9th Edition TNM Staging for Thymic Malignancies

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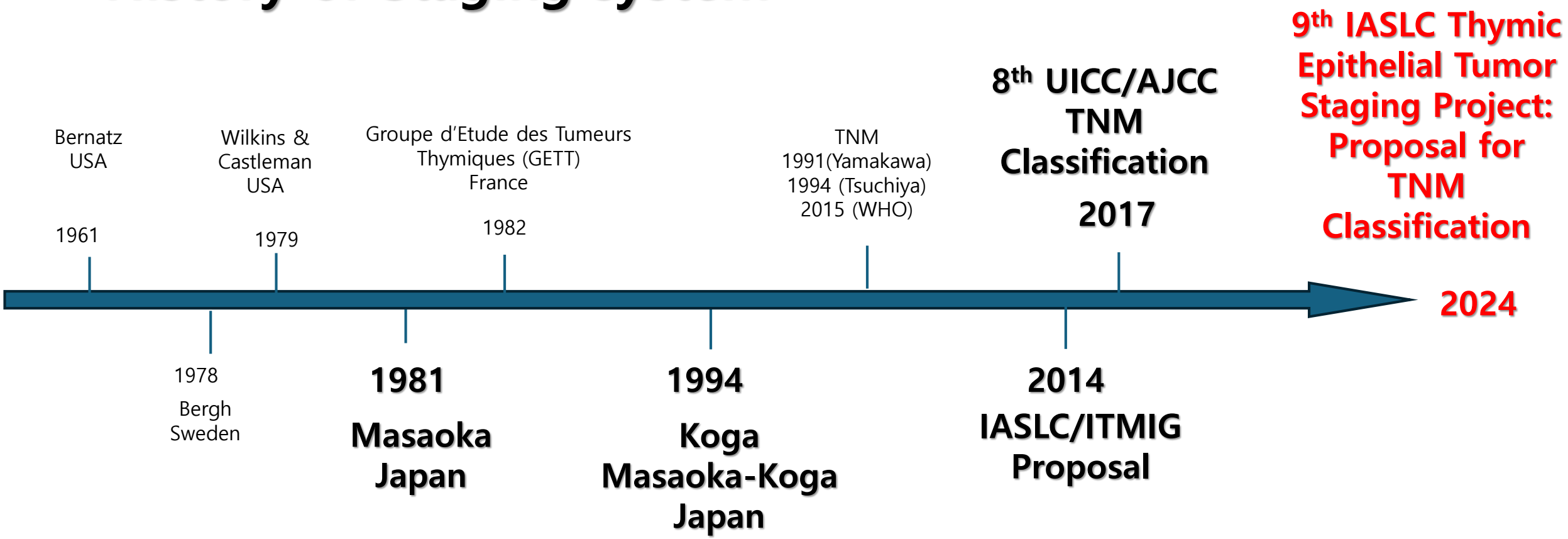
History of Staging system



https://youtu.be/2xeKg53pXwM?si=gqPjG47VzVIdgH7a

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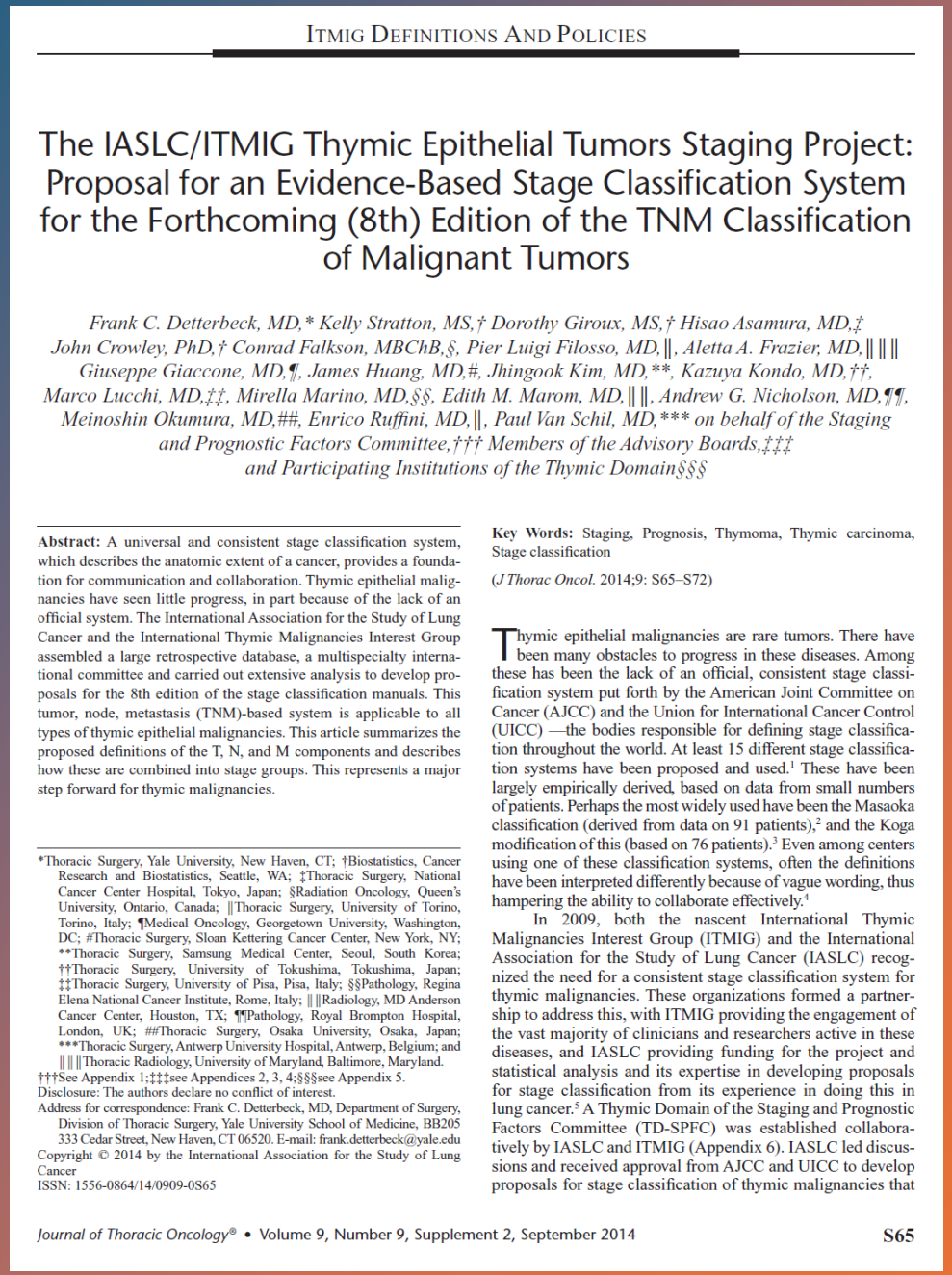

The IASLC/ITMIG Thymic Epithelial Tumors Staging Project: Proposal for an Evidence-Based Stage Classification System for the Forthcoming (8th) Edition of the TNM Classification of Malignant Tumors

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Abstract: A universal and consistent stage classification system, which describes the anatomic extent of a cancer, provides a foundation for communication and collaboration. Thymic epithelial malignancies have seen little progress, in part because of the lack of an official system. The International Association for the Study of Lung Cancer and the International Thymic Malignancies Interest Group assembled a large retrospective database, a multispecialty international committee and carried out extensive analysis to develop proposals for the 8th edition of the stage classification manuals. This tumor, node, metastasis (TNM)-based system is applicable to all types of thymic epithelial malignancies. This article summarizes the proposed definitions of the T, N, and M components and describes how these are combined into stage groups. This represents a major step forward for thymic malignancies.

