ORIGINAL ARTICLE

The International Association for the Study of Lung Cancer Thymic Epithelial Tumors Staging Project: Proposals for the N and the M Components for the Forthcoming (Ninth) Edition of the TNM Classification of Malignant Tumors

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ABSTRACT

Introduction: Stage classification is an important underpinning of management in patients with cancer and rests on a combination of three components—T for tumor extent, N for nodal involvement, and M for distant metastases. This article details the revision of the N and the M components of thymic epithelial tumors for the ninth edition of the TNM classification of malignant tumors proposed by the Thymic Domain of the International Association for the Study of Lung Cancer Staging and Prognostic Factors Committee.

Methods: The N and M components of the eighth edition staging system were verified by a large international collaborative data source through a data-driven analysis. A total of 9147 cases were included for analysis, including 7662 thymomas, 1345 thymic carcinomas, and 140 neuroendocrine thymic tumors.

Results: Lymph node involvement rates were 1.5% in thymomas and 17.6% and 27.7% in thymic carcinomas and neuroendocrine thymic tumors, respectively. Rates of lymph node metastasis were increasingly higher in tumors with higher T stage and higher-grade histologic type. Survival analysis validated the differences in the N and M categories proposed in the eighth edition staging system. Good discrimination in overall survival was detected among pathologic (p)N and pM categories in patients with thymoma and thymic carcinoma.

Conclusions: No changes are proposed from the eighth edition for the N and M components. The proposed stage classification will provide a useful tool for management of the disease among the global thymic community.

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Keywords: Staging; Thymoma; Thymic carcinoma; Lymph node; Metastasis

Introduction

The major purpose of stage classification for malignant tumors is to provide a common language on the basis of the anatomical extent of the disease which is fundamental to patient management. This has been lagging behind in thymic epithelial tumors (TETs) owing to their rarity, until the first international TNM stage classification as a universal, clearly defined system, proposed by the Thymic Domain of the Staging and Prognostic Factors Committee (TD-SPFC) of the International Association for the Study of Lung Cancer (IASLC) and the International Thymic Malignancies Interest Group (ITMIG), was accepted worldwide.[1] It is a single system for both thymoma and thymic carcinoma (TC) and is consistent with the general format of the eighth edition of the American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC) stage classification system.

Synchronous to the AJCC-UICC stage revision process, which takes a 7-year interval, the TD-SPFC has been working on the ninth edition of the stage classification system since the release of the eighth edition in 2016. This process included both data collection from all over the world and identifying unsolved issues in the use of the previous staging system.[2] Thanks to the substantial contribution from the international thymic community, a similarly large number of cases have been collected, especially with a larger number of patients with lymph node involvement and/or distant organ metastasis. These have provided the TD-SPFC N and M subcommittees a good opportunity to revisit the incidence of lymph node involvement in different tumor histologic types and the potential heterogeneity in different presentations of metastatic disease and their effect on prognosis. This article reports on the deliberations and outcomes of this process along with the proposed recommendations for the N and the M components of TET for the ninth TNM stage classification of malignant tumors.

Materials and Methods

A general overview of the database used for this analysis and the principles guiding the development of a stage classification system are described in a separate manuscript.[3] In summary, a large international database including anonymized information from 11,347 patients with TETs was collected by several regional organizations (Japanese Association for Research in the Thymus [JART], Chinese Alliance for Research in Thymoma [ChART], European Society of Thoracic Surgeons, Korean

Association for Research in the Thymus, Réseau Tumeurs THYmiques et Cancer), Spanish Thymic Group, along with the ITMIG, in addition to contributions from individual centers in Europe, Australia, the United states, and England. A total of 9147 cases were assessable for survival and included for analysis, including 7662 thymomas, 1345 TCs, and 140 neuroendocrine thymic tumors (NETTs). The IASLC provided infrastructure and funding to allow an extensive analysis, which was performed by the Cancer Research And Biostatistics group to develop TNM-based, data-driven stage classification proposals to inform the ninth edition of the AJCC-UICC stage classification system. Owing to the anonymized information used in this study, informed patient consent was waived. Articles describing details of data collection, the T component, and the stage grouping will be provided separately.[4,5]

The limited amount of detailed data on N and M categories for the formation of the eighth edition restricted our ability to assess whether there were statistically significant differences in the outcomes of various cohorts. Analysis was based primarily on a visual separation of survival and recurrence curves, similarities of the N classification to a consensus-based ITMIG-IASLC mediastinal thymic node map, similarities of the M classification to the Masaoka and Masaoka-Koga stage classification systems, and practical considerations relative to the conduct of surgery for TET and a consensus opinion about what was worthwhile to distinguish.[6] Thus, the first effort of the TD-SPFC during the ninth edition of the TNM classification was to validate the proposals introduced in the eighth stage classification system with this new, broader set of international multicenter database. The greater number of N+ and M+ patients now available allows analysis of survival in each N/M categories and thus a more robust statistical basis for stage classification. In the T classification process, most patients included had relatively early-stage disease and underwent complete resection. Because of the relatively indolent nature of thymic tumors, freedom from recurrence (FFR), rather than survival, was considered a better measure for comparison of prognosis in early-stage disease. For the N and M categories, however, patients with N+ or M+ tumors are in advanced stage and would have more survival events. In addition, few can be rendered disease free, limiting the utility of FFR in this population. Therefore, the TD-SPFC decided that overall survival (OS) in the whole population with any type of resection (R-any) would be an appropriate end point for outcome analysis for the N and M components. Owing to the differences in histologic types, all analyses were performed separately in both thymomas and TCs; only select analyses were conducted for NETTs owing to the small number of patients with NETT available in the data collected.

Statistical analysis of the data was performed by Cancer Research And Biostatistics biostatisticians using the SAS Systems for Windows version 9.4 (SAS Systems, Cary, NC). OS, FFR was estimated using the method of Kaplan-Meier, and cumulative incidence of recurrence was used to account for the competing risk of death. All outcomes were measured from the date of first intervention and censored at the date of last follow-up. Cox regression models were used to obtain hazard ratios (HRs) for OS and FFR.

Results

Analysis of the N Component

Pathologic (p) N (pN) category information (pN0, pN1, pN2) was available in most patients (6820 of 9147, 74.6%), whereas clinical (c) N (cN) category diagnosis was mostly missing and identified (cN0, cN1, cN2) in only a few patients (2317 of 9147, 25.3%) (Supplementary Table 1). There was a high concordance between the pN0 and cN0 categories (89.0% and 97.7% of pathologic N0 status correctly identified clinically for TC and thymoma, respectively; Supplementary Fig. 1*A* and *B*) mostly because nodal involvement is a relatively uncommon event in TET. Nevertheless, there was low concordance between the pN+ and the cN+ patients (35.9% and 10.0% of pN+ status were correctly identified clinically for TC and thymoma, respectively; Supplementary Fig. 1*A* and *B*). The data, however, were limited on patients with both cN+ and pN+ status, as few patients with cN+ included in the database without resection had their suspected lymph nodes sampled for pathologic examination. Among the patients with cN+ disease, 75.8% of the patients with TC and 85.9% with those with thymoma had surgical resection versus 94.1% and 98.7%, respectively, in patients with cN0 (Fig. 1*A*). Unfortunately, for patients with cN+ tumors who underwent resection of the tumor, N1 and N2 nodes were sampled in less than 40% and 10% of patients with cN1 and cN2, respectively, during the operation. On the basis of these data, there was insufficient sample size on patients with both cN-category and lymph node sampling data to draw any reliable conclusion on the accuracy of cN classification.

