International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2025: 7.089

Correlation of Computed Tomography and Histopathology / Cytology in Bronchogenic Carcinoma

Dr. Shefali Dipal Kamdar[1], Dr. Jagruti K. Sutaria[2], Dr. Anjana Patel[3], Dr. Parthkumar Nakrani[4]

[1]Resident Doctor, Department of Radiology, Pandit Deendayal Upadhyay Government Medical College & Civil Hospital, Rajkot, Gujarat, India (Corresponding Author)

[2]Additional Professor, Department of Radiology, Pandit Deendayal Upadhyay Government Medical College & Civil Hospital, Rajkot, Gujarat, India

[3]Professor and Head of Department, Department of Radiology, Pandit Deendayal Upadhyay Government Medical College & Civil Hospital, Rajkot, Gujarat, India

[4]Resident Doctor, Department of Radiology, Pandit Deendayal Upadhyay Government Medical College & Civil Hospital, Rajkot, Gujarat, India

Abstract: ***Background: Bronchogenic carcinoma, arising from the bronchial epithelium, stands as the leading cause of cancer-related deaths worldwide. Early detection and accurate staging are vital for treatment choices. Computed Tomography (CT) plays an important role in diagnosing and staging, while histopathology/cytology provides the definitive diagnosis. Objectives: To evaluate the role of Computed Tomography and histopathology/cytology in the diagnosis of bronchogenic carcinoma, and to assess characterization and differentiation of subtypes. Materials and Methods: This prospective observational study included 100 patients with clinically suspected bronchogenic carcinoma. Evaluation was performed using contrast-enhanced multi-detector CT, followed by tissue diagnosis via CT-guided biopsy, bronchoscopic biopsy, or FNAC. Findings were correlated with histopathological diagnosis. Results: The study showed a male predominance (82%), with maximum incidence in the seventh decade (60-69 years). Cough was the most frequent presenting symptom (28%). The majority of tumors were centrally located (58%) and presented at an advanced stage (Stage IV in 57.53% of NSCLC cases). Squamous cell carcinoma was the most common histopathological subtype (36%), closely followed by adenocarcinoma (34%). CT demonstrated strong diagnostic reliability with an overall accuracy of 82% when compared to histopathology. Conclusion: CT is the primary imaging modality for detecting tumor extent, local invasion, and metastasis in bronchogenic carcinoma. While it shows strong correlation with histopathological subtypes, tissue examination remains the gold standard for definitive diagnosis and treatment planning.***

Keywords: Bronchogenic carcinoma; Computed tomography; Histopathology; Cytology; Subtype; Squamous cell carcinoma; Adenocarcinoma; TNM Staging

1. Introduction

Bronchogenic carcinoma is a type of lung cancer arising from the bronchial epithelium and stands as the leading cause of cancer-related deaths worldwide. It includes major subtypes like non-small cell lung cancer (NSCLC)—such as adenocarcinoma and squamous cell carcinoma—and small cell lung cancer (SCLC). In 2022, it caused about 2.48 million new cases globally.

Computed Tomography plays an important role in diagnosing and staging bronchogenic carcinoma by showing tumor size, location, nodal involvement, and distant spread. Multi-detector CT (MDCT) allows for high-resolution, thin-section scans that depict bony erosions and vascular encasement accurately. However, CT alone cannot confirm the exact tissue type, necessitating a biopsy.

Histopathology from biopsies or resections provides definitive diagnosis by examining cellular details under a microscope. Cytology, from fine-needle aspiration (FNAC) or bronchial brushing, offers quick preliminary results. A strong correlation between CT findings and pathology is essential for optimizing treatment plans and improving patient prognosis.

2. Aims and Objectives

1) To evaluate the role of Computed Tomography and histopathology/cytology in the diagnosis of bronchogenic carcinoma.
2) To characterize and differentiate subtypes of bronchogenic carcinoma.
3) To explore the intricate relationship between CT imaging findings and the detailed microscopic analysis.