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†††See Appendix 1;‡‡‡see Appendices 2, 3, 4;§§§see Appendix 5.

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Thymic epithelial malignancies are rare tumors. There have been many obstacles to progress in these diseases. Among these has been the lack of an official, consistent stage classification system put forth by the American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC) —the bodies responsible for defining stage classification throughout the world. At least 15 different stage classification systems have been proposed and used.[1] These have been largely empirically derived, based on data from small numbers of patients. Perhaps the most widely used have been the Masaoka classification (derived from data on 91 patients),[2] and the Koga modification of this (based on 76 patients).[3] Even among centers using one of these classification systems, often the definitions have been interpreted differently because of vague wording, thus hampering the ability to collaborate effectively.[4]

In 2009, both the nascent International Thymic Malignancies Interest Group (ITMIG) and the International Association for the Study of Lung Cancer (IASLC) recognized the need for a consistent stage classification system for thymic malignancies. These organizations formed a partnership to address this, with ITMIG providing the engagement of the vast majority of clinicians and researchers active in these diseases, and IASLC providing funding for the project and statistical analysis and its expertise in developing proposals for stage classification from its experience in doing this in lung cancer.[5] A Thymic Domain of the Staging and Prognostic Factors Committee (TD-SPFC) was established collaboratively by IASLC and ITMIG (Appendix 6). IASLC led discussions and received approval from AJCC and UICC to develop proposals for stage classification of thymic malignancies that

8th UICC/AJCC TNM Classification

- In 2009, IASLC and ITMIG collaborated to develop a TNM-based staging system using a large worldwide retrospective database of over 8000 patients.
- Creation of the Thymic Domain of the Staging and Prognostic Factors Committee (TD-SPFC) within the IASLC.
- The proposed TNM classification system for thymic tumors was incorporated into the 8th edition of the TNM classification for thoracic malignancies, approved by UICC and AJCC, becoming effective in 2017 and 2018, respectively.
- Following the release of the eighth TNM edition, the TD-SPFC began working on proposals for the 9th edition, expected in 2024.

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Web-based Cross-sectional Survey Questionnaire

항목	비율(%)
응답 수	217
국가 수	37
대륙 수	4
유용하다고 생각한 비율	78
일상적으로 사용한 비율	64
림프절 지도 인지 비율	72
림프절 지도 사용 비율	48
림프절 지도가 효과적이라고 생각한 비율	54
흉선종 환자의 N1 림프절 절제율	50
흉선 암종 환자의 N1 림프절 절제율	66
흉선종 환자의 N2 림프절 절제율	21
흉선 암종 환자의 N2 림프절 절제율	41
림프절 절제술이 가장 많이 수행된 종양 단계	T3 (33%)
림프절 절제술이 덜 자주 수행된 종양 단계	T2 (9%), T1 (8%)

8th Edition TNM staging system for TET

TABLE 1. T

Category
T1
a
b
T2
T3
T4

[a]Involvement
[b]A tumor is cl
with or without any invasion of structures of lower T levels.

TABLE 3. Stage Grouping

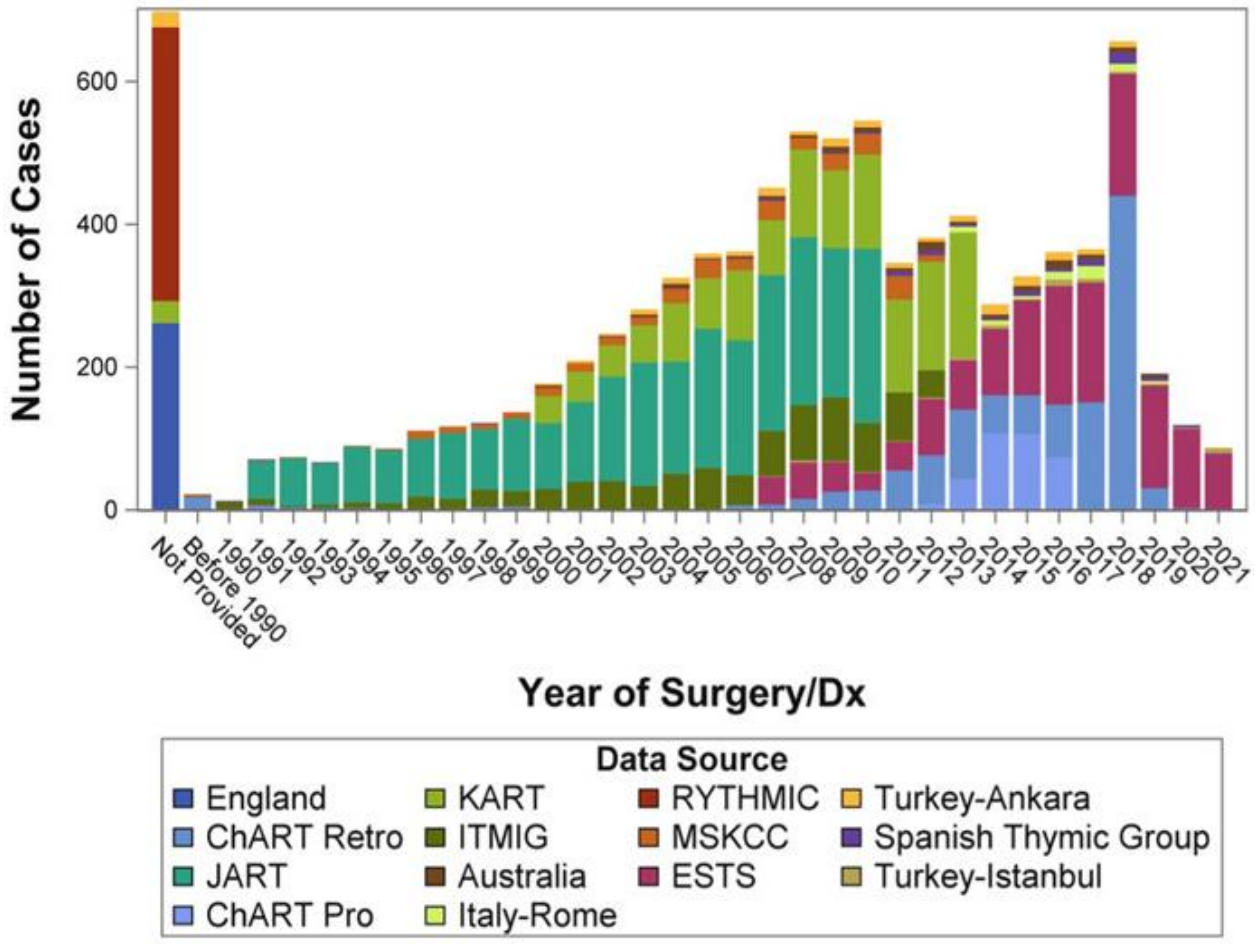
Stage	T	N	M
I	**T1**	N0	M0
II	**T2**	N0	M0
IIIa	**T3**	N0	M0
IIIb	**T4**	N0	M0
IVa	T any	**N1**	M0
	T any	N0,1	**M1a**
IVb	T any	**N2**	M0,1a
	T any	N any	**M1b**

ement of)[a]
distant sites
e(s)
or distant organ metastasis
[a]Involvement must be pathologically proven in pathologic staging.