Overall lymph node involvement rates were 1.5% in thymomas, 17.6% in TCs, and 27.7% in NETTs. This is in line with the previous findings in regional database retrospective studies from the JART and the ChART.[7,8] According to the ITMIG-IASLC lymph node map which divides nodal involvement into anterior (perithymic, N1) and deep (N2) categories,[9] rate of lymph node involvement in these two regions differs considerably between different tumor histologic types. Rates of N1 and N2 involvement were 1.1% and 0.4% in thymomas, 8.3%

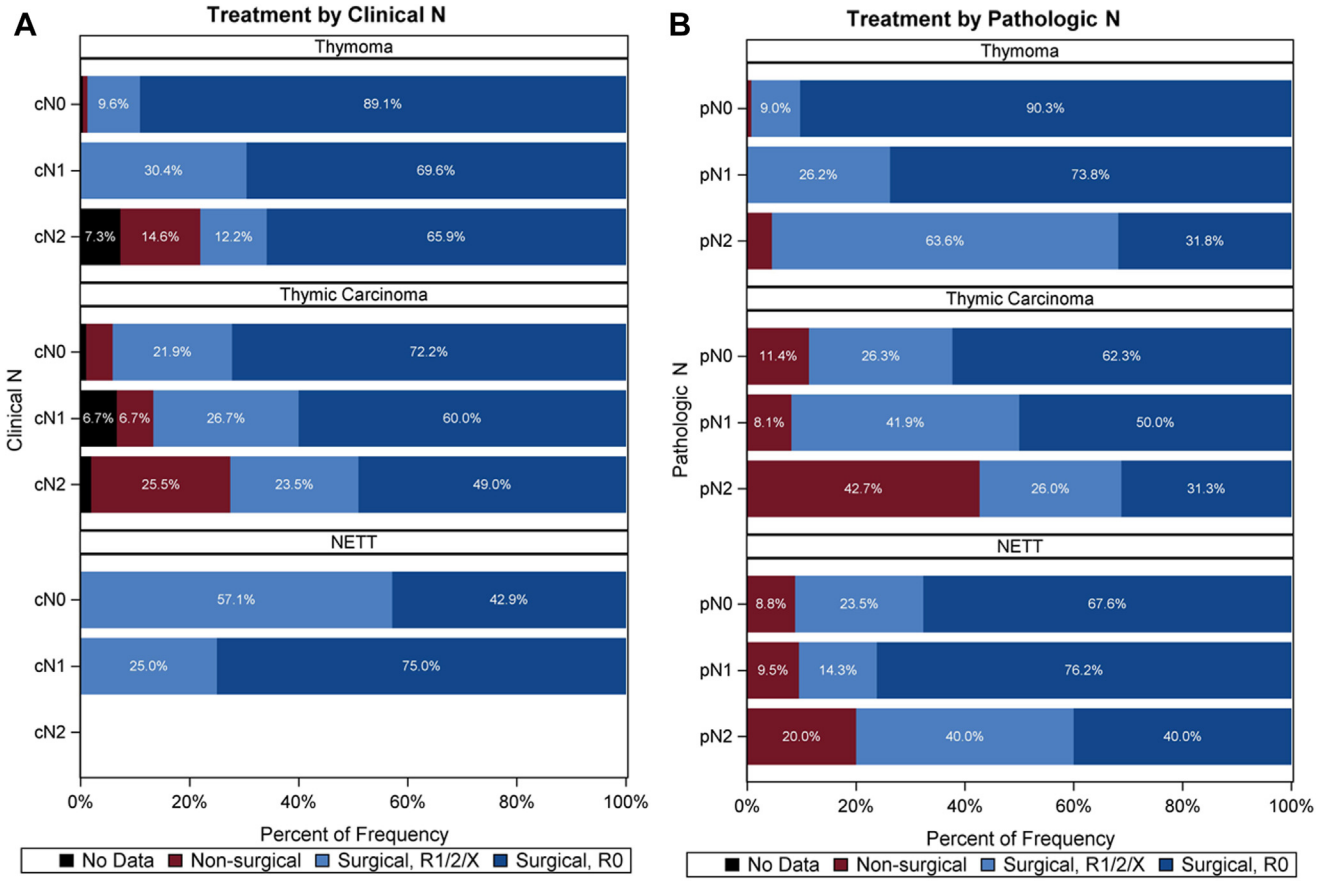


Figure 1. Surgical resection status by (*A*) clinical N and (*B*) pathologic N for thymoma, thymic carcinoma, and NETT. NETT, neuroendocrine thymic tumor.

and 9.3% in TCs, and 22.3% and 5.3% in NETTs, respectively. Far less N2 nodes were sampled during resection than N1 nodes, the latter of which are readily retrieved together with a total thymectomy. This is in accordance with the TD-SPFC survey in which N1 dissection was reported to be carried out in 50% of thymomas and 66% of TCs, but N2 dissection was only performed in 21% and 41% thymomas and TCs, respectively.[10] There was an association of higher T categories with a greater likelihood of nodal involvement in both thymoma and TCs ($p < 0.001$). Higher T categories were associated with overall nodal involvement, but also specifically associated with nodal involvement in the N1 region and the N2 region (Supplementary Table 2). For NETT, there was a trend for increasingly greater nodal involvement for tumors with higher T categories. Statistical difference, however, was not detected among different T categories, as the rate of lymph node metastasis was already quite high (20.9%) in T1 NETT tumors.

As presented in Figure 1*B* there was a higher percentage of nonsurgical patients and those undergoing non-R0 resection in the pN+ categories than in the pN0 category. Therefore, the TD-SPFC decided to focus on OS in patients regardless of resection status (R-any). Survival analysis was performed in 2317 patients with both known cN-category (N0, N1, N2) and survival data, including 1938 with thymoma, 354 with TC, and 25 with NETT. OS was generally better in patients with cN0 tumors with R-any, T-any, and M-any than in those with cN+. Five-year survival (95% confidence interval [CI]) was 92% (90%–93%) for those with thymoma, 72% (66%–78%) for those with TC, and 71% (47%–96%) for those with NETT (Fig. 2*A-C*). The survival curves could not be reliably assessed for patients with cN1 or cN2 tumors because of insufficient sample size. For the 6820 patients with both known pN-category (N0, N1, N2) and survival data, including 5690 with thymomas, 1036 with TC, and 94 with NETT, there was better discrimination among different pN categories than among cN categories (Fig. 3*A-C*). We had robust enough data to reveal that patients with nodal involvement, especially N2 disease, had much worse OS than those without lymph node metastasis. In patients with TC, OS was significantly worse for pN1 compared with pN0 (HR = 1.5, 95% CI: 1.1–2.1, $p = 0.017$) and significantly worse for pN2