3. Materials and Methods

This prospective observational study was conducted on 100 patients suspected of having bronchogenic carcinoma, evaluated over a period of 1.5 years at the Department of Radiodiagnosis, PDU Government Medical College and Civil Hospital, Rajkot, Gujarat. Written informed consent was obtained from all participants.

Equipment Used: Computed Tomography: 128-slice Wipro GE H-211 CT scanner.

Imaging Technique Used: All patients underwent contrast-enhanced CT of the thorax using a multi-detector CT

scanner. Slice thickness ranged from 1–5 mm. Intravenous non-ionic iodinated contrast was administered at 1–1.5 mL/kg, and scanning was performed in the arterial and venous phases as required. CT images were evaluated for location, size, margins, cavitation, necrosis, lymph node enlargement, and distant metastasis.

CT Findings in Different Types of Bronchogenic Carcinoma-

Bronchogenic carcinoma demonstrates varied CT appearances depending upon the histological subtype, location, enhancement pattern, cavitation, necrosis, and metastatic spread. Computed Tomography plays an important role in identifying characteristic imaging features that help differentiate the major subtypes of lung carcinoma.

1) **Squamous cell carcinoma** commonly presents as a centrally located hilar or perihilar mass arising from the segmental or lobar bronchi. CT typically shows an irregular or lobulated soft tissue lesion with bronchial narrowing or abrupt bronchial cut-off. Post-obstructive atelectasis, consolidation, and hyperinflation are common associated findings. Cavitation is a characteristic feature and usually appears as thick irregular-walled cavities with nodular inner margins or air-fluid levels. Central necrosis with heterogeneous enhancement is frequently seen. Mediastinal and hilar lymphadenopathy, vascular encasement, and chest wall invasion may occur in advanced disease.
2) **Adenocarcinoma** usually appears as a peripheral solitary pulmonary nodule or mass with spiculated or lobulated margins. Ground-glass opacity and part-solid nodulesare important CT features, particularly in lepidic predominant lesions. Air bronchograms, pleural tags, pleural retraction, and vessel convergence are commonly observed. Cavitation is uncommon and generally thin walled. Contrast-enhanced CT demonstrates mild-to-moderate enhancement. Peripheral location with early pleural involvement and distant hematogenous metastases are common features.
3) **Small cell lung** carcinoma commonly manifests as a large centrally located hilar or mediastinal mass with extensive mediastinal and hilar lymphadenopathy. CT frequently demonstrates bulky nodal masses causing bronchial compression and vascular encasement, especially involving the superior vena cava and pulmonary arteries. The lesion usually shows homogeneous or mildly heterogeneous enhancement with relatively less cavitation and necrosis. Pleural or pericardial effusions and early distant metastases are commonly associated.
4) **Large cell carcinoma** generally appears as a large peripheral pulmonary mass with lobulated or poorly defined margins. CT commonly demonstrates heterogeneous enhancement with extensive central necrosis and occasional cavitation. Pleural and chest wall invasion are relatively common due to peripheral location.

4. Observations and Analysis

Table 1: Age Distribution of Patients with Bronchogenic Carcinoma Undergoing Correlation of Computed Tomography and Histopathology/Cytology

Age Group (years)	n (%)
≤39	4 (4.0%)
40–49	11 (11.0%)
50–59	23 (23.0%)
60–69	32 (32.0%)
≥70	30 (30.0%)
Mean ± SD (years)	61.3 ± 11.6

Table 2: Gender Distribution of Patients with Bronchogenic Carcinoma in the Study Correlating Computed Tomography with Histopathology/Cytology

Gender	n (%)
Female	18 (18.0%)
Male	82 (82.0%)

Table 3: Distribution of Presenting Symptoms in Patients with Bronchogenic Carcinoma Evaluated for Correlation Between Computed Tomography and Histopathology/Cytology