IASLC/ITMIC Staging Project – Thymic Domain

	8th Edition (2017)	9th Edition (2024)
Periods of Disgnosis	1990-2012	1990-2021
Total atients submitted	10,808	11,347
Regional distribution		
Europe	2653(33%)	3113(34%)
Asia/Australia	4043(50%)	5628(62%)
North America	1383(17%)	406(4%)
South/Central America	66	0
Final enrolled patients	8145	9147
-Thymoma	7016(86%)	7662(84%)
-Thymic carcinoma	962(12%)	1345(15%)
-Neuroendocrine thymic tumor	164(2%)	140(105%)
Treatment modalities -Surgery included -Non-surgical	8018 (98%) 127(2%)	8830(96%) 251(4%)
Resection status		
R0	6621(81%)	7647(84%)
R+	1105(19%)	1121(16%)

Data Sources For the 9th TNM staging



Supplemental table 1. Contributing centers.

Data Source	Total Number of Patients Submitted	Thymoma, Thymic Carcinoma or NETT	Survival Data Available
Total	11,347	10,567	9,147
ChART Prospective database	625	590	343
ChART Retrospective database	1,532	1,483	1,172
ESTS	2,305	1,739	1,411
England	285	283	262
Turkey-Istanbul	77	49	47
ITMIG	1,233	1,218	813
JART	2,711	2,670	2,659
KART	1,363	1,360	1,357
MSKCC	322	320	288
Italy-Rome	64	63	63
RYTHMIC	395	385	383
Spanish Thymic Group	124	119	86
Australia	114	111	97
Turkey-Ankara	197	177	166

NETT: Neuroendocrine Thymic Tumors; ChART: Chinese Alliance for Research in Thymoma; ESTS: European Society of Thoracic Surgeons; ITMIG: International Thymic Malignacies Interest Group; JART: Japanese Association for Research in the Thymus; KART: Korean Association for Research in the Thymus; MSKCC: Memorial Sloan Kettering Cancer Center; Réseau Tumeurs THYMiques et Cancer (RYTHMIC).

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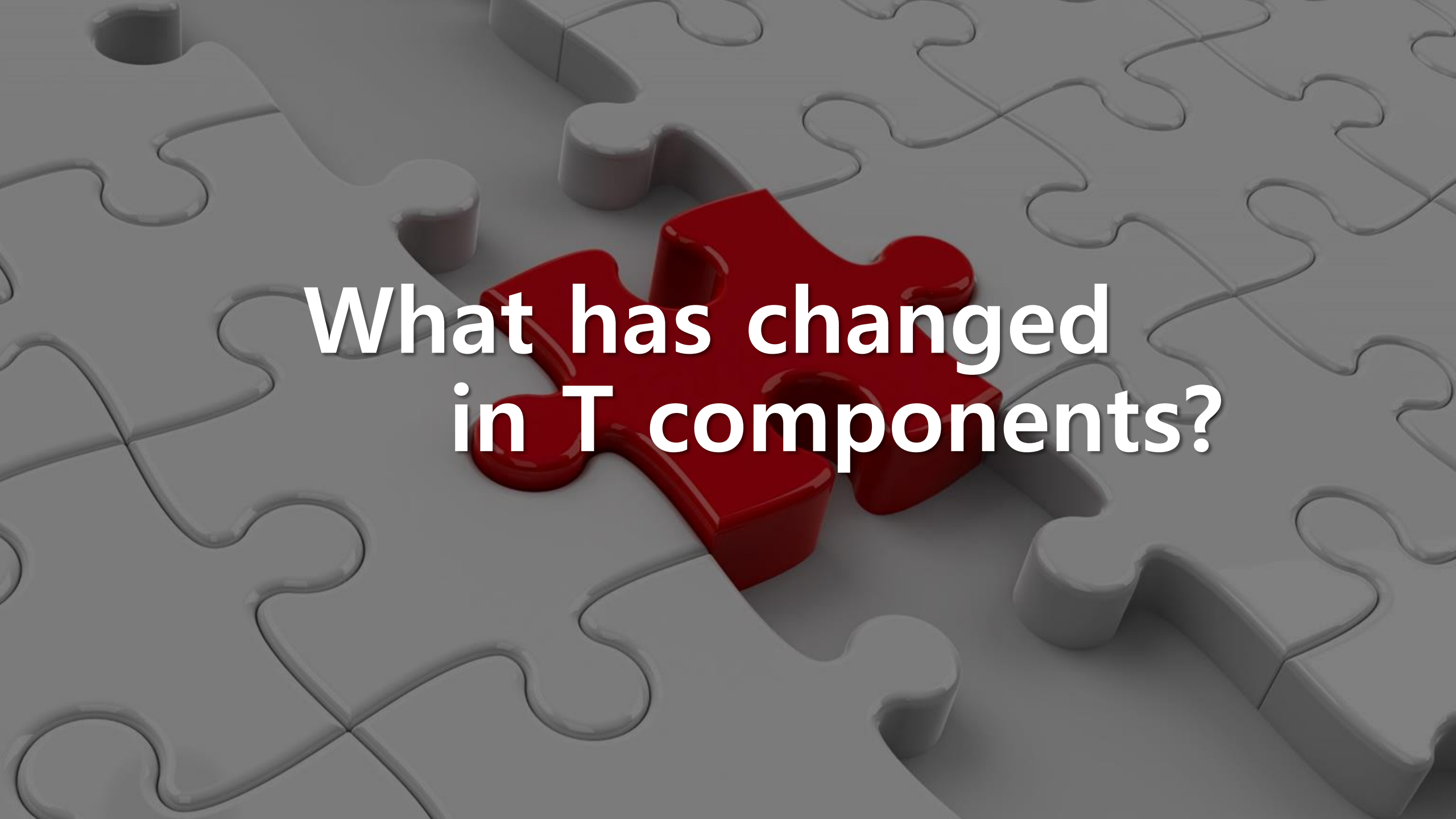
What has changed
in T components?