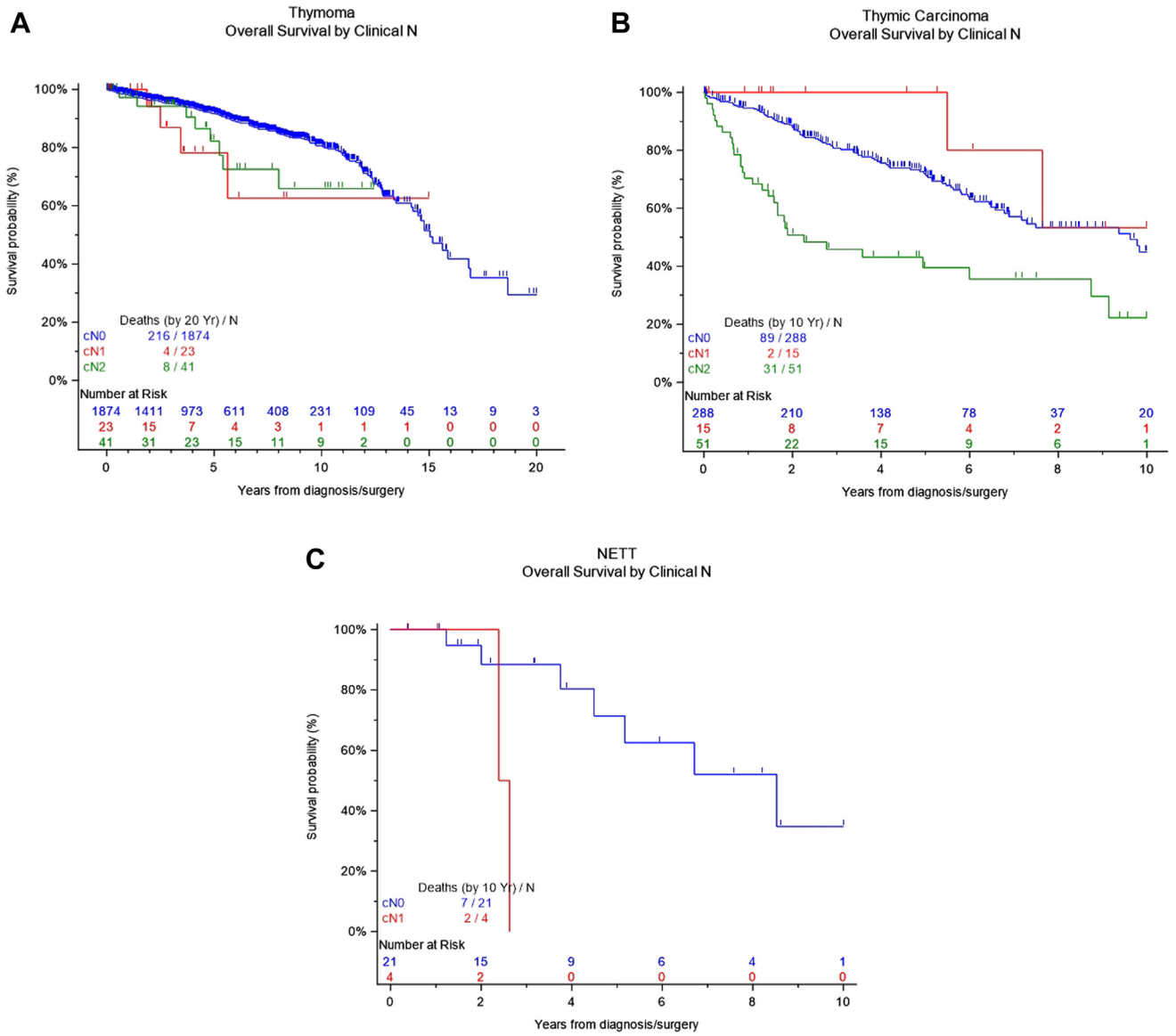


Figure 2. Overall survival by clinical N in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

compared with pN1 (HR = 1.8, 95% CI: 1.2–2.7, p = 0.006). In patients with thymoma, OS was significantly worse for pN1 compared with pN0 (HR = 2.9, 95% CI: 1.8–4.7, $p < 0.001$) and numerically worse for pN2 compared with pN1 (HR = 1.1, 95% CI: 0.5–2.5, p = 0.85). Nevertheless, there was a very low power to detect differences with only eight events of a total of 22 patients with pN2 thymomas. The total cases and events in pN+ cases for patients with NETT were too few for discrimination. Although multivariable modeling reduced the available sample size owing to covariate data availability, results were generally similar when adjusting for age, sex, region, performance status, and surgical resection status (Supplementary Table 3). A similar OS analysis was performed in R-any and T-any but M0 only, but there was a less clear discrimination among the different N categories, because of even fewer assessable N+ cases. Our results, therefore, confirm the separation of N0, N1, and N2 categories of the eighth edition of the classification system.[6] On the basis of these findings, the TD-SPFC found that there was support for the eighth edition N categories without any change for the ninth TNM (Table 1).

Analysis of the M Component

Basis of the Eighth Edition Descriptors. Metastases from thymic tumors are historically separated into the following three categories: M0 if there are no metastatic sites, M1a if there are pleural or pericardial nodules separate from the primary tumor mass, and M1b if there

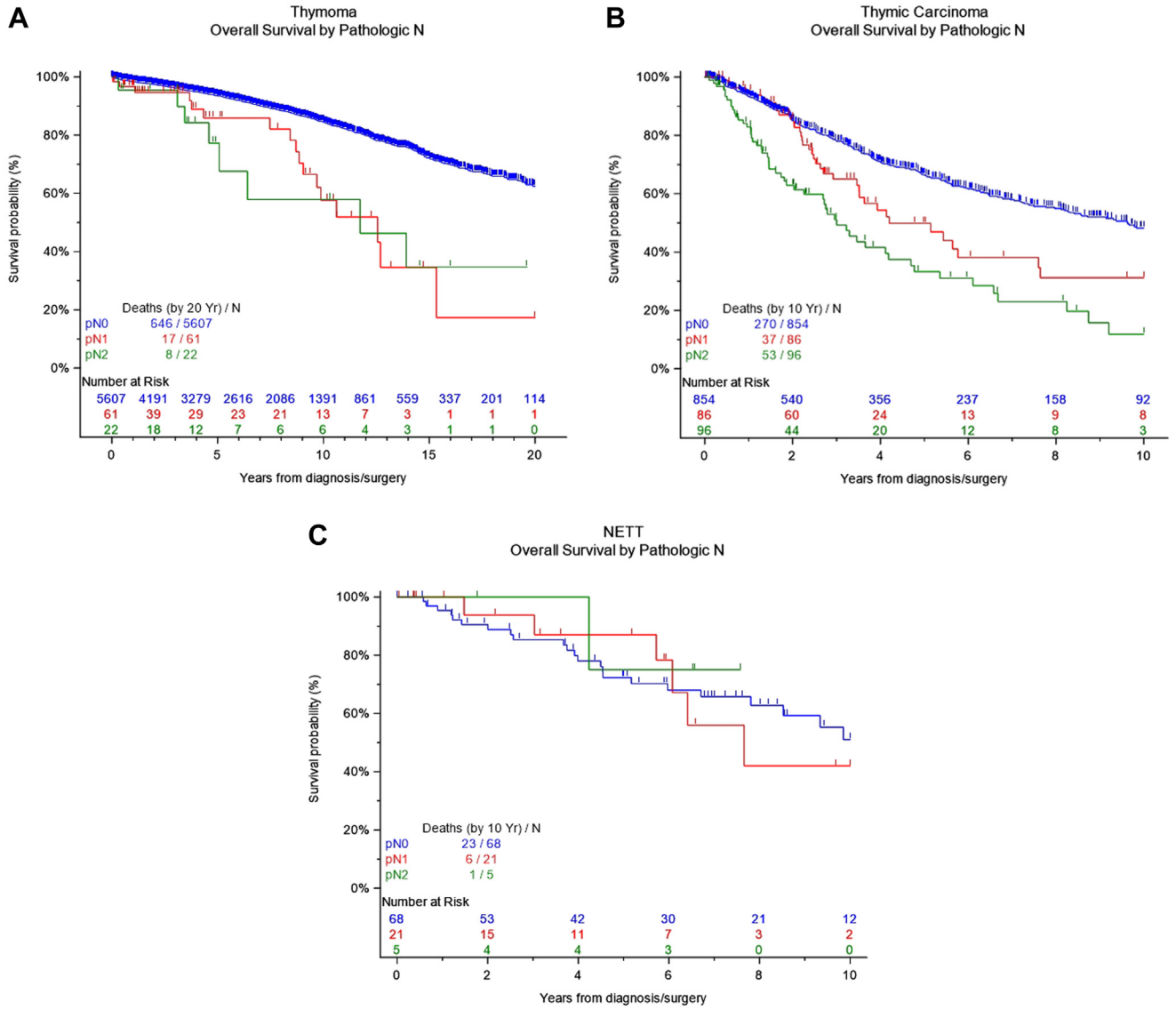


Figure 3. Overall survival by pathologic N in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