Symptom	Present n (%)
Cough	28 (28.0%)
Weight loss	24 (24.0%)
Breathlessness	21 (21.0%)
Hemoptysis	14 (14.0%)
Chest pain	6 (6.0%)
Anorexia	5 (5.0%)
Fever	2 (2.0%)

Table 4: Location of Cancer

Location of Cancer	n (%)
Central	51(58 %)
Peripheral	37 (42%)

Table 5: Lobar Distribution of Bronchogenic Carcinoma on Computed Tomography According to Side and Its Correlation with Histopathology/Cytology

Lobe	Total n (%)
Upper Lobe (UL)	47 (53.0%)
Lower Lobe (LL)	22 (25.0%)
Middle Lobe (ML)	19 (22.0%)
Total	88 (100%)

Table 6: Computed Tomography Radiological Characteristics of Bronchogenic Carcinoma and Their Correlation with Histopathology/Cytology

Feature	Present n (%)
Enhancement	(97.0%)
Distal collapse / Bronchial obstruction	(82.0%)
Mediastinal lymph nodes	(71.0%)
Pleural effusion	(54.0%)
Hilar involvement	(52.0%)
Calcification	(45.0%)
Blood vessel encasement	(44.0%)
Necrosis	(27.0%)
Cavitation	(20.0%)
Pleural involvement	(20.0%)

Table 7: Distant Organ Involvement on Computed Tomography in Patients with Bronchogenic Carcinoma and Its Correlation with Histopathology/Cytology

Organ Involvement	Present n (%)
Lung (contralateral)	32 (36%)
Liver	6 (6.8%)
Bone	4 (4.5%)
Adrenal	3 (3.4%)
Brain	2 (2.3%)
Spleen	1 (1.1%)
Peritoneal/Omentum	1 (1.1%)
Pericardial fat	1 (1.1%)
Kidney	1 (1.1%)

Table 8: Computed Tomography Impression (Radiological Subtype) in Patients with Bronchogenic Carcinoma and Its Correlation with Histopathology/Cytology

CT Impression	n (%)
Squamous Cell Carcinoma	33 (33.0%)
Adenocarcinoma	31 (31.0%)
Small Cell Carcinoma	15 (15.0%)
Large Cell / Other	9 (9.0%)
Normal	12 (12.0%)

Table 9: Extent of Disease According to Computed Tomography Subtype in Patients with Bronchogenic Carcinoma

(A) Non–Small Cell Carcinoma (Non-SCC)

Stage	n (%)
Stage I	3 (4.1%)
Stage II	4 (5.47%)
Stage IIIa	6 (8.2%)
Stage IIIb	18 (24.65%)
Stage IV	42 (57.53%)

(B) Small Cell Carcinoma (SCC)

Extent	n (%)
Limited	6 (40%)
Extensive	9 (60%)

Table 10: TNM Classification Based on Computed Tomography in Patients with Bronchogenic Carcinoma

TNM	Category	n (%)
T	T1	37 (42.0%)
	T2	38 (43.18%)
	T3	7 (8%)
	T4	6 (6.82%)
N	N0	10(15.87%)
	N1	5 (7.93%)
	N2	42 (66.66%)
	N3	6 (9.52%)
M	M0	37 (42.0%)
	M1	51 (58.0%)

Table 11: Method of Tissue Diagnosis in Patients with Bronchogenic Carcinoma for Correlation with Computed Tomography Findings

Method	n (%)
FNAC	53 (53.0%)
Core Biopsy	47 (47.0%)

Table 12: Association Between Method of Tissue Sampling and Final Histopathological Subtype in Patients with Bronchogenic Carcinoma (n = 100)