T staging of 8th and 9th Edition

TABLE 1. T Descriptors

Category	Definition (Involvement of)[a,b]
T1	
a	Encapsulated or unencapsulated, with or without extension into mediastinal fat
b	Extension into mediastinal pleura
T2	Pericardium
T3	Lung, brachiocephalic vein, superior vena cava, chest wall, phrenic nerve, hilar (extrapericardial) pulmonary vessels
T4	Aorta, arch vessels, main pulmonary artery, myocardium, trachea, or esophagus

[a]Involvement must be pathologically proven in pathologic staging.
[b]A tumor is classified according to the highest T level of involvement that is present with or without any invasion of structures of lower T levels.

Table 1. Proposed T Component of Thymic Tumors for the Ninth Edition of the TNM Classification of Malignant Tumors

T	Description
T1	Tumor limited to the thymus with or without encapsulation, or directly invades into the mediastinum alone or directly invades the mediastinal pleura but does not involve any other mediastinal structure.
T1a	5 cm or less in its greatest dimension[a]
T1b	larger than 5 cm in its greatest dimension[a]
T2	Tumor directly invades the pericardium (either partial or full-thickness), the lung, or the phrenic nerve
T3	Tumor directly invades any of the following: (1) brachiocephalic vein, (2) superior vena cava, (3) chest wall, or (4) extrapericardial pulmonary arteries or veins
T4	Tumor directly invades any of the following: (1) aorta (ascending, arch, or descending); (2) arch vessels; (3) intrapericardial pulmonary artery or veins; (4) myocardium; (5) trachea; or (6) esophagus.

[a]Irrespective of mediastinal pleura invasion. Mediastinal pleura invasion is to be recorded as an "additional histologic descriptor."

OS by Pathologic T category (proposed ninth TNM) in N0M0R-any

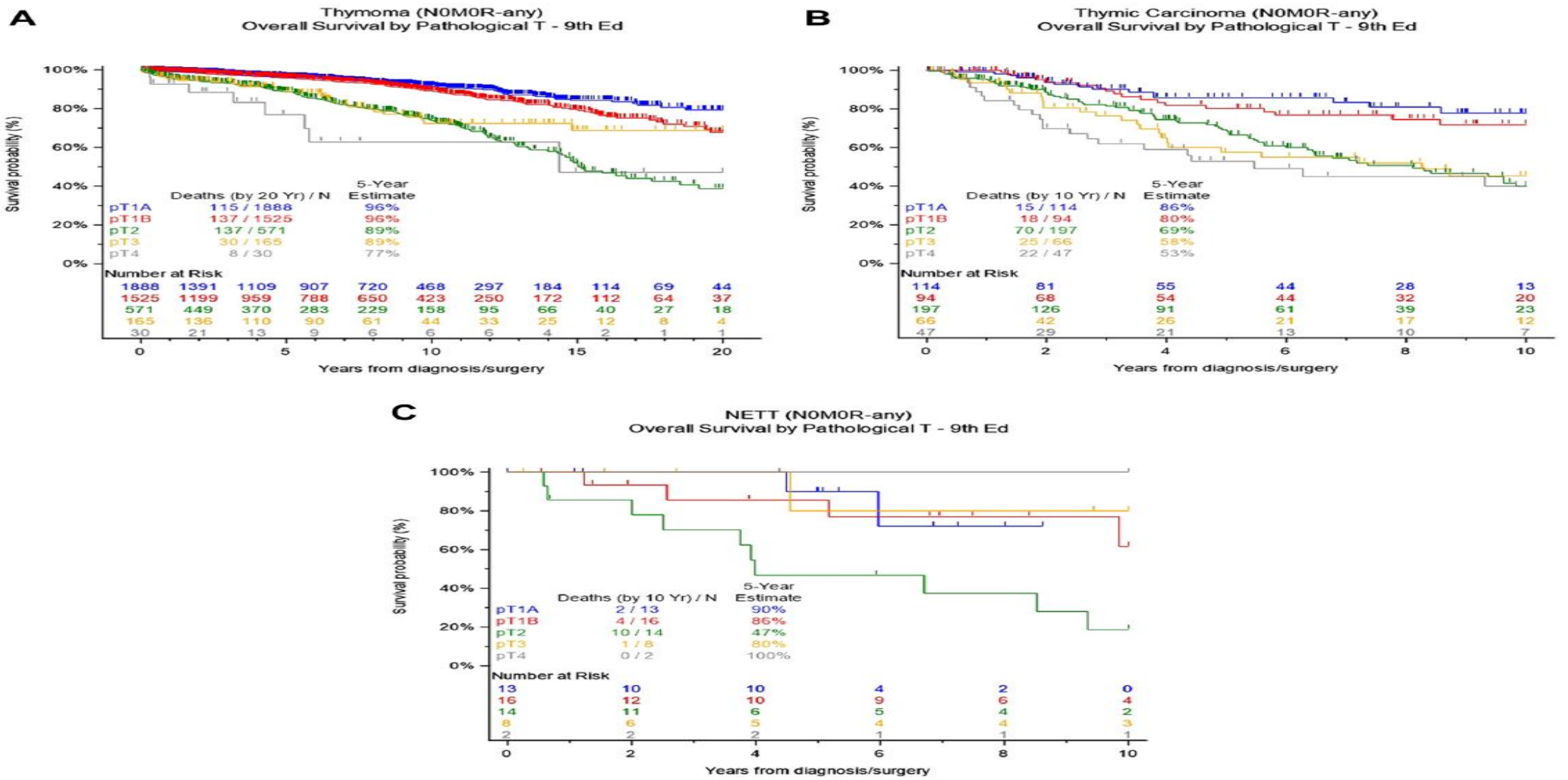

Figure 1. OS by pathologic T category (proposed ninth TNM) in N0M0R-any for **(A)Thymoma, (B) Thymic Carcinoma, and (C) NETT.** NETT, neuroendocrine thymic tumor; OS, overall survival; R-any, regardless of R status.

