The Clinical Staging of Lung Cancer Through Imaging

A Radiologist's Guide to the Revised Staging System and Rationale for the Changes

Seth Kligerman, MD

KEYWORDS

• Lung cancer • Staging • Revised • PET-CT • Clinical staging

KEY POINTS

- Changes to the staging system for lung cancer were made to more accurately reflect the relationship between patient survival with characteristics of the primary tumor (T) and presence or extent of nodal (N) and metastatic disease (M).
- Similar to nonsmall cell lung cancer, survival in both small cell lung cancer and bronchopulmonary carcinoid tumors correlates with the revised system and these tumors should be staged using this system.
- Lung cancers surrounded by lung with a maximum diameter of less than or equal to 2 cm, greater than 2 cm but less than or equal to 3 cm, greater than 3 cm but less than or equal to 5 cm, greater than 5 cm but less than or equal to 7 cm, and greater than 7 cm are now designated T1a, T1b, T2a, T2b, and T3, respectively.
- Although a new lymph node map was proposed, no changes have been made to the nodal classification for lung cancer.
- Local metastatic disease, which includes contralateral pulmonary metastases as well as pleural and pericardial metastases, is classified as M1a and those with distant metastases are classified as M1b.
- Although PET and CT alone are good tools for lung cancer staging, the combination of the 2 in PET-CT merges form and function allowing for more accurate clinical staging.

INTRODUCTION

In the United States, lung cancer remains the most common cause of cancer-related death in both men and women. In 2013, it is estimated that over 87,000 men and 72,000 women will die of lung cancer in the United States alone.[1] This estimate exceeds the number of expected deaths from breast, prostate, colon, and pancreatic cancer combined. In 2009, the International Union Against Cancer and the American Joint Committee on Cancer accepted a revised staging system for lung cancer based on proposals from the International Staging Project of the International Association for the Study of Lung Cancer (IASLC). Compared with the prior system, many changes have been adopted including the use of the new system to stage not only non-small cell lung cancer (NSCLC) but also small cell lung cancer (SCLC) and bronchopulmonary carcinoid tumors. Because imaging plays such an important role in the clinical staging of lung cancer, it is imperative that these new guidelines are recognized by

Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, 22 South Greene Street, Baltimore, MD 21201, USA
E-mail address: skligerman@umm.edu

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radiologists to provide better patient care. In addition, it is important that radiologists understand not only the various imaging techniques used for the clinical staging of lung cancer but also the strengths and weaknesses of each modality to provide the best patient care possible.

IASLC POPULATION AND METHODOLOGY

Between 1990 and 2000, the Cancer Research and Biostatistics (CRAB) office evaluated 81,015 cases of newly diagnosed lung cancer from 46 sites across 19 countries. Of these, NSCLC was the most common, comprising 67,725 (83.5%) cases, while 13,290 (16.5%) were SCLC.[2] Sarcomas, carcinoid tumors, and other rare forms of lung cancer were not included in the initial analysis. Survival statistics were calculated based on the prognostic impact of various factors, including the T, N, and M designations as well as the final stage. Adjustments were made for cell type, sex, age, and the region where the data was collected. The results and recommendations were internally validated by the CRAB database and externally validated by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database. In addition, many recent publications have validated the changes adding further support to the revisions.[3–6]

T CLASSIFICATION

Many of the important changes in the 7th edition of the TNM Classification occurred within the T classification. The T classification is designed to evaluate the primary lung tumor by determining the size of the primary tumor as measured in the long-axis diameter, extent of invasion of the primary tumor, and presence or absence of satellite nodules (**Table 1**).

Because data on tumor size were readily available on a large volume of patients, accurate survival statistics were calculated on patients with completely resected tumors of varying sizes who had lesions surrounded by lung (no areas of tumor invasion) and no evidence of nodal or metastatic disease. Using this data, patients with nodules less than or equal to 2 cm in long axis diameter had a 5-year survival of 77%. By comparison, using the same criteria, those with nodules measuring greater than 2 cm but less than or equal to 3 cm had a 5-year survival of 71%.[7] Given the large number of patients, these differences were statistically significant and have led to the subdivision of the T1 designation with nodules less than or equal to 2 cm being classified as T1a (**Fig. 1**) and

Table 1
Overview of the revised 7th edition of the TNM classification of lung tumors with comparison to the 6th edition

	Prior System	New System
Tumor designation		
Size		
≤2 cm	T1	**T1a**[a]
>2 but ≤3 cm	T1	**T1b**[a]
>3 but ≤5 cm	T2	**T2a**[a]
>5 but ≤7 cm	T2	**T2b**[a]
>7 cm	T2	**T3**[a]
Pleural/pericardial invasion		
Visceral pleura	T2	**T2a**[b] **or T2b**[c]
Parietal pleura	T3	T3
Mediastinal pleura	T3	T3
Parietal pericardium	T3	T3
Central airway invasion		
Endobronchial tumors in mainstem bronchus >2 cm from carina	T2	**T2a**[b] **or T2b**[c]
Endobronchial tumors in mainstem bronchus <2 cm from carina but not involving carina	T3	T3
Tumor extending to carina	T4	T4
Lung atelectasis		
Tumor causing atelectasis of less than entire lung	T2	**T2a**[b] **or T2b**[c]
Tumor causing atelectasis of entire lung	T3	T3
Satellite nodules		
Same lobe	T4	**T3**
Same lung, different lobe	M1	**T4**
Soft tissue invasion		
Chest wall and superior sulcus	T3	T3
Diaphragm	T3	T3
Mediastinum	T4	T4
Heart or great vessels	T4	T4
Trachea	T4	T4
Esophagus	T4	T4
Osseous invasion		
Rib	T3	T3
Vertebral body	T4	T4

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