Method	Squamous Cell Carcinoma, n (%)	Adenocarcinoma n (%)	Small Cell Carcinoma n (%)	Large Cell/ Other n (%)	Normal n (%)
Core Biopsy (n=47)	18 (38.3%)	15 (31.9%)	8 (17.0%)	4 (8.5%)	2 (4.3%)
FNAC (n=53)	18 (34.0%)	19 (35.8%)	6 (11.3%)	6 (11.3%)	4 (7.5%)
Total	36(36.0%)	34 (34.0%)	14 (14.0%)	10 (10.0%)	6 (6.0%)
P value	0.832				

Table 13: Final Histopathological Findings in Patients with Bronchogenic Carcinoma for Correlation with Computed Tomography

Histopathology Subtype	n
Squamous Cell Carcinoma	36
Adenocarcinoma	34
Small Cell Carcinoma	14
Large Cell/Other	10
Normal	6
Total	100

Table 14: Correlation Between Histopathological Final Subtype and CT Impression in Patients with Bronchogenic Carcinoma (n = 100)

Histopathology Subtype	CT Impression				
	Adenocarcinoma n (%)	Large Cell/ Other, n (%)	Normal n (%)	Small Cell Carcinoma, n (%)	Squamous Cell Carcinoma n (%)
Adenocarcinoma	29 (85.3%)	1(2.9%)	3(8.8%)	0 (0%)	1 (2.9%)
Large Cell/Other	0 (0%)	8 (80%)	2 (20%)	0 (0%)	0(0%)
Normal	2(33.3%)	0(0%)	0(0%)	1 (16.7%)	3(50%)
Small Cell Carcinoma	0 (0%)	0 (0%)	2(14.3%)	12(85.7%)	0(0%)
Squamous Cell Carcinoma	0(0%)	0 (0%)	5(13.9%)	2(5.6%)	29(80.6%)
Total	31 (31.0%)	9 (9.0%)	12(12.0%)	15(15.0%)	33(33.0%)
P value	<0.001				

Table 155: Overall Accuracy Between Computed Tomography and Histopathology in Patients with Bronchogenic Carcinoma

Accuracy	n (%)
Yes	82 (82.0%)
No	(18.0%)

Table 16: Association Between CT Findings and Histopathological Findings in Patients with Suspected Bronchogenic Carcinoma

CT Finding	Histopathology Positive, n (%)	Histopathology Negative, n (%)	Total, n (%)
Positive	82	6	88
Negative	12	0	12
Total	94	6	100

5. Discussion

This study evaluated 100 cases of clinically suspected bronchogenic carcinoma over a 1.5-year period. The highest incidence was observed in the 60-69 years age group, with a significant male predominance (82%). These findings are consistent with the known epidemiology of lung cancer, primarily linked to smoking history.

Cough and weight loss were the most frequent presenting symptoms. The majority of the tumors were centrally located (58%). Contrast-enhanced CT revealed enhancement in 97% of cases, with distal collapse or bronchial obstruction noted in 82% of patients. TNM staging on CT demonstrated that a substantial proportion of patients presented with advanced disease, with 57.53% of NSCLC cases categorized as Stage IV.

Histopathologically, squamous cell carcinoma was the most prevalent subtype (36%), followed by adenocarcinoma (34%). This aligns with regional trends, though the near-equal proportion of adenocarcinoma reflects the rising incidence of this subtype globally. There was a highly significant correlation ($p < 0.001$) between CT impression and final histopathology, with an overall accuracy of 82%. CT effectively predicted the histological subtype, particularly for adenocarcinoma and small cell carcinoma, demonstrating its reliability as an initial diagnostic and staging modality.