FFR by pathologic T category (proposed ninth TNM) in N0M0R0 cases

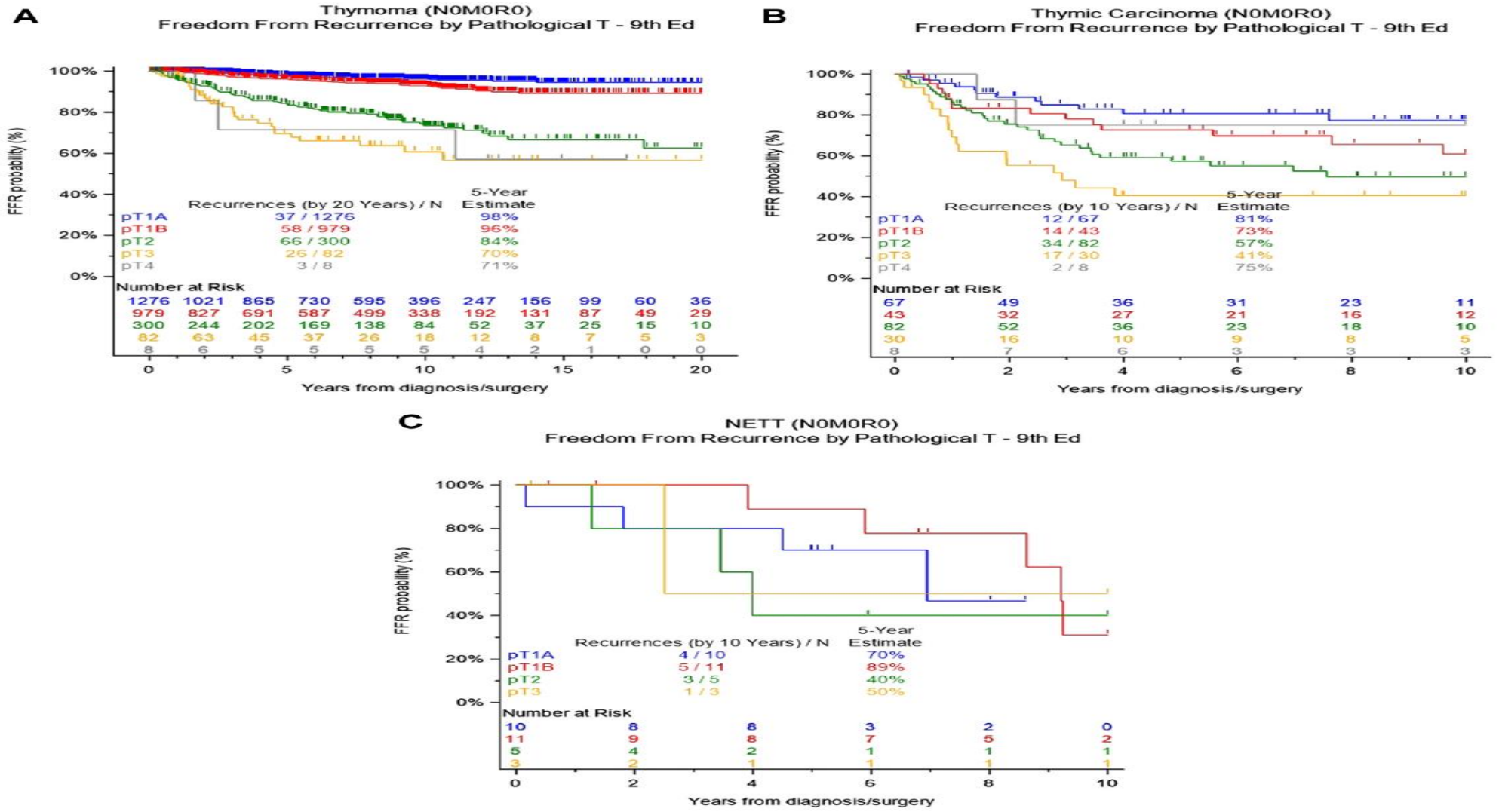

Figure 2. FFR by pathologic T category (proposed ninth TNM) in N0M0R0 cases for **(A)Thymoma, (B) Thymic Carcinoma, and (C) NETT.** FFR, Freedom-from-recurrence; NETT, neuroendocrine thymic tumor; R0, complete resection.

CIR by pathologic T category (proposed ninth TNM) in N0M0R0 cases

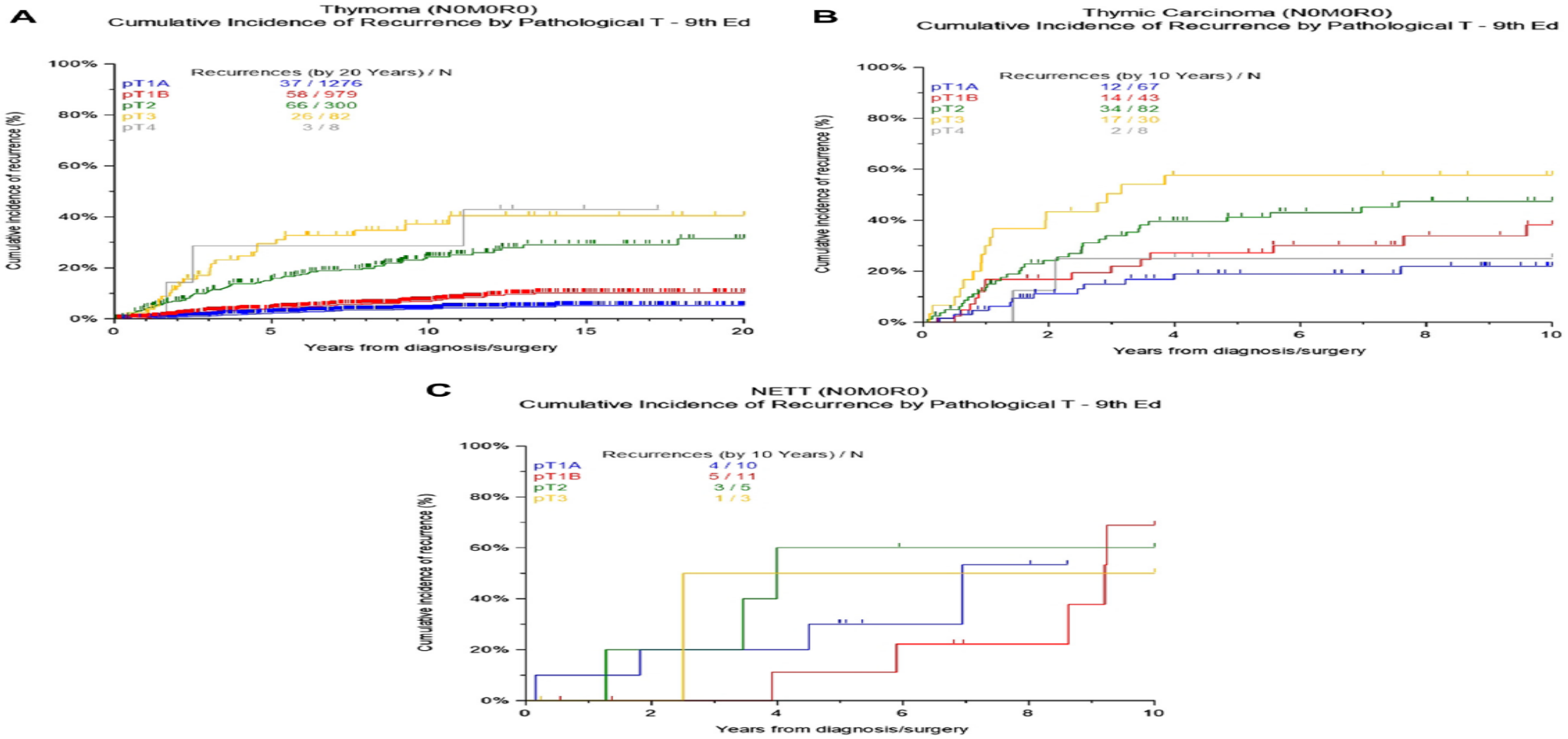

Figure 3. CIR by pathologic T category (proposed ninth TNM) in N0M0R0 cases for **(A)Thymoma, (B) Thymic Carcinoma, and (C) NETT.** CIR, cumulative incidence of recurrence; NETT, neuroendocrine thymic tumor; R0, complete resection.

