tomographic screening. N Engl J Med. 2011;365(5):395-409. doi:10.1056/NEJMoa1102873.
2. de Koning HJ, van der Aalst CM, de Jong PA, Scholten ET, Nackaerts K, Heuvelmans MA, et al. Reduced lung-cancer mortality with volume CT screening in a randomized trial. N Engl J Med. 2020;382(6):503-513. doi:10.1056/NEJMoa1911793.
3. Zhao YR, Ru Zhao Y, Xie X, de Koning HJ, Mali WP, Vliegenthart R, Oudkerk M. NELSON lung cancer screening study. Cancer Imaging. 2011;11:S79-84.

4. De Torres JP, Bastarrika G, Wisnivesky JP, Alcaide AB, Campo A, Seijo LM, Pueyo JC, Villanueva A, Lozano MD, Montes U, Montuenga L, Zulueta JJ. Assessing the relationship between lung cancer risk and emphysema detected on low-dose CT of the chest. Chest. 2007 Dec;132(6):1932-8. doi: 10.1378/chest.07-1490.
5. Wilson DO, Weissfeld JL, Balkan A, Schragin JG, Fuhrman CR, Fisher SN, Wilson J, Leader JK, Siegfried JM, Shapiro SD, Sciurba FC. Association of radiographic emphysema and airflow obstruction with lung cancer. Am J Respir Crit Care Med. 2008 Oct 1;178(7):738-44. doi: 10.1164/rccm.200803-435OC. Epub 2008 Jun 19.
6. Lynch DA, Austin JH, Hogg JC, Grenier PA, Kauczor HU, Bankier AA, et al. CT-definable subtypes of chronic obstructive pulmonary disease: a statement of the Fleischner Society. Radiology. 2015;277(1):192-205. doi:10.1148/radiol.2015141579
7. Cohen D, Hondelink LM, Solleveld-Westerink N, Uljee SM, Ruano D, Cleton-Jansen AM, et al. Optimizing mutation and fusion detection in NSCLC by sequential DNA and RNA sequencing. J Thorac Oncol. 2020;15(6):1000-1014. doi:10.1016/j.jtho.2020.01.019.
8. Maldonado F, Bartholmai BJ, Swensen SJ, Midthun DE, Decker PA, Jett JR. Are airflow obstruction and radiographic evidence of emphysema risk factors for lung cancer? A nested case-control study using quantitative emphysema analysis. Chest. 2010 Dec;138(6):1295-302. doi: 10.1378/chest.09-2567.
9. Agarwal AK, Raja A, Brown BD. Chronic obstructive pulmonary disease. In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2025 Jan–.

Available from: https://www.ncbi.nlm.nih.gov/books/NBK559281/ (cited 2026 Jun 21).

10. Mannino DM. Epidemiology and global impact of chronic obstructive pulmonary disease. Semin Respir Crit Care Med. 2005 Apr;26(2):204-10. doi: 10.1055/s-2005-869539.
11. Young RP, Hopkins RJ, Christmas T, Black PN, Metcalf P, Gamble GD. COPD prevalence is increased in lung cancer, independent of age, sex and smoking history. Eur Respir J. 2009 Aug;34(2):380-6. doi: 10.1183/09031936.00144208.
12. Oudkerk M, Liu S, Heuvelmans MA, Walter JE, Field JK. Lung cancer LDCT screening and mortality reduction - evidence, pitfalls and future perspectives. Nat Rev Clin Oncol. 2021 Mar;18(3):135-151. doi: 10.1038/s41571-020-00432-6.
13. Kovalchik SA, Tammemagi M, Berg CD, Caporaso NE, Riley TL, et al. Targeting of low-dose CT screening according to the risk of lung-cancer death. N Engl J Med. 2013;369(3):245-254. doi:10.1056/NEJMoa1301851.
14. Becker N, Motsch E, Trotter A, Heussel CP, Dienemann H, Schnabel PA, Kauczor HU, Maldonado SG, Miller AB, Kaaks R, Delorme S. Lung cancer mortality reduction by LDCT screening-Results from the randomized German LUSI trial. Int J Cancer. 2020 Mar 15;146(6):1503-1513. doi: 10.1002/ijc.32486.
15. Krist AH, Davidson KW, Mangione CM, Barry MJ, Cabana M, Caughey AB, et al. Screening for lung cancer: US Preventive Services Task Force recommendation statement. JAMA. 2021;325(10):962-970. doi:10.1001/jama.2021.1117