6. Summary and Conclusion

1) In the present study of 100 cases, a strong male preponderance (82%) was observed, with the peak incidence in the seventh decade (60-69 years).
2) The most common presenting symptoms were cough, weight loss, and breathlessness. Central tumor location (58%) predominated over peripheral involvement.
3) Computed Tomography revealed that a majority of the patients presented at an advanced stage (Stage III and IV), with frequent findings of mediastinal lymphadenopathy (71%), pleural effusion (54%), and distant metastasis.
4) Squamous cell carcinoma and adenocarcinoma were the most frequent histological subtypes. CT demonstrated high accuracy (82%) in characterizing the morphological features and predicting the histological subtype.
5) While MDCT is the imaging modality of choice for staging, evaluating tumor extent, and guiding biopsies, histopathological and cytological examination remains the gold standard for definitive diagnosis and tailoring targeted treatments.

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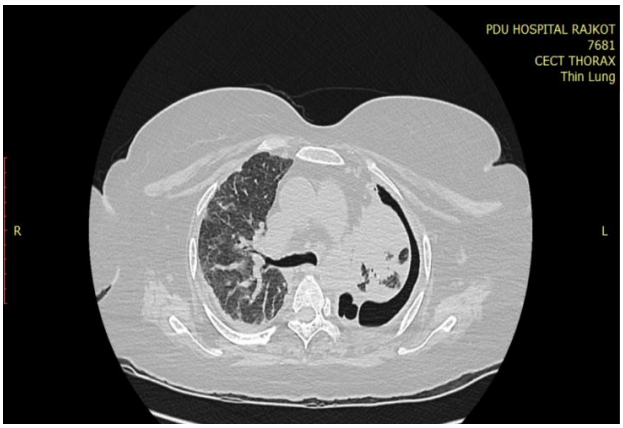
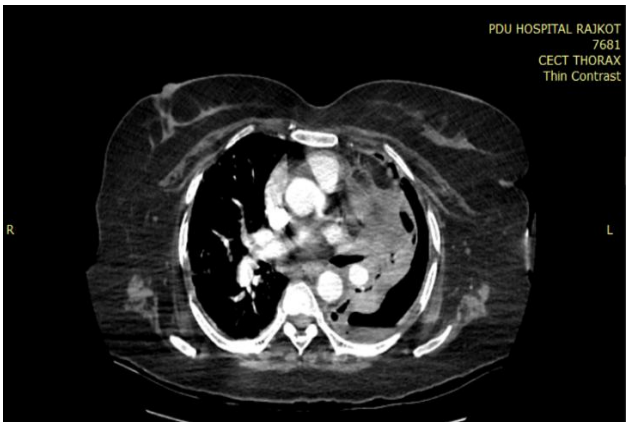
Case No. I





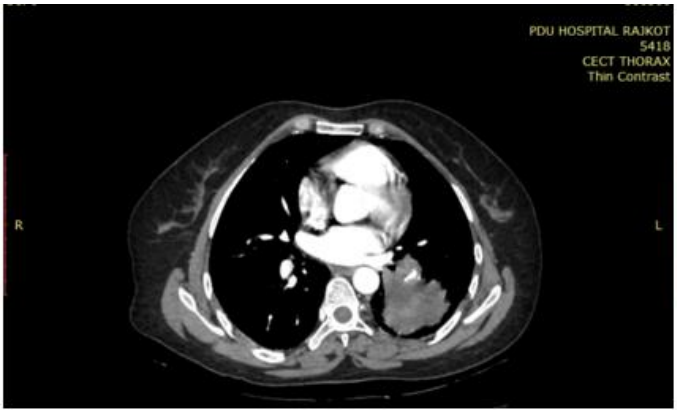
Approx. 49 x 52 x 42 mm (CC X AP X TR) size of ill-defined heterogeneously enhancing soft tissue density lesion is noted in left upper lobe with evidence of bronchus cut-off of anterior segmental branch of left upper lobe.