Thymic Carcinoma – Overall Survival

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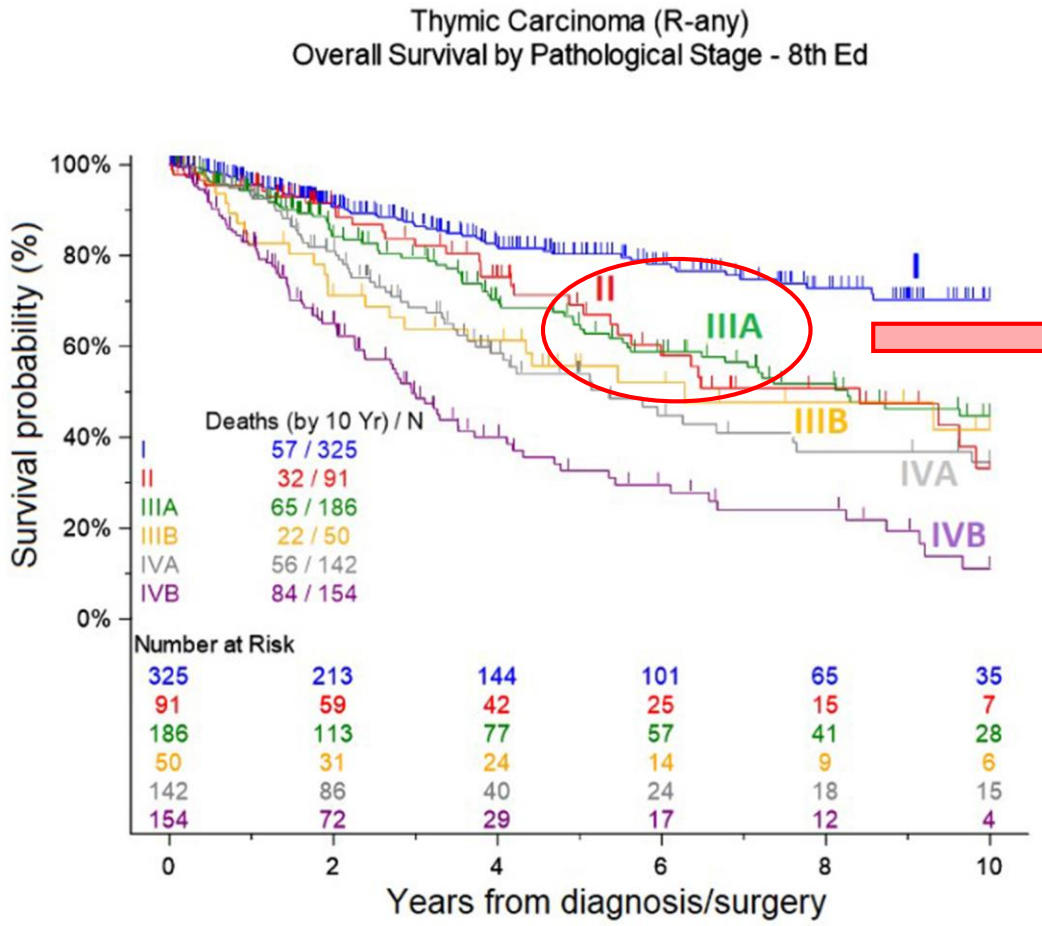