are pulmonary intraparenchymal nodules and/or distant (extrathoracic) metastases. This classification originated from the Masaoka-Koga staging system[11,12] that was further clarified by ITMIG.[13] For M1a, pleural or pericardial tumor nodules may be located on the visceral or parietal pleura or the pericardial or epicardial surfaces. This differs from direct extension of a TET to the pericardium or pleura without separate nodules which is then classified as T3 disease which is stage III. The M1b category includes the following: (1) pulmonary nodules that are in the lung, with a rim of normal lung between the nodule and the pleural surface; (2) any extrathoracic metastatic lesion; and (3) any nonregional lymph nodes (e.g., high neck, retrocrural, axillary, or extrathoracic lymph nodes). The clinical management of patients in these two groups usually differs[14,15]; patients with M1a tumors may be considered for surgical resection of the primary tumor and pleural lesions, whereas those with M1b tumors

Table 1. Proposals for the N and the M Components for the Ninth Edition of the TNM Classification

Descriptors	Definition (Involvement of)
N0	No nodal involvement
N1	Anterior (perithymic) nodes
N2	Deep intrathoracic or cervical nodes
M0	No metastatic pleural, pericardial, or distant sites
M1	
a	Separate pleural or pericardial nodule(s)
b	Pulmonary intraparenchymal nodule or distant organ metastasis

Note: Involvement must be pathologically proven in pathologic staging.

are more likely to be directed to systemic therapies with limited room for local treatment.

The eighth edition of the TNM classification further reinforced these M1a and M1b categories.[6] On the basis of a cohort of 753 patients with metastatic TET, the findings were the following: (1) OS among N0 R-any patients was better for patients with M1a than for M1b tumors (5-y survival 71% and 56%, respectively), although the difference was not statistically significant (p = N.S.); (2) overall rates of death were worse among patients with N0,1 M1b tumors than among those with N0 M1a tumors (45% versus 31%). Finally, the decision to maintain the M1a and M1b categories for this first TNM was also based on a visual impression that the outcome curves were different for M1a and M1b. Ultimately, in the eighth edition database, there were too few patients to analyze further differences in the outcomes of patients with pleural versus pericardial versus lung metastases. Most patients with M1b tumors had pulmonary nodules, given the surgical orientation of the data set.

Description of the M Component Data. Most patients had pathologic-stage information; data on cM0, cM1a, and cM1b categories were available for 24.7% of thymoma and 25.9% TC cases, respectively (Supplementary Table 1). Surgical resection status by cM and pM for thymoma, TC and NETT is shown in Figure 4*A* and *B*. Surgical resection was undertaken in only 51.0% and 69.1% of patients with cM1a and M1b TC and thymoma versus 97.0% and 99.6% in patients with cM0 tumors, respectively (Fig. 4*A*). The limited number of resected M1 cases, together with the high proportion of M0 cases, affected the correlation analyses between cM and pM. The correlation was not high between pM category and the cM categories. Pathologic M1a was correctly identified clinically in 76% of thymoma and 53% of TC; pM1b was correctly identified in 14% of thymoma and 33% of TC (Supplementary Fig. 2*A* and *B*)

M Component Analysis. Owing to sparse data, there was limited power to conduct analyses of OS by cM (Fig. 5*A-C*). OS curves separated well for pM categories in patients with TC and for pM0 and pM1a in patients with thymoma; there were limited sample sizes for NETT (Fig. 6*A-C*). For both FFR and cumulative incidence of recurrence, pM0 separated well from pM1a and pM1b in

