Multidetector Computed Tomography Findings in the Revised Tumor, Nodal and Metastasis Staging of Non-Small Cell Carcinoma of the Lung: A Pictorial Essay

Non-small cell carcinoma of the lung is one of the leading causes of cancer deaths. Early diagnosis and accurate staging is hence crucial. Through this pictorial essay, we aim to create awareness regarding the revised staging system for this lung tumor and CT findings of different stages of non-small cell carcinoma of the lung.

MDCT with its multiplanar imaging capability plays an important role not only in making the diagnosis but also in accurate staging which determines the prognosis.

Keywords: Carcinoma, Lung, Staging, Multidetector, Computed Tomography

Introduction

Non-small cell lung cancer (NSCLC) is an important cause of cancer death. Early diagnosis and accurate staging is hence very crucial. Computed tomography (CT) plays an important role in the evaluation of lung carcinoma. It helps to characterize lung nodules detected by radiography, aids in guided biopsy and most importantly, accurately stages the tumor. The staging system for lung carcinoma that is followed currently is based on the 6th edition of the TNM classification of malignant tumor which was introduced in 2002. The International Association for the Study of Lung Cancer (IASLC) established its Lung Cancer Staging Project to form recommendations for the seventh edition. Based on the recommendation, the revised TNM staging system for lung carcinoma was formulated. Multidetector computed tomography (MDCT) helps in the accurate staging of lung carcinoma because of the superior multiplanar reformatted images. In this article, we aim to highlight the importance of MDCT in staging NSCLC by presenting a pictorial essay on the revised staging of lung carcinoma.

Imaging

CT plays an important role in the evaluation of lung tumor. It identifies small nodules not visible by radiography. Besides, it also has a role in characterizing them as benign or malignant. The other important roles are in disease staging and aiding guided procedures. In our study, all cases were subjected to CT using GE Brightspeed 16 slice MDCT and were histopathologically confirmed as NSCLC using fine needle aspiration cytology (FNAC) or biopsy. Sagittal
and coronal reformatted images were used for accurate tumor staging such as measuring the exact distance of the tumor from the carina.

**Tumor Staging**

**T1**

These are tumors which are equal to or less than 3 cm in size, covered by visceral pleura and do not involve the mainstem bronchus. In the revised edition, these are further subcategorized into T1a and T1b. Tumors which are equal to or less than 2 cm in maximum dimension are classified as T1a (Fig. 1), whereas those greater than 2 cm but less than or equal to 3 cm are staged as T1b (Fig. 2).

**T2**

Tumors which are greater than 3 cm but are less than or equal to 7 cm are classified as T2. Those which are greater than 3 cm and less than or equal to 5 cm are subcategorized as T2a (Fig. 3), while those greater than 5 cm but less than or equal to 7 cm are categorized as T2b (Fig. 4).

Any tumor which involves the mainstem bronchus (2 cm or more from the carina) (Fig. 5), invades the visceral pleura, is associated with obstructive pneumonitis or atelectasis extending to the hilar region without involving an entire lung (Fig. 6) are also categorized as T2. Tumors with these features are classified as T2a if the size of the tumor is equal to or less than 5 cm.

**T3**

![Fig 1](image1.png) A 45-year-old woman with an incidentally detected nodule on chest radiograph. Axial CECT shows a 1.69 cm sized nodule in the left upper lobe (white arrowhead), subsequently confirmed as malignancy suggestive of T1a tumor stage.

![Fig 2](image2.png) A 65-year-old man, chronic smoker, with an incidentally detected nodule while undergoing abdominal CT. Axial CECT shows a 2.54 cm sized nodule in the left lower lobe (white arrowhead) subsequently confirmed as malignancy suggestive of T1b tumor stage.

![Fig 3](image3.png) A 70-year-old man with chronic cough. Axial CECT shows a peripherally located mass in the left upper lobe (white arrowhead) measuring 4.26 cm suggestive of T2a tumor stage.

![Fig 4](image4.png) A 58-year-old man with left sided chest pain and chronic cough. Coronal reformatted CECT shows a 5.96 cm mass (white arrow) in the left upper lobe suggestive of T2b tumor stage. Though initially the mass was thought to infiltrate the chest wall, this was subsequently ruled out by iatrogenic pneumothorax during FNAC.
Any tumor with the following features is categorized as T3:
- Any tumor more than 7 cm in size (Fig. 7).
- Infiltrates the chest wall, including superior sulcus tumor (Fig. 8).
- Infiltrates the diaphragm (Fig. 9).
- Infiltrates the phrenic nerve.
- Infiltrates the mediastinal pleura or the parietal

Fig. 5. A 72-year-old man with hemoptysis. A. Axial CECT shows a right hilar mass involving the right main bronchus (white arrow). B. Coronal reformatted images show the mass involving the right main bronchus is located more than 2 cm away from the carina, suggestive of a T2 tumor (T2a since the primary is less than 5 cm in size).