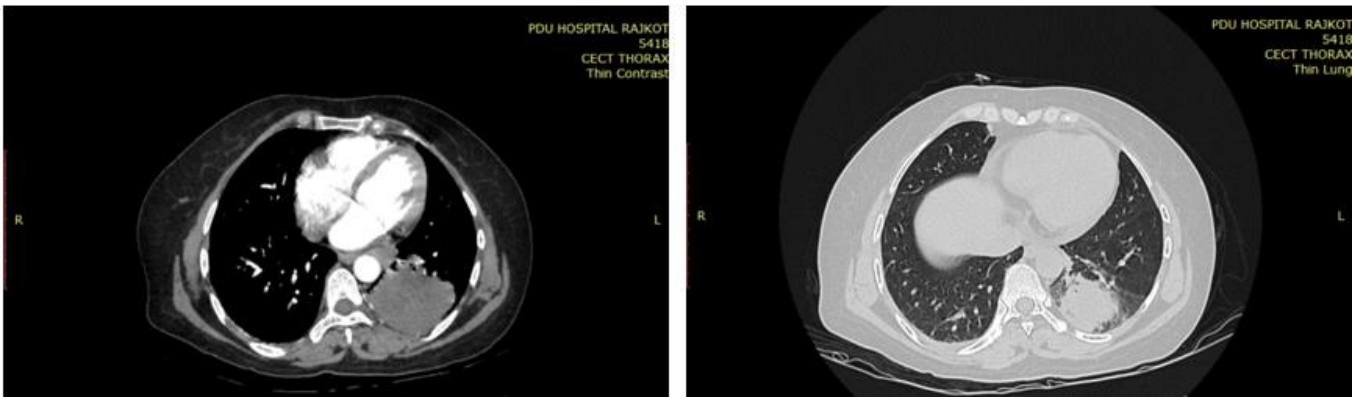
- Medially the lesion is reaching superior mediastinum up to subcarinal region.
- The lesion is abutting and encasing superior and anterior wall of proximal left pulmonary artery at D4 level causing approx. 20% luminal narrowing.
- The lesion is abutting superior wall of descending thoracic aorta at D3-4 junction level without luminal narrowing.

Diffuse areas of ground glass opacities with subpleural and interlobular septal thickening noted in right lung fields.

Few tiny subcentrimetric random and subpleural nodules noted in right upper lobe.

Case No. II





Approx. 53 x 69 x 51 mm (AP x TR x CC) size of well-defined soft tissue density lesion with irregular lobulated margin which shows mild post-contrast enhancement is noted involving left infra hilar region extending to left lower lobe with areas of surrounding ground glass haziness and it shows bronchus cut off sign.

The lesion is encasing the lower lobe branch of left pulmonary artery.