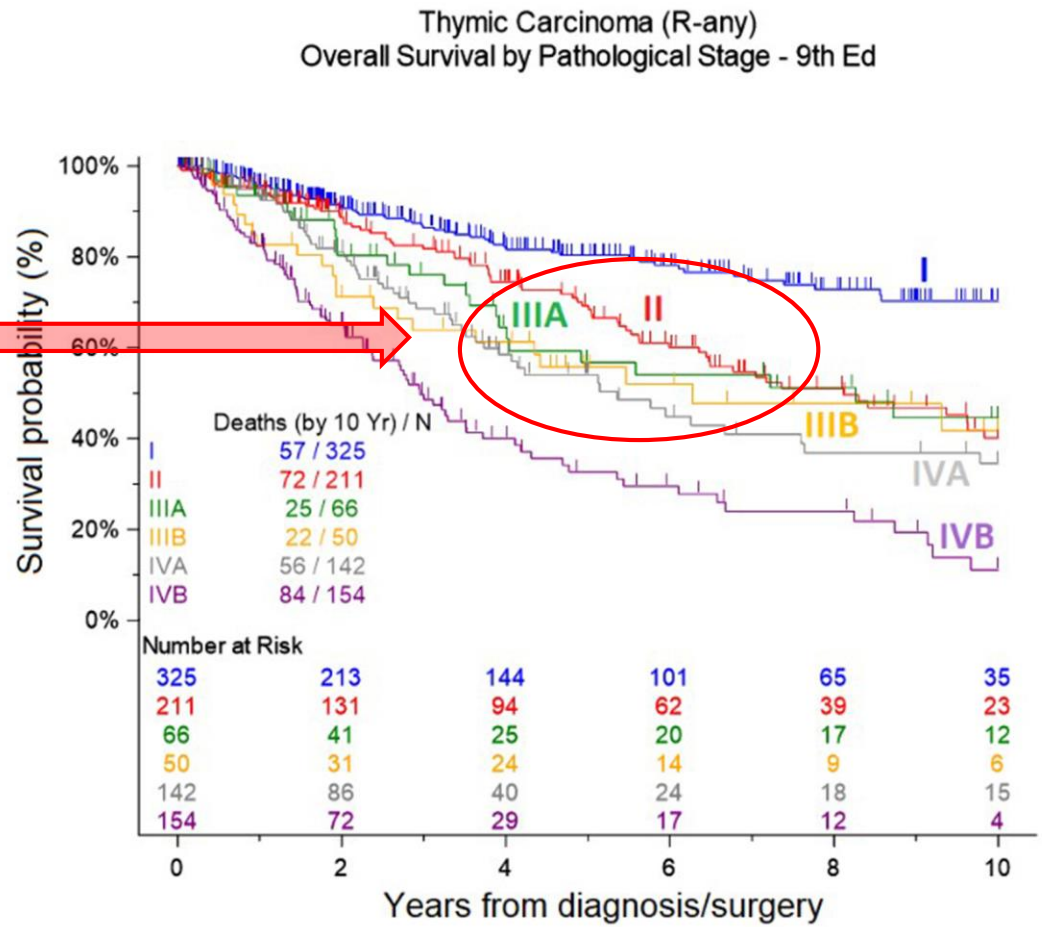

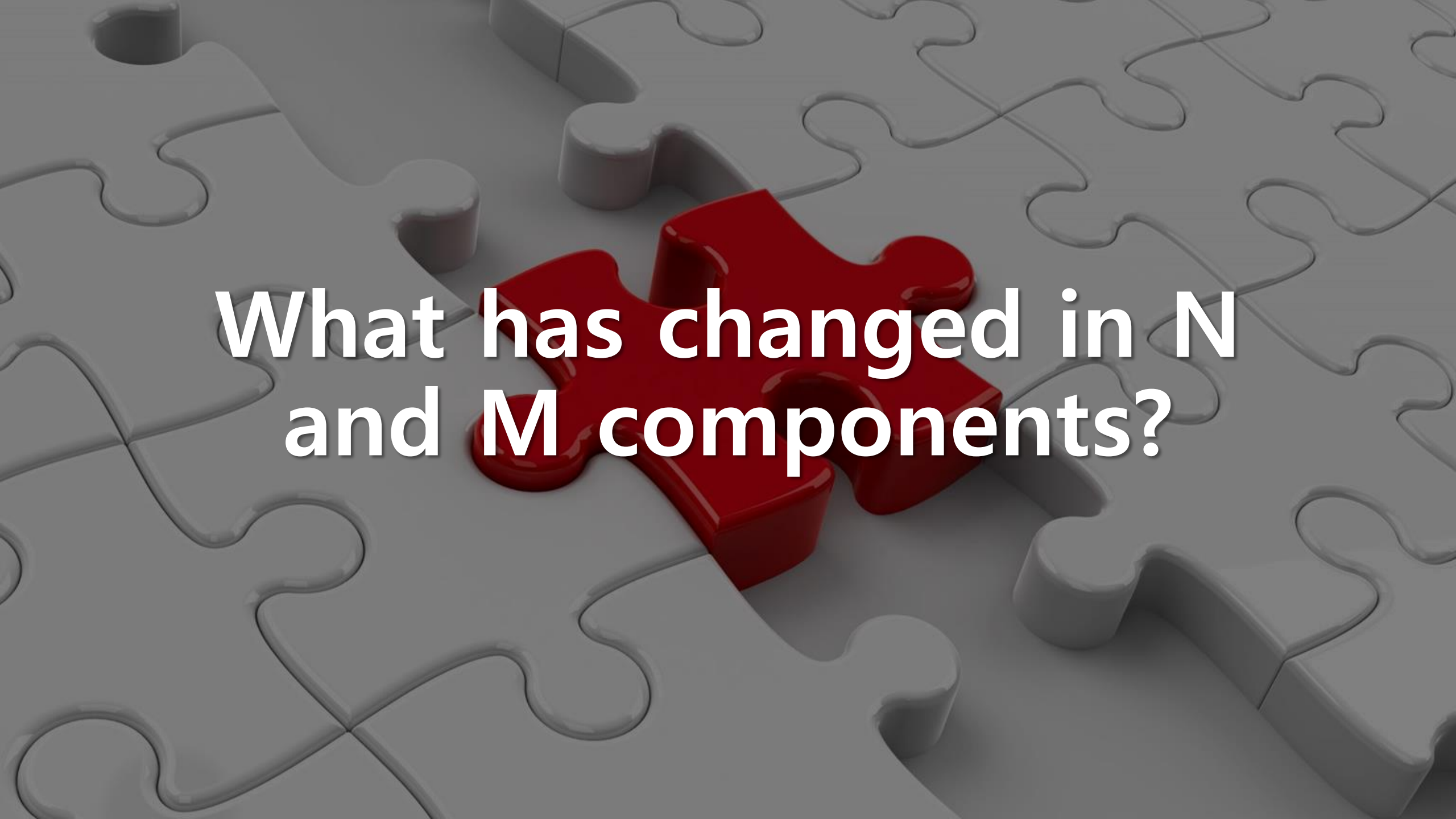
What has changed in N and M components?

N and M Staging of 8th and 9th Edition

Category	Definition (Involvement of)[a]
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

[a]Involvement must be pathologically proven in pathologic staging.

No changed

N and M Categories	Description
N0	No nodal involvement
N1	Anterior (perithymic) nodes
N2	Deep intrathoracic or cervical nodes (e.g., paratracheal, subcarinal, aortopulmonary window, hilar, jugular, and supraclavicular nodes)
M0	No metastatic pleural, pericardial, or distant sites
M1a	Separate pleural or pericardial nodule(s)
M1b	Pulmonary intraparenchymal nodule or distant organ metastasis

Distribution of clinical and pathologic stage

Supplemental table 2a. Distribution of clinical and pathologic stage. Missing cases included.

	Thymoma	*Thymic Carcinoma*	*NETT*	*Overall*
Clinical Stage				
Missing or Not Determined	5727 (74.7%)	990 (73.6%)	114 (81.4%)	6831 (74.7%)
I	1501 (19.6%)	162 (12.0%)	15 (10.7%)	1678 (18.3%)
II	99 (1.3%)	20 (1.5%)	1 (0.7%)	120 (1.3%)
IIIA	154 (2.0%)	57 (4.2%)	6 (4.3%)	217 (2.4%)
IIIB	31 (0.4%)	14 (1.0%)	1 (0.7%)	46 (0.5%)
IVA	94 (1.2%)	39 (2.9%)	2 (1.4%)	135 (1.5%)
IVB	56 (0.7%)	63 (4.7%)	1 (0.7%)	120 (1.3%)
Pathologic Stage				
Missing or Not Determined	2053 (26.8%)	305 (22.7%)	51 (36.4%)	2409 (26.3%)
I	4266 (55.7%)	325 (24.2%)	38 (27.1%)	4629 (50.6%)
II	281 (3.7%)	91 (6.8%)	8 (5.7%)	380 (4.2%)
IIIA	639 (8.3%)	278 (20.7%)	18 (12.9%)	935 (10.2%)
IIIB	34 (0.4%)	50 (3.7%)	2 (1.4%)	86 (0.9%)
IVA	306 (4.0%)	142 (10.6%)	16 (11.4%)	464 (5.1%)
IVB	83 (1.1%)	154 (11.4%)	7 (5.0%)	244 (2.7%)

For the analysis all cases with valid histologic type and survival data were included.
NETT: Neuroendocrine Thymic Tumors

Supplemental table 2b. Distribution of clinical and pathologic stage. Missing cases excluded

Summary of data for the stage analysis

	Thymoma	*Thymic Carcinoma*	*NETT*	*Overall*
Data Available, n/N (%)				
Clinical Stage	1935/7662 (25.3%)	355/1345 (26.4%)	26/140 (18.6%)	2316/9147 (25.3%)
Pathological Stage	5609/7662 (73.2%)	1040/1345 (77.3%)	89/140 (63.6%)	6738/9147 (73.7%)
Clinical Stage, n (%)				
I	1501 (77.6%)	162 (45.6%)	15 (57.7%)	1678 (72.5%)
II	99 (5.1%)	20 (5.6%)	1 (3.8%)	120 (5.2%)
IIIA	154 (8%)	57 (16.1%)	6 (23.1%)	217 (9.4%)
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IVB	83 (1.5%)	154 (14.8%)	7 (7.9%)	244 (3.6%)

n/N=number of cases with data available out of included cases in the 9th edition database.