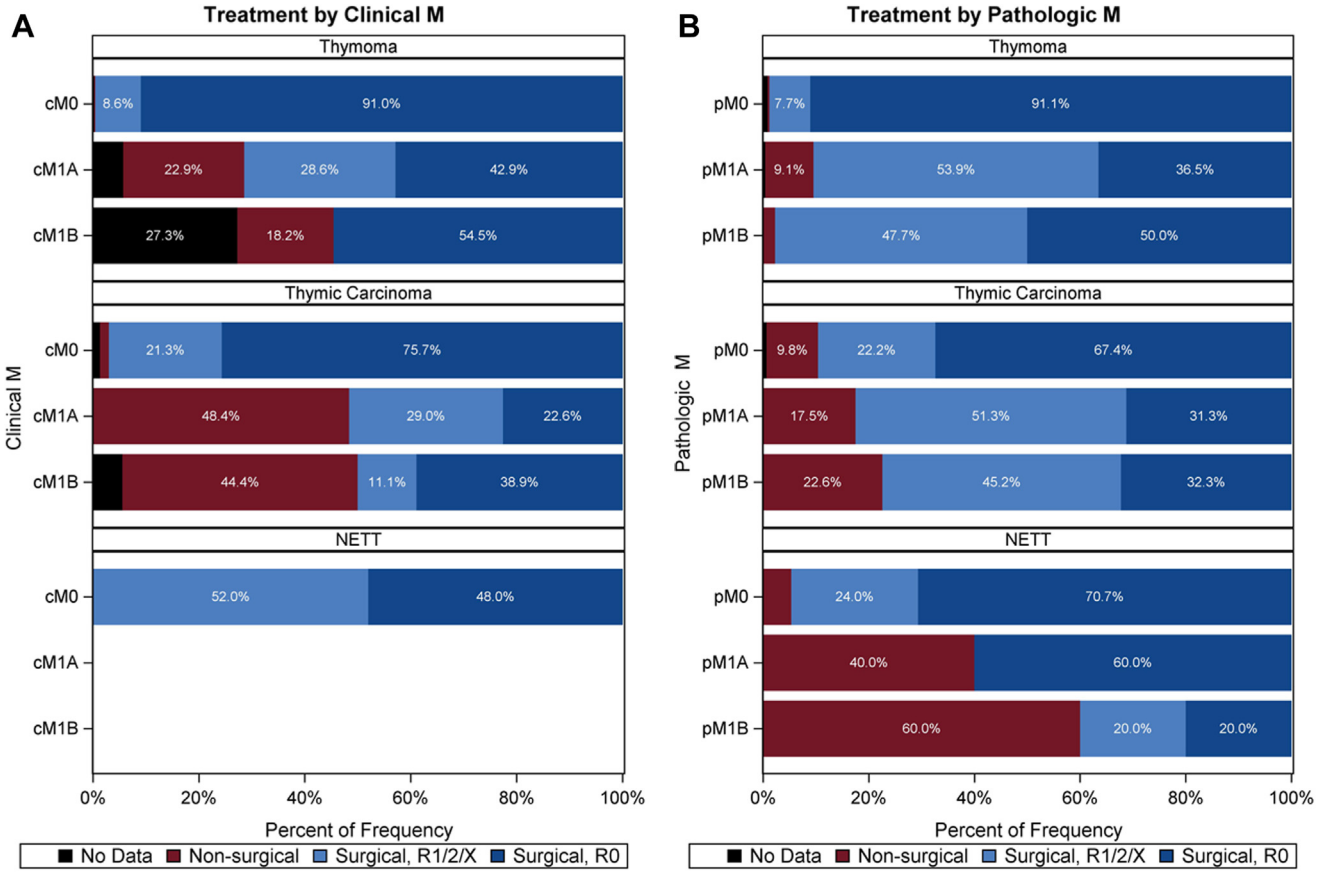


Figure 4. Surgical resection status by (*A*) clinical M and (*B*) pathologic M for thymoma, thymic carcinoma, and NETT. NETT, neuroendocrine thymic tumor.

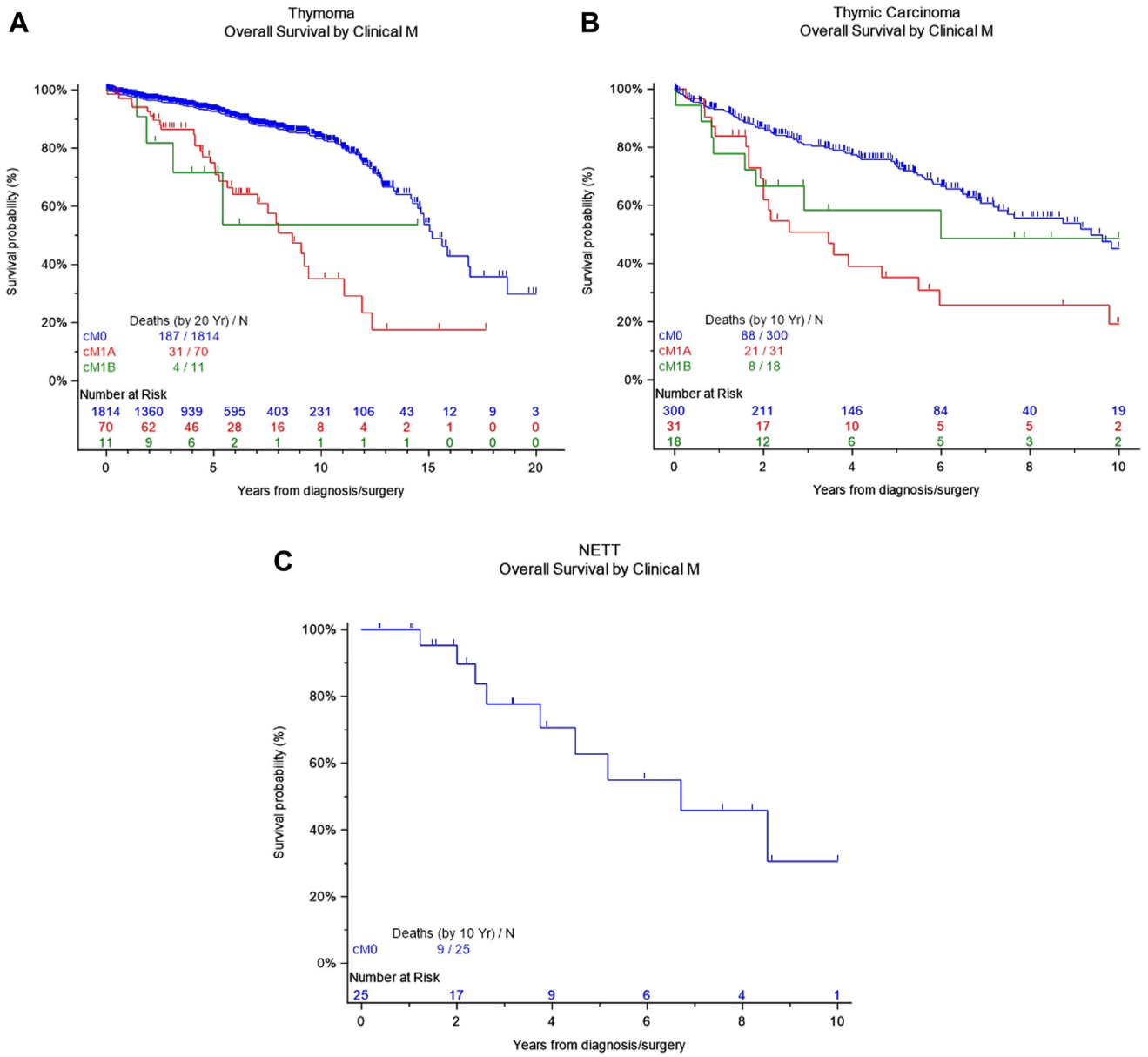


Figure 5. Overall survival by clinical M in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

patients with TC and thymoma (Supplementary Fig. 3*A-D*). At multivariate analysis, in patients with TC, although OS was not significantly worse for pM1a than for pM0 (HR = 1.35, 95% CI: 0.91–2.00, $p = 0.133$) or for pM1b than for pM1a (HR = 1.68, 95% CI: 0.99–2.86, $p = 0.053$), FFR was significantly worse for pM1a than for pM0 (HR = 2.63, 95% CI: 1.33–5.26, $p = 0.004$) (Supplementary Table 4). In patients with thymoma, OS and FFR were significantly worse for pM1a than for pM0 (HR = 3.23, 95% CI: 2.38–4.55, $p < 0.001$ and HR = 14.30, 95% CI: 9.09–43.00, $p < 0.001$). Data were too sparse to make meaningful comparisons of recurrence in patients with pM1b tumors, as there were only three and nine patients with pM1b, respectively, with recurrence data for TC and thymoma. Analysis of specific M descriptors was hampered by the limited granularity of the available data. In patients with thymoma, there was no difference in OS or FFR by pM1a descriptors, pleural nodule, pericardial nodule, or both, or pM1b descriptors, lung lesion, non-lung lesion, or both. In the patients with TC, there was a tendency toward longer OS in patients with pM1a pleural nodules versus pericardial nodules or both and no OS difference in patients with pM1b lung versus non-lung metastases. The committee concluded that the eighth edition M categories were validated by the ninth edition data. Strict statistical validation in each