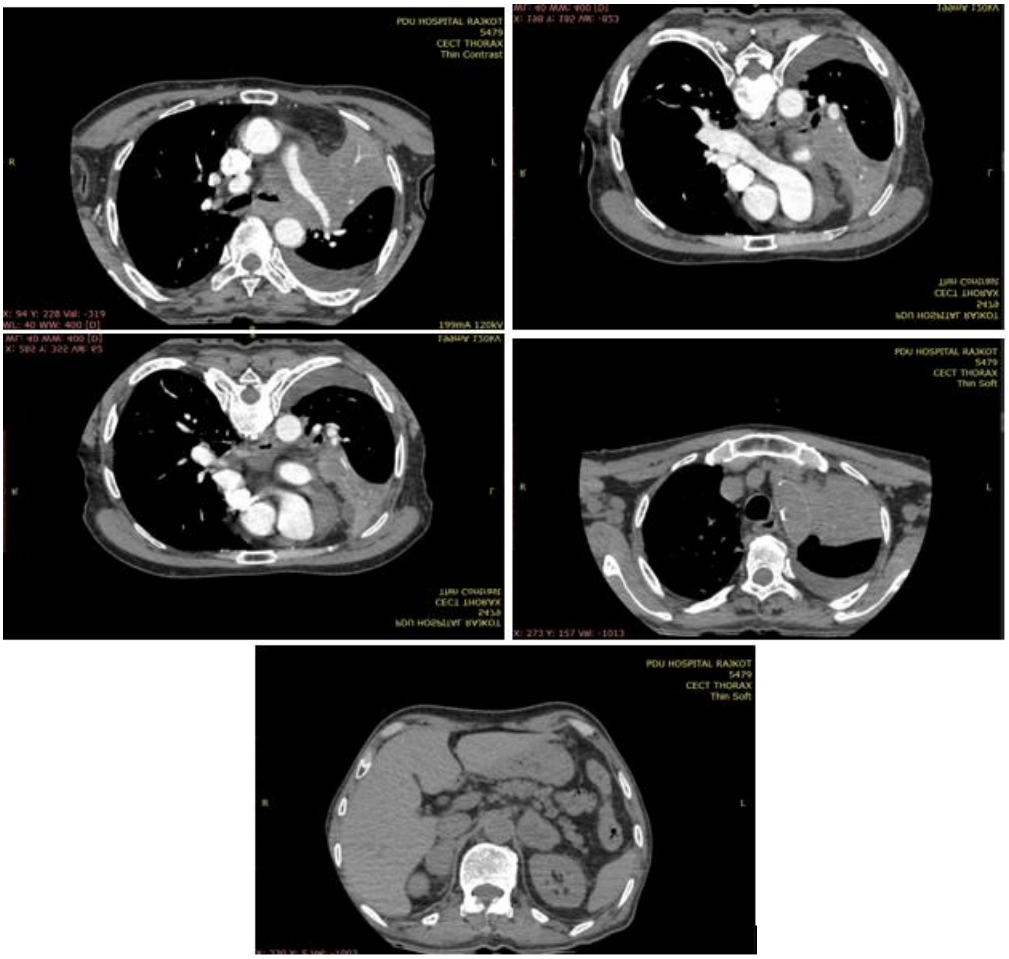
Anteriorly, the lesion is abutting posterior pericardium.

Medially, the lesion is abutting descending aorta.

Irregular interlobular septal thickening is noted in posterior and lateral basal segment of the left lower lobe:-Suggest possibility of lymphatic spread.

Approx. 10 x 19 x 17 mm (TR x AP x CC) size of well-defined soft tissue density pleural based lesion with heterogeneous post-contrast enhancement is noted at the level of right 4th costovertebral joint in right paraspinal location which appears to be extending into spinal cord. P/o: - Neoplastic etiology – metastatic lesion is more likely.

Case No. III



Approx. 95 x 80 x 121 mm (AP x TR x CC) sized of heterogeneously enhancing soft tissue density lesion with lobulated margin and internal few tiny calcification within is noted in left hilum with extension into upper lobe and visceral mediastinum with abrupt cut off of the left upper lobe bronchus with distal drowning lung.
The lesion causes narrowing of the left main bronchus.
The lesion causes complete encasement of left branch of main pulmonary trunk with luminal narrowing and mild compression of the right branch of the pulmonary trunk near bifurcation.
The left pulmonary vein cannot be visualized separately form the lesion.
The lesion is causing partial encasement of the descending aorta (Approx. 180 degree).
There is loss of fat plane between the lesion and arch of the aorta.