Fig. 6. A 62-year-old man, chronic smoker with left upper lobe collapse on chest radiograph. A. Axial CECT shows an enhancing endobronchial mass (white arrowhead) causing collapse. B. Coronal reformatted images show collapse of the left upper lobe (white arrow) extending to the hilar region, but not involving the entire lung suggestive of T2 tumor stage (T2a since the primary is less than 5 cm in size).

Fig. 7. A 72-year-old man, chronic smoker with hemoptysis and chest pain. Coronal reformatted image shows a large mass in the left upper lobe more than 7 cm in size (white arrow) suggestive of T3 stage.
pericardium (Fig. 10).
- Involves the main bronchus less than 2 cm from the carina but does not involve the carina (Fig. 11).
- Associated with atelectasis or obstructive pneumonia of the entire lung (Fig. 12).
- Associated with separate tumor nodule(s) in the same lobe (Fig. 13).

**T4**
The following are included in T4:
- Tumors of any size which invade the mediastinum, the heart, great vessels (Fig. 14), trachea, recurrent laryngeal nerve, esophagus (Fig. 15), vertebral body or carina (Fig. 16).
- Those associated with separate nodule(s) in a different ipsilateral lobe (Fig. 17).

**Nodal Staging**
No changes have been brought to the lymph node staging in the revised edition of TNM staging.

**N1**
Involvement of the ipsilateral peribronchial and/or ipsilateral hilar and intrapulmonary lymph nodes including involvement by direct extension.

**N2**
Metastasis to ipsilateral mediastinal and/or subcarinal lymph node(s).
N3

Metastasis to contralateral mediastinal/hilar or ipsilateral/contralateral scalene or supraclavicular lymph nodes.

Fig. 13. A 67-year-old man with chronic cough. Axial CECT shows a central mass lesion (white arrowhead) with a tumor nodule located peripherally in the same lobe (white arrow) suggestive of T3 stage.

Fig. 14. A 60-year-old man presented with superior vena cava syndrome. Axial CECT shows a central mass lesion associated with distal pneumonitis infiltrating the right pulmonary artery (white arrowhead) and the superior vena cava (white arrow) suggestive of T4 stage.

Fig. 15. A 77-year-old chronic smoker presented with dysphagia and chronic cough.
A. Axial CECT shows centrally located bronchogenic carcinoma. White arrow shows the mass encasing the right pulmonary artery
B. After administration of oral contrast the mass is seen infiltrating the thoracic esophagus (white arrowhead), suggestive of T4 disease.

Fig. 16. A 74-year-old man with non-resolving pneumonia.
A. Axial CECT shows central bronchogenic carcinoma. White arrow head shows the mass encasing the left pulmonary artery. Long white arrow shows the thoracic aorta being encased by the mass.
B. Coronal reformatted image shows the mass involving the carina (white arrowhead).
All these are features of T4 disease.

Fig. 17. A 54-year-old man, chronic smoker with right lower zone opacity on chest radiograph. Axial CECT shows a right lower lobe mass (white arrow head) with a probably tumoral nodule in the lateral segment of the right middle lobe (white arrow) suggesting a T4 stage.
Metastasis

M1

These are further classified as M1a and M1b.

M1a: Tumors associated with separate tumor nodule(s) in a contralateral lobe (Fig. 18), pleural nodule(s) or malignant pleural/pericardial effusion (Fig. 19).

M1b: Tumors associated with distant metastasis (Fig. 20).

Conclusion

MDCT is an accurate tool for NSCLC staging. The latest TNM staging for NSCLC is based on recommendation by the IASLC with each different stage having different prognostic and therapeutic implications. Hence, it is important to be familiar with this latest edition of TNM staging and to incorporate it in our reports. The advantages of MDCT include lesser scan time, isotropic imaging with superior sagittal and coronal reformation and enhanced detection of smaller subcentimeter sized nodules. However, the lack of specificity unlike positron emission tomography (PET) such as distinguishing benign and malignant lymph nodes or metastatic nodules from granulomas, reflect the lack of functional information, which is one major limitation of MDCT. However, since PET is not readily available, MDCT will continue to play a major role in the staging of NSCLC.

References