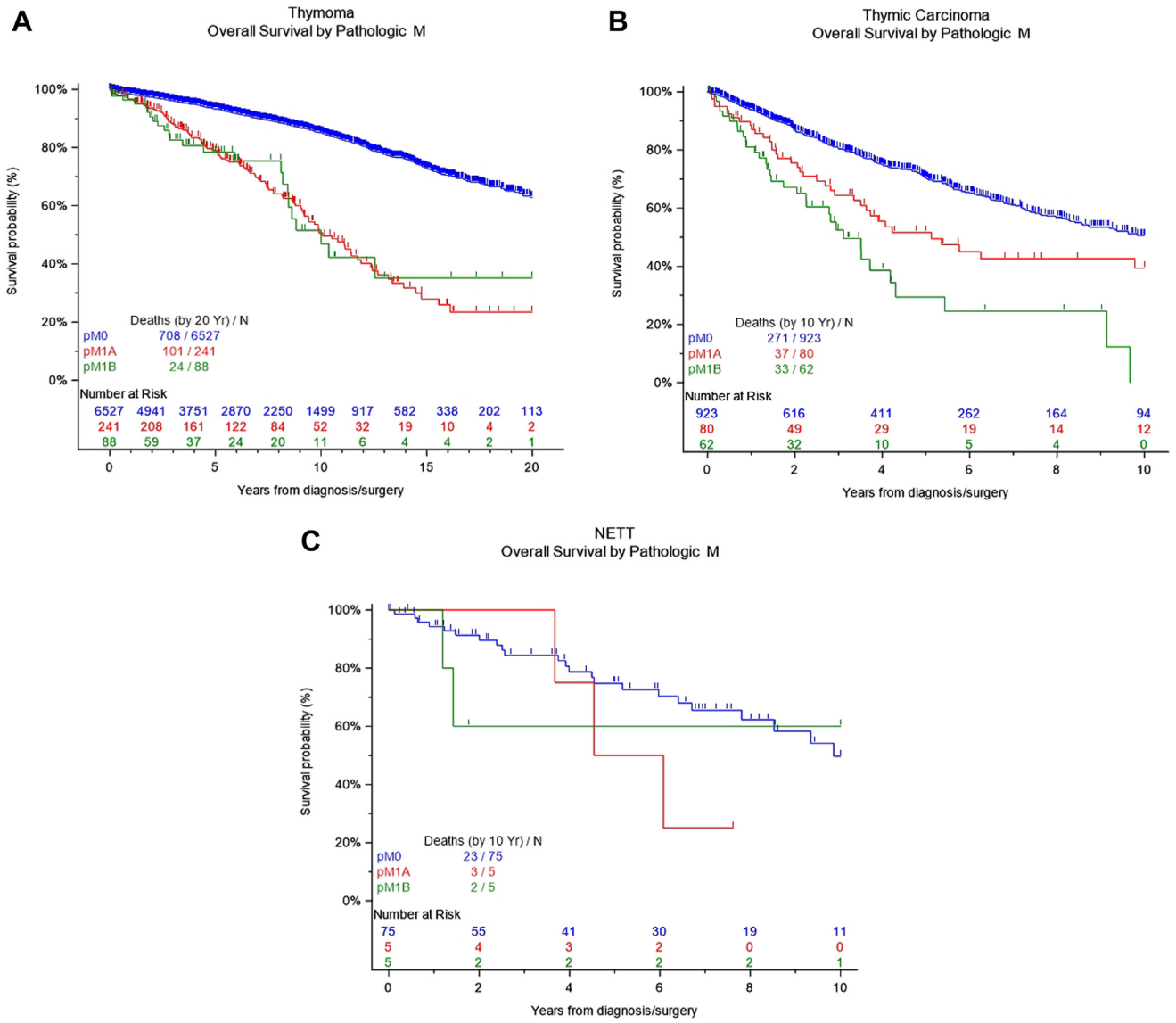


Figure 6. Overall survival by pathologic M in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

thymic tumor type was not always possible owing to sample size. These conclusions held up in adjusted analyses as well. Further investigations of specific M descriptors were not possible in a robust manner owing to limited granularity of the available data. Nevertheless, there was no clear evidence that the existing descriptors were inappropriate (Table 1).

Discussion

Development of a uniform stage classification system is a major prerequisite for progress in treatment, particularly in an uncommon disease such as TET. The lack of an official stage classification has been an impediment for TET, until the eighth edition TNM classification in which the first internationally recognized TNM classification for TET was introduced on the basis of the analyses of an international database developed by IASLC and ITMIG.[1] Nevertheless, unsolved issues remained with the eighth edition of the stage classification system as there were not enough data available, rendering limited statistical power to rely on analysis outcomes only. With a larger number of patients with advanced disease of N+ and/or M+ contributed to the database for the revision toward the ninth edition, survival differences were validated across the N and the M categories proposed in the eighth edition. Although there have been relatively more data collected, problems in further refinement of the N and M descriptors still remained because of insufficient number of events. The TD-SPFC thus decided to retain the classification of TETs as it is in the eighth edition of the TNM classification of malignant tumors, without making any change to the N or M classifications.

Clinically, there is a need for a cN classification to compare management strategies and outcomes, especially in nonsurgical patients. Theoretically, there would be a higher percentage of nodal involvement in nonsurgical patients who often have more advanced disease. Unfortunately, few patients suspected to have cN+ disease had their lymph nodes sampled in the data collected. Therefore, the ninth edition analysis focused on pN status for tumor classification. During the process that led to the classification proposed for the eighth edition TNM, OS among patients with R-any status was found to be better for the N1 than for the N2 category. With less than 100 patients with N+, however, the differences did not reach statistical significance. In recent years, there have been increasing reports revealing the association between lymph node status and survival in patients with TETs. By studying the Surveillance, Epidemiology, and End Results database, Weksler et al.[16,17] found that the presence of nodal metastases had significant, independent, adverse impact on survival in patients with either thymoma or TC including NETT. A ChART multicenter retrospective database study also found a similar association between nodal status and survival outcomes in patients with TET, which was echoed by another JART database analysis.[7,8] In the process toward the ninth edition TNM, worse survival outcomes were found with increasing pN-category in patients with both thymoma and TC. In addition, with nearly 300 N+ cases, statistically significant differences were detected among pN0, pN1, and pN2 diseases in patients with TC and among pN0 and pN1 in those with thymoma. The results were similar when adjusted for patient characteristics and surgical resection status by multivariate analysis. It is for the first time that a stepwise worsening of survival with increasing N category was proven by a data-driven process.

In the ITMIG-IASLC consensus-based node map, prevascular (anterior) mediastinal node and low anterior cervical perithymic metastasis is designated as N1, whereas other neck and deep mediastinal nodal involvement is classified as N2.[18] This was based on the following three considerations[9]: The "speculation" that N1 nodes signify less advanced disease because they are closer to the thymus than N2; a "practical" reason to separate the anterior and deep regions as N1 nodes are already included in the thymectomy specimen whereas harvesting N2 nodes would require an extra effort; and whether there would be "available" data to reveal a distinction in outcomes among different N categories. Although survival among different pN categories was generally well separated in the analyses of the ninth edition database, there is still a paucity of detailed information on nodal groups sampled during the operation. Significant differences in OS between patients with pN0 and pN1 were still found in multivariate analysis, but not between pN1 and pN2, owing to further reduced sample size and events. The sole prospective observational study in patients with TET revealed that the rate of lymph node metastasis could almost double with intentional nodal sampling.[19] Rates of lymph node metastasis in the two Surveillance, Epidemiology, and End Results database analyses were much higher than the results from other regional retrospective database studies,[16,17] probably because only patients with a certain number of lymph nodes harvested were included in the former. To stage lymph nodes accurately, ITMIG has proposed that prevascular mediastinal nodes be routinely removed along with the thymus and encouraged a systematic sampling of deep nodes in TCs, or thymomas with invasion of neighboring structures.[20] In the database for the ninth edition, the rate of lymph node involvement was much higher in TC than in thymomas. Lymph node metastasis was an early event in patients with NETT, similar to the findings in previous multicenter studies.[21] N status was also found to be significantly associated with T category, echoing the previous findings that increasing lymphatic involvement was expected with extension of the primary tumor. In the prospective observational study mentioned previously, the risk of lymph node metastasis could be clearly discriminated by combination of histologic tumor type and T category.[19] These findings further support the ITMIG recommendation on more attention to lymph node harvesting during resection, especially in those tumors with a higher histologic grade and/or those with local invasion. This would be important for curative removal of disease and for providing more granular information for future stage revisions.