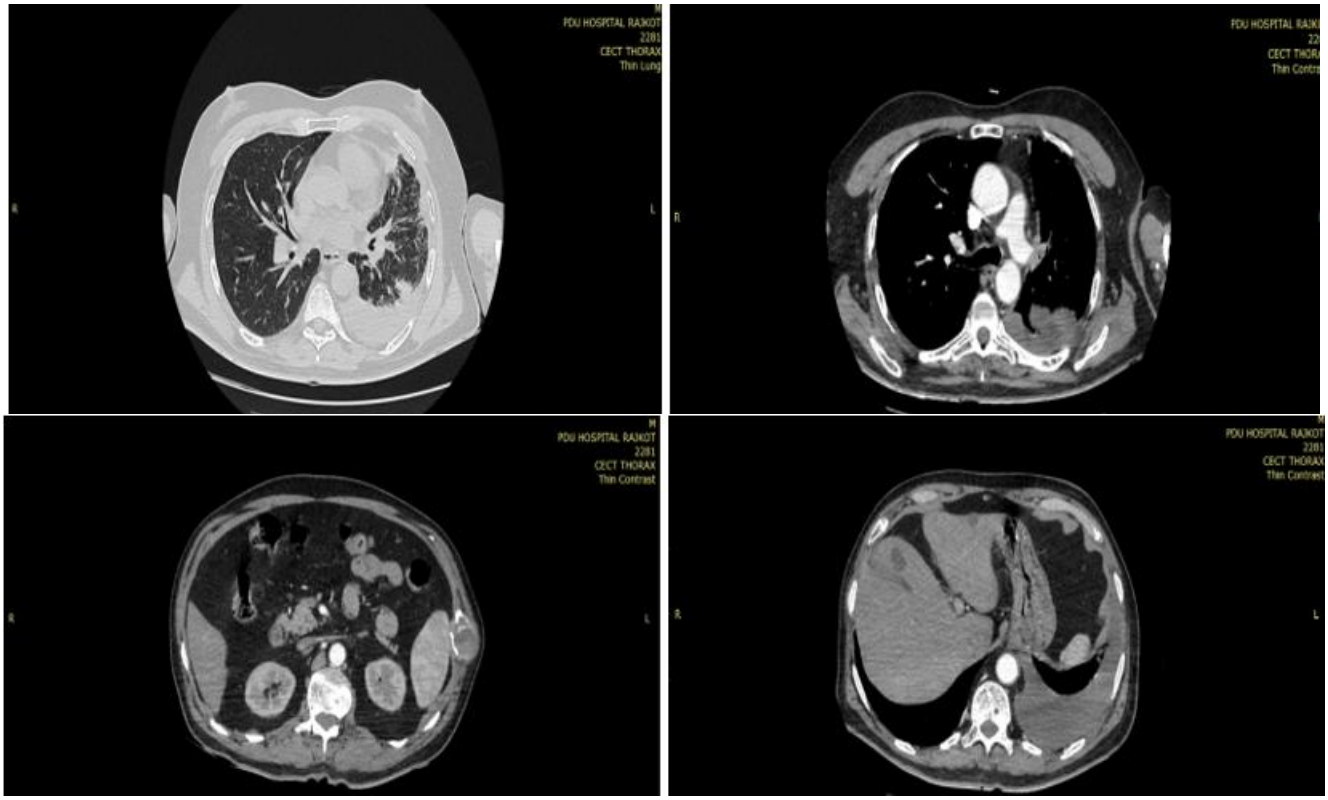
There is loss of fat plane between the lesion and mid thoracic oesophagus at and below the level of carina causing its compression.

Few enlarged mediastinal lymph nodes noted. P/o – Metastatic nodes likely.

Left side moderate pleural effusion noted with fissural extension.

Visualized part of abdomen shows bilateral bulky and enlarged adrenal glands in plain study. P/o – Adrenal secondary metastasis likely.

Case No. IV



Approx. 37 x 32 x 23.5 mm (AP X TR X CC) size of irregular marginated soft tissue density enhancing lesion is noted in lingual segment of left upper lobe of lung.

Few subpleural and random nodular lesions noted in right upper lobe and basal segments of left lower lobes, larger one measures approx.15 x 12 mm at postero-lateral basal segment of left lower lobe.-Secondaries.

Approx. 35 x 32 x 33 mm sized soft tissue enhancing lesion is noted involving lateral aspect of 10th rib on left side. -Metastatic lesion

Left side moderate pleural effusion noted extending into interlobar fissure.

Visualized part of liver shows few non enhancing cystic lesions in both lobes, larger one 28 x 24mm. P/o – Simple cyst likely.