



“A System for the Clinical Staging of Lung Cancer”—A Commentary

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This seminal article by Mountain et al. [1] is the first description of the application of the TNM classification scheme to the clinical staging of lung cancer. This original study consisted of 2,155 proven cases of lung cancer. The staging was based on results of physical examination findings, radiographic studies, endoscopic studies, mediastinoscopy, and thoracentesis. More than 300 survival curves were plotted for various characteristics of the primary tumor, spread to the regional lymph nodes, and distant metastases in various combinations. Various TNM sets were then assigned to stage groups to indicate prognosis.

The TNM system (which was already in place at the time of the article by Mountain et al. [1]) uses common language to provide a basis for categorizing extent of disease. This classification by Mountain et al. [1] meets several important clinical objectives by aiding the clinician in the planning of treatment and making a quantitative estimate of prognosis. It makes possible comparison of the results of different treatments. The TNM staging classification is applicable to non-small cell lung cancer (NSCLC) and has been in universal use since 1986. It was modified in 1997 to more accurately group patients with similar prognosis and treatment options and in particular to identify patients who would benefit from surgery [2].

Since the introduction of this classification, imaging has played an important role in the clinical staging of lung cancer. At the time of the original publication by Mountain et al. [1], only standard chest radiography and conventional tomography were available for chest imaging, and assessment of distant metastatic disease was generally limited to nuclear medicine studies such as bone scintigraphy.

CT has now become the most important diagnostic imaging procedure for the regional staging of lung cancer [3]. Helical CT and

MDCT systems with automated bolus injection of contrast material provide detailed images of both local tumor extent (the T factor) and nodal metastases (the N factor). The introduction of the American Thoracic Society CT map of nodal stations has permitted accurate CT localization of abnormal nodes [4]. However, CT has important limitations in staging of the primary tumor. Sensitivity and specificity for both chest wall involvement and mediastinal invasion can be less than 65% [5–8]. These are critical areas that may determine surgical versus nonsurgical management. In the 1990s, many studies compared CT findings with the gold standard of mediastinoscopy or surgery for staging of lymph node metastases. Those studies showed that, regardless of the threshold size of lymph node chosen, CT findings in isolation could not be taken as clear evidence of malignant nodal involvement. About 20% of all nodes deemed malignant based on CT criteria will be benign [3, 5–8]. CT, however, continues to play an important and necessary part in the evaluation of patients with lung cancer.

MRI plays an important role in the evaluation and staging of superior sulcus (or Pancoast's) tumors. Direct multiplanar imaging and large differences in signal intensity between tumor and soft tissue allow better assessment of invasion into the root of the neck, chest wall, and vertebral bodies [6, 9–11].

Because of the limitations of CT and MRI, the search for a better noninvasive technique for staging of lung cancer has led to the application of ¹⁸F-FDG PET for imaging both the mediastinum for nodal disease and the remainder of the body for distant metastases. A meta-analysis has confirmed that PET is significantly more accurate than CT in the detection of nodal mediastinal metastases, with a sensitivity and specificity of 79% and 91%, respectively, for PET versus 60% and 77% for CT [12]. The development of fusion im-

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aging with PET/CT has permitted more precise localization of lymphadenopathy, allowing accurate separation of N1 from N2 disease and N2 from N3 disease. PET is sufficiently sensitive that a patient with negative mediastinal PET results may proceed directly to surgical resection of the primary tumor without a staging mediastinoscopy [13]. PET has also been shown to be more sensitive than conventional imaging in the detection of extrathoracic metastases—except brain metastases because of the high glucose uptake of the normal brain [13]. One of the major benefits of PET is its ability to minimize unnecessary thoracotomies [14].

In conclusion, the TNM classification system for the staging of lung cancer has led to important advances in the determination of prognosis and treatment of patients with this disease. Imaging, particularly CT and PET, has become an important tool for the determination of the extent of disease and appropriate clinical staging. The original work by Mountain et al. [1] provided an important framework for the appropriate management of patients with lung cancer.

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