With regard to the M component, the TD-SPFC M-Subcommittee for the ninth edition had established a road map of analyses that would be conducted to refine these descriptors.[2] A first plan was to describe the subgroups available with regard to the following: (1) the number of patients with M1a/M1b disease in thymoma versus TC versus NETT; (2) sites of metastases, that is, pleural or pericardial for M1a and pulmonary, nodal, or extrathoracic for M1b; (3) number of metastatic sites, that is, number of pleural implants for M1a and number of distant sites for M1b; and (4) information about definite/local treatment versus systemic therapy only and resection status in operated cases. One additional objective was to revisit the correlation between clinical and pathologic staging. The M-component Subcommittee estimates that cTNM is needed to further assess the patient outcomes in the setting of metastatic disease not amenable to resection and stratify patients receiving exclusive systemic therapies. Finally, one additional question was to define the best end points for analyzing

patient outcomes; in the setting of metastatic disease, disease progression may be hard to assess in a retrospective manner, as time interval between imaging may be diverse depending on the follow-up recommendations[14,15]; therefore, OS is a stronger end point.

We expected to conduct these analyses in thymoma and TC separately, which was ultimately done; one key consideration is that metastatic disease at diagnosis is far more frequent in TC than in thymomas. Meanwhile, we understand that distinguishing the two entities in the setting of aggressive, high-grade, metastatic disease may be challenging. From the analyses of the eighth edition database, the risk of recurrence was comparable in the two histologic types for patients with M1a/M1b.[6] The SPFC-TD pointed out very early in the revision process that there was an urgent need to collect more advanced cases for the ninth edition. In this respect, the contribution of databases including advanced cases (e.g., Réseau Tumeurs THYmiques et Cancer, ChART, Korean Association for Research in the Thymus) was instrumental.

A key recommendation is to collect additional variables for the M component in existing and ongoing databases to further decipher the diversity of metastatic disease in TET; this should include the number and side—left or right—of pleural/pericardial implants and treatment in M1a cases, number of lesions and site of distant metastases, and delivery of local treatment for M1b cases. Indeed, the TD-SPFC M-Subcommittee suggests, based on improved outcomes after complete resection of recurrence,[22–24] that patients with single pleural implant amenable to surgical resection have a better outcome than patients with multiple implants or carcinomatosis, even if these may be eligible for pleuropneumonectomy or intrapleural chemo-hyperthermia.[25,26] Similarly, patients with oligometastatic disease in the lung or at distant sites are believed to have a better OS than patients with multiple metastases, as these may be eligible to local ablative therapies. In addition, this information will be related to clinical TNM more than pathologic TNM, as most metastatic sites are not confirmed pathologically in routine practice. We then expect to collect more data for the clinical/pathologic correlation analyses. Ultimately, the subsequent M-component classification would include additional descriptors, such as what has been proposed so far for lung cancer: one example could be M1a for single metastasis or implant, M1b for multiple implants, homolateral, M1c for multiple implants, bilateral, or multiple distant lesions. This may also affect stage grouping as M1a thymic tumor with a single, resected pleural implant may have a better outcome than unresected T3/T4N0M0 tumors.

In conclusion, the proposals made to the UICC-AJCC are that the categories and descriptors for the N and M components of the classification of TET for the ninth edition TNM remain unchanged from the eighth edition system. The analyses of data for the ninth edition verified the survival differences in different N/M categories proposed in the eighth edition. Furthermore, for the first time, this data-driven process saw statistical significant differences that were underpowered in the eighth edition. Therefore, it is recommended that the IASLC TNM classification should be used in the management and studies for TET in the future. More efforts should be called for in future data collection, especially on lymph node examination and on nonsurgical patients with advanced disease, so that more detailed stratification among different nodal groups or sites of distant metastasis could be possible in future renditions of TNM stage classification.

CRediT Authorship Contribution Statement

Wentao Fang: Conceptualization, Methodology, Writing—Original draft preparation.

Nicolas Girard: Conceptualization, Methodology, Writing—Original draft preparation.

Vanessa Cilento: Data collection and harmonization; Formal statistical analysis.

Emily Goren: Data collection and harmonization; Formal statistical analysis.

Daniel Dibaba: Data collection and harmonization; Formal statistical analysis.

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Appendix 1

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Appendix 2. Chairpersons and Members of the Subcommittees of the Lung Cancer, Thymic Epithelial Tumors, Pleural Mesothelioma, and Esophageal Cancer Domains of the IASLC Staging and Prognostic Factors Committee

IASLC Staging and Prognostic Factors Committee Chair: Hisao Asamura.

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Lung Cancer Domain Vice Chair: Kemp Kernstine.

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Lung Cancer Domain Lepidic & GGO Subcommittee. William Travis (chair), Philippe Joubert (co-chair), Hisao Asamura, Frank Detterbeck, Giuseppe Cardillo, Wendy Cooper, Ritu R. Gill, Jin Mo Goo, Young Tae Kim, Ho Yun Lee, Heber MacMahon, Edith M. Marom, David Naidich, Andrew G. Nicholson, Mizuki Nishino, Helmut Prosch, Ramon Rami-Porta, Valerie Rusch, Shuji Sakai, Yasushi Yatabe, Shun-ichi Watanabe.

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Lung Cancer Domain Stage. Hisao Asamura (chair), Giuseppe Cardillo, Frank Detterbeck, John Edwards, Kwun Fong, Meredith Giuliani, James Huang, Kemp Kernstine, Edith M. Marom, Andrew G. Nicholson, Ramón Rami-Porta, William Travis, Ming Tsao, Paul Van Schil, Shun-ichi Watanabe.

Lung Cancer Domain Lymph Node Chart Subcommittee. Shun-ichi Watanabe (chair), Jin Mo Goo (co-chair), Hisao Asamura, Hans Hoffman, James Huang, Kemp Kernstine, Yolanda Lievens, Raymond U. Osarogiagbon, Paul Martin Putora, Ramón Rami-Porta, Valerie Rusch, Paul Van Schil, Jeff Yang.

Lung Cancer Domain Validation and Methodology Subcommittee. Frank Detterbeck (chair), Alyson Mahar (co-chair), Hisao Asamura, Meredith Giuliani, Mirella Marino, Raymond U. Osarogiagbon, Valerie Rusch.

Lung Cancer Domain Prognostic Factors Subcommittee. Frank Detterbeck (chair), Raymond U. Osarogiagbon (co-chair), Alex Brunelli, Kwun Fong, James Huang, Young Tae Kim, Mark Krasnik, Hiu Liu, Jan van Meerbeeck, Luis M. Montuenga, Andrew G. Nicholson, Valerie Rusch, Robert Samstein, Navneet Singh, Martin Tammemägi, Ricardo Terra, Ming Tsao, Akif Turna, Terence Williams.

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Lung Cancer Domain Multiple Pulmonary Nodules Subcommittee. Frank Detterbeck (chair), Alyson Mahar (co-chair), Sarit Appel, Jason Chang, Keneng Chen, Nicolas Girard, Jin Mo Goo, Young Tae Kim, Heber MacMahon, Andrew G. Nicholson, Paul Martin Putora, Natasha Rekhtman, M Patricia Rivera, Lynn Tanoue, Ricardo M. Terra, William Travis, Paula Ugalde.

