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Role of imaging techniques in the TNM classification of non-small cell bronchogenic carcinoma☆

R. Cano Alonso[a,*], L. Herráiz Hidalgo[a], E. Álvarez Moreno[a], C. Paniagua Correa[b], V. Martínez de Vega[a]

[a] *Departamento de Diagnóstico por la Imagen, Hospital Universitario Quirón, Madrid, Spain*
[b] *Departamento de Medicina Nuclear, Hospital Universitario Quirón, Madrid, Spain*

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Abstract The Seventh Edition of the TNM classification for non-small cell bronchogenic carcinomas includes a series of changes in the T and M descriptor, in particular a re-classification of malignant pleural and pericardial effusions and of separated tumor nodes, new tumour size cut-off values and sub-divisions of the T1–T2 and M1 categories. We review these corrections that led to the changes in the staging system that affects stages II–III. Furthermore, we describe and illustrate the role of the different imaging techniques in tumour staging (CT, PET, PET–CT and MRI), highlighting their respective indications, advantages and disadvantages, as well their complementary function.

PALABRAS CLAVE
Carcinoma broncogénico no microcítico;
Diagnóstico por la imagen;
Tomografía computarizada;
Tomografía por emisión de positrones;
Resonancia magnética

Papel de las técnicas de imagen en la nueva clasificación TNM del carcinoma broncogénico no microcítico

Resumen La séptima edición de la clasificación TNM para los carcinomas broncogénicos no microcíticos incluye una serie de cambios en los descriptores T y M, particularmente una reclasificación de los derrames malignos pleurales y pericárdicos y de los nódulos tumorales separados, nuevos valores de corte de tamaño tumoral y subdivisiones de las categorías T1-T2 y M1. Revisamos estas correcciones, que generan cambios en el sistema de estadificación que afectan a los estadios II-III. Además, describimos e ilustramos el papel de las diferentes técnicas de imagen en la estadificación tumoral (TC, PET, PET-TC y RM), resaltando sus respectivas indicaciones, ventajas y desventajas, así como su función complementaria.

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* Corresponding author.
E-mail address: rcanoalonso@gmail.com (R. Cano Alonso).

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Introduction

The TNM classification for non-small cell bronchogenic carcinoma (NSCBC) is an internationally accepted and validated system for the management of patients, treatment planning, and prognosis assessment. This system classifies a tumor according to its primary characteristics (T), involvement of regional lymph nodes (N), and distant metastasis (M).[1–7] The combination of these parameters determines the tumor stage at the clinical-diagnostic stage (based on the clinical history, imaging tests, and pretreatment histologic samples) or at the surgical-pathologic stage (histologic type of the resected tumor).[1,3,5,6]

The Seventh Edition of the TNM (TNM-7) classification[8] was developed by the International Association for the Study of Lung Cancer (IASLC) as part of the Lung Cancer Study Project. The IASLC conducted a retrospective statistical analysis of the prognostic value (expressed as survival rate) of the TNM descriptors using an international database including 100,869 NSCBC patients treated between 1990 and 2000. The TNM-7 classification was later approved by the American Joint Committee on Cancer (AJCC) and the International Union against Cancer (IUAC) for use from January 1, 2010, replacing the Sixth Edition (TNM-6) classification.[3,4,6–15]

This paper describes the changes introduced in the TNM-7, mainly a re-classification of the pleuropericardial involvement and the separate tumor nodules (formerly known as *satellites*), the use of new tumor size cut-off values, and sub-divisions of the T1–T2 and M1 categories.[1,3–6,9–11,14,15] Although no changes were made in the N descriptor, more accurate anatomic boundaries are described between nodal stations and their distribution in *nodal zones*.[1,4,7,11,14,16] The use of this new classification is also recommended for small-cell carcinomas and carcinoid tumors.

The TNM-7 system analyses survival rates retrospectively, specifying the methods for clinical assessment (particularly imaging techniques) and treatments applied.[9,12,13] Since imaging techniques and treatments are continually being improved, which has an impact on survival a periodical follow-up is necessary. The present study also summarizes the role of imaging techniques in the NSCBC staging (computed tomography [CT], positron emission tomography computed tomography [PET CT], and magnetic resonance [MR]), highlighting their indications, advantages, disadvantages, and complementary role.

TNM-7: Changes

T descriptors define anatomic parameters of a tumor, such as size, endobronchial location, distance to the carina, invasion of neighbouring structures, atelectasis, separate nodules, etc.[17] The changes introduced, which were validated for all histologic subtypes, include[9,13]:

- Introduction of cut-off values for tumors 2, 3, 5 and 7 cm in size, subdividing the T1–T2 categories according to the long axis of the lesion. Although the cut-off between both categories remains 3 cm, T1 is subdivided into T1a ($\leq$2 cm) and T1b (>2 cm and $\leq$3 cm). T2 is subdivided into T2a (>3 cm and $\leq$5 cm) and T2b (>5 cm and $\leq$7 cm).
- Any tumor > 7 cm is reclassified as T3.
- The separate nodules localized in the same lobe as the primary nodule are moved from T4 to T3. The separate nodules localized in a different lobe from the ipsilateral lung are moved from M1 to T4.
- Pleural implants and pleuropericardial effusions are moved from T4 to M1.

There were no recommended changes for the N descriptor, although the IASLC suggests a new nodal map that reconciles differences between the established maps (the Naruke map, developed by Japan Lung Cancer Society, and the Mountain-Dresler map, developed by the American Thoracic Society). The new map also homogenizes the nomenclature by grouping the 14 nodal stations into 6 anatomic zones (upper, aortopulmonary, subcarinal, lower, hilar, and peripheral). Furthermore, the anatomic boundaries between nodal stations are accurately described, particularly the boundary between the right and left paratracheal stations, which is now the left lateral tracheal border and not the tracheal midline. Accordingly, the pretracheal nodes belong to one or another paratracheal chain. The lower cervical nodes, supraclavicular nodes, and nodes of the sternal notch are now considered an independent station (station 1)[1,4,6,7,11,14–16] (Fig. 1).

The relationship between survival and number of stations (solitary or multiple) involved within each N category was analysed. Better survival was observed for involvement of a solitary station, although evidence was insufficient to recommend subclassification of N1–N2 into N1a–N2a (solitary) and N1b–N2b (multiple).[1,4,6,9,15,16]

The relationship between the localization of the primary tumor and the associated adenopathy, and skip metastases (N2 with no evidence of N1) was also evaluated, but no significant results were obtained.[1,11,15,16]

Concerning the M descriptor, the M1 category is divided into M1a (intrathoracic metastases: malignant pleuropericardial effusion, pleural implants, contralateral lung nodules) and M1b (extrathoracic metastases)[1,9,12,13,18] (Fig. 2). Although there may be a relationship between survival and number of metastasized organs, there is no evidence to justify subdivision of the M1b category.[11]

The IASLC recommends the use of the TNM-7 system for small-cell lung carcinoma and carcinoid tumors since an inversely proportional relationship between survival and tumor stage has been reported.[4,6,7]

Table 1 outlines T, N, and M descriptors in the TNM-7 system,[8,9] highlighting the differences with respect to descriptors in the TNM-6 system.[3,5,19,20] Figs. 3 and 4 illustrate such differences.

Staging

The combination of the descriptors determines tumor stage. In the TNM-7 system, staging is a more complex task since 17 stage migrations took place (10 cases were downstaged and 7 cases were upstaged), despite the fact that subdivisions of the T and M descriptors do not entail the creation of new