Lung Cancer Domain Molecular Subcommittee. David Carbone (co-chair), Fred Hirsch (co-chair), Luiz Henrique Araujo, Hisao Asamura, Elisabeth Brambilla, Jason Chang, Frank Detterbeck, Oliver Gautschi, Nagla Karim, Keith Kerr, Peter Kneuertz, Eric Lim, Philip Mack, José-María Matilla, Luis M. Montuenga, Andrew G. Nicholson, Raymond U. Osarogiagbon, Harvey Pass, Carolyn J Presley, Ramón Rami-Porta, Natasha Rekhtman, Harry Ren, Robert Samstein, Kenichi Suda, Ricardo M. Terra, William Travis, Ming Tsao, Terence Williams, Ignacio Wistuba, Dawei Yang, Yasushi Yatabe.

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Cancer Research And Biostatistics. Vanessa Cilento, Daniel Dibaba, Megan Eisele, Dorothy Giroux, Emily Goren, Antje Hoering, Katie Nishimura, Adam Rosenthal.

Thymic Epithelial Tumors Domain

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Pleural Mesothelioma Domain

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Esophageal Cancer Domain

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APPENDIX 3. Participating Institutions in the Third Phase of the IASLC Thymic Tumors Staging Project

Participating institutions ordered by number of eligible cases submitted

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Supplementary Data

Note: To access the supplementary material accompanying this article, visit the online version of the *Journal of Thoracic Oncology* at www.jto.org and at https://doi.org/10.1016/j.jtho.2023.09.1447.

References

1. Marom EM, Detterbeck FC. Overview. *J Thorac Oncol*. 2014;9(suppl 2):S63–S64.
2. Ruffini E, Rami-Porta R, Huang J, et al. The International Association for the Study of Lung Cancer Thymic Epithelial Tumors Staging Project: unresolved issues to be addressed for the next Ninth Edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2022;17:838–851.
3. Rimner A, Ruffini E, Cilento V, et al. International Association for the Study of Lung Cancer Thymic Epithelial Tumors Staging Project: an overview of the central database informing revision of the forthcoming (Ninth) edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2023;18:1386–1398.
4. Okumura M, Marino M, Cilento V, et al. The International Association for the Study of Lung Cancer Thymic Epithelial Tumors Staging Project: proposal for the T component for the forthcoming (Ninth) edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2023;18:1638–1654. https://doi.org/10.1016/j.jtho.2023.08.024.
5. Ruffini E, Huang J, Cilento V, et al. The IASLC thymic Epithelial Tumors Staging Project: proposal for a Stage Classification for the forthcoming (9th) edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2023;18:1655–1671. https://doi.org/10.1016/j.jtho.2023.09.002.
6. Kondo K, Van Schil P, Detterbeck FC, et al. The IASLC/ITMIG thymic Epithelial Tumors Staging Project: proposals for the N and M components for the forthcoming (8th) edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2014;9(suppl 2):S81–S87.
7. Kondo K, Monden Y. Lymphogenous and hematogenous metastasis of thymic epithelial tumors. *Ann Thorac Surg*. 2003;76:1859–1865.
8. Gu Z, Wei Y, Fu J, et al. Lymph node metastases in thymic malignancies: a Chinese Alliance for Research in thymomas retrospective database analysis. *Interact Cardiovasc Thorac Surg*. 2017;25:455–461.
9. Bhora FY, Chen DJ, Detterbeck FC, et al. The ITMIG/IASLC thymic epithelial tumors staging project: a proposed lymph node map for thymic epithelial tumors in the forthcoming. 8th edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2014;9(suppl 2):S88–S96.
10. Ruffini E, Fang W, Guerrera F, et al. The International Association for the Study of Lung Cancer thymic tumors staging project: the impact of the Eighth edition of the Union for International Cancer Control and American Joint Committee on Cancer TNM stage classification of thymic tumors. *J Thorac Oncol*. 2020;15:436–447.
11. Masaoka A, Monden Y, Nakahara K, Tanioka T. Follow-up study of thymomas with special reference to their clinical stages. *Cancer*. 1981;48:2485–2492.
12. Koga K, Matsuno Y, Noguchi M, et al. A review of 79 thymomas: modification of staging system and reappraisal of conventional division into invasive and non-invasive thymoma. *Pathol Int*. 1994;44:359–367.
13. Detterbeck FC, Nicholson AG, Kondo K, Van Schil P, Moran C. The Masaoka-Koga stage classification for thymic malignancies: clarification and definition of terms. *J Thorac Oncol*. 2011;6(suppl 3):S1710–S1716.
14. Girard N, Ruffini E, Marx A, Faivre-Finn C, Peters S, ESMO Guidelines Committee. Thymic epithelial tumours: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2015;26(suppl 5):v40–v55.
15. Fang W, Fu J, Shen Y, et al. Thymomas. Management of thymic tumors-consensus based on the Chinese Alliance for Research in thymomas Multi-institutional retrospective studies. *J Thorac Dis*. 2016;8:641–645.
16. Weksler B, Holden A, Sullivan JL. Impact of positive nodal metastases in patients with thymic carcinoma and thymic neuroendocrine tumors. *J Thorac Oncol*. 2015;10:1642–1647.
17. Weksler B, Pennathur A, Sullivan JL, Nason KS. Resection of thymoma should include nodal sampling. *J Thorac Cardiovasc Surg*. 2015;149:737–742.
18. Marom EM, Fang W, Ruffini E, et al. The IASLC Thymic Epithelial Tumors Staging Project: a re-assessment of the ITMIG/IASLC Lymph Node Map for Thymic Epithelial Tumors for the forthcoming 9th edition of the TNM classification of malignant tumors. *J Thorac Oncol*. 2023;18:1672–1688. https://doi.org/10.1016/j.jtho.2023.09.001.
19. Fang W, Wang Y, Pang L, et al. Lymph node metastasis in thymic malignancies: a Chinese multicenter prospective observational study. *J Thorac Cardiovasc Surg*. 2018;156:824–833.e1.
20. Detterbeck FC, Moran C, Huang J, et al. Which way is up? Policies and procedures for surgeons and pathologists

regarding resection specimens of thymic malignancy. *J Thorac Oncol*. 2011;6(suppl 3):S1730–S1738.
21. Fang W, Filosso PL, Roden AC, et al. Clinicopathological features and current treatment outcomes of neuroendocrine thymic tumours. *Eur J Cardio Thorac Surg*. 2021;59:1004–1013.
22. Blumberg D, Port JL, Weksler B, et al. Thymoma: a multivariate analysis of factors predicting survival. *Ann Thorac Surg*. 1995;60:908–914.
23. Bae MK, Byun CS, Lee CY, et al. Clinical outcomes and prognosis of recurrent thymoma management. *J Thorac Oncol*. 2012;7:1304–1314.
24. Margaritora S, Cesario A, Cusumano G, et al. Single-centre 40-year results of redo operation for recurrent thymomas. *Eur J Cardiothorac Surg*. 2011;40:894–900.
25. Mizuno T, Okumura M, Asamura H, et al. Surgical management of recurrent thymic epithelial tumors: a retrospective analysis based on the Japanese nationwide database. *J Thorac Oncol*. 2015;10:199–205.
26. Maury JM, Girard N, Tabutin M, et al. Intra-Thoracic chemo-hyperthermia for pleural recurrence of thymoma. *Lung Cancer*. 2017;108:1–6.