NETT: Neuroendocrine Thymic Tumors

Bubble depiction of the clinical and pathologic concordance of N

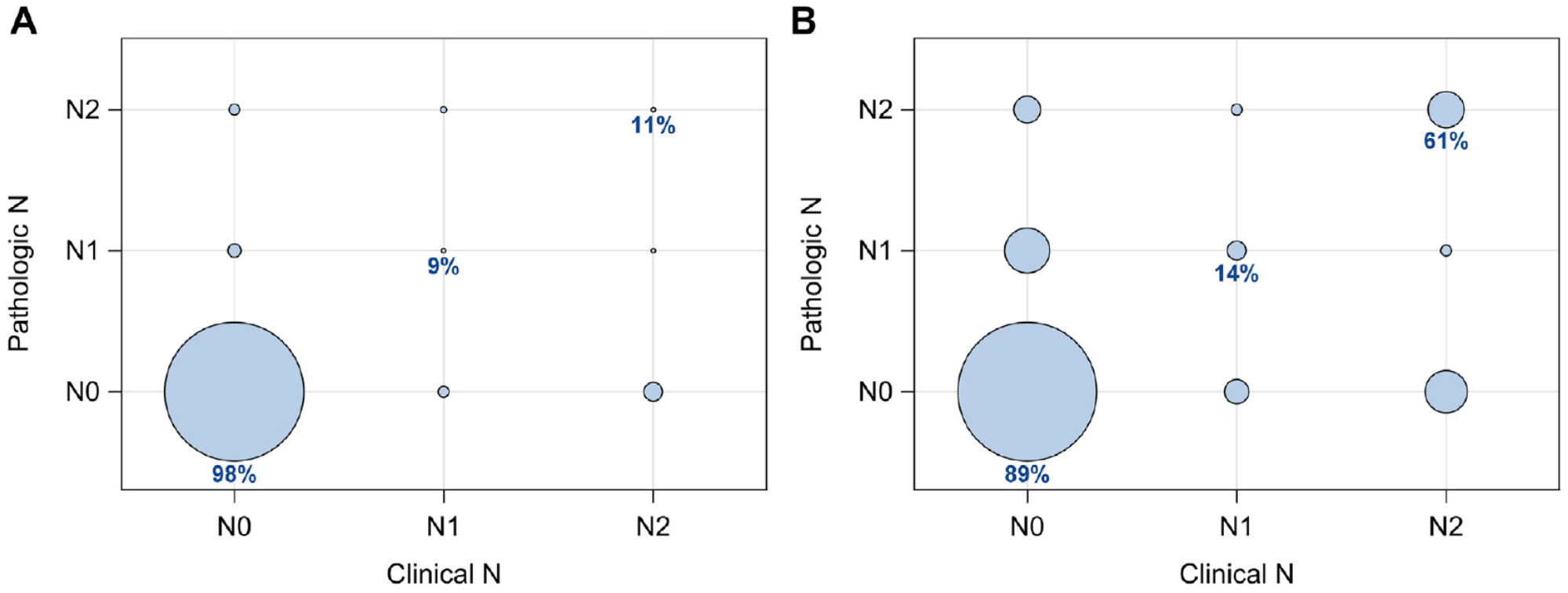


Figure 1. Bubble depiction of the clinical and pathologic concordance of N. The size of the bubble corresponds with the percent of pathologic N patients correctly identified clinically (by imaging). (*A*) Thymoma. (*B*) Thymic carcinoma.

Overall survival by clinical N

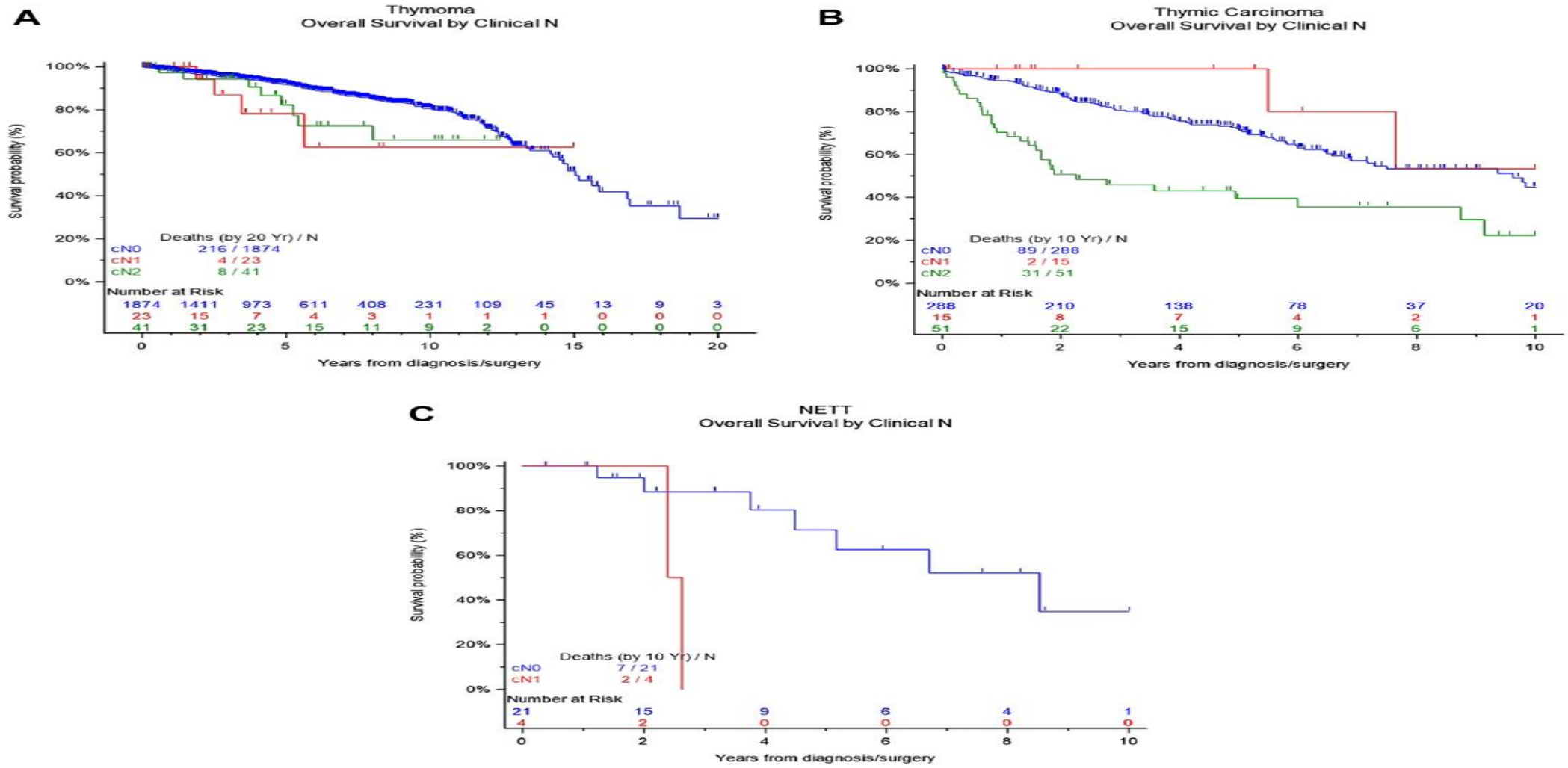


Figure 2. Overall survival by clinical N in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

Overall survival by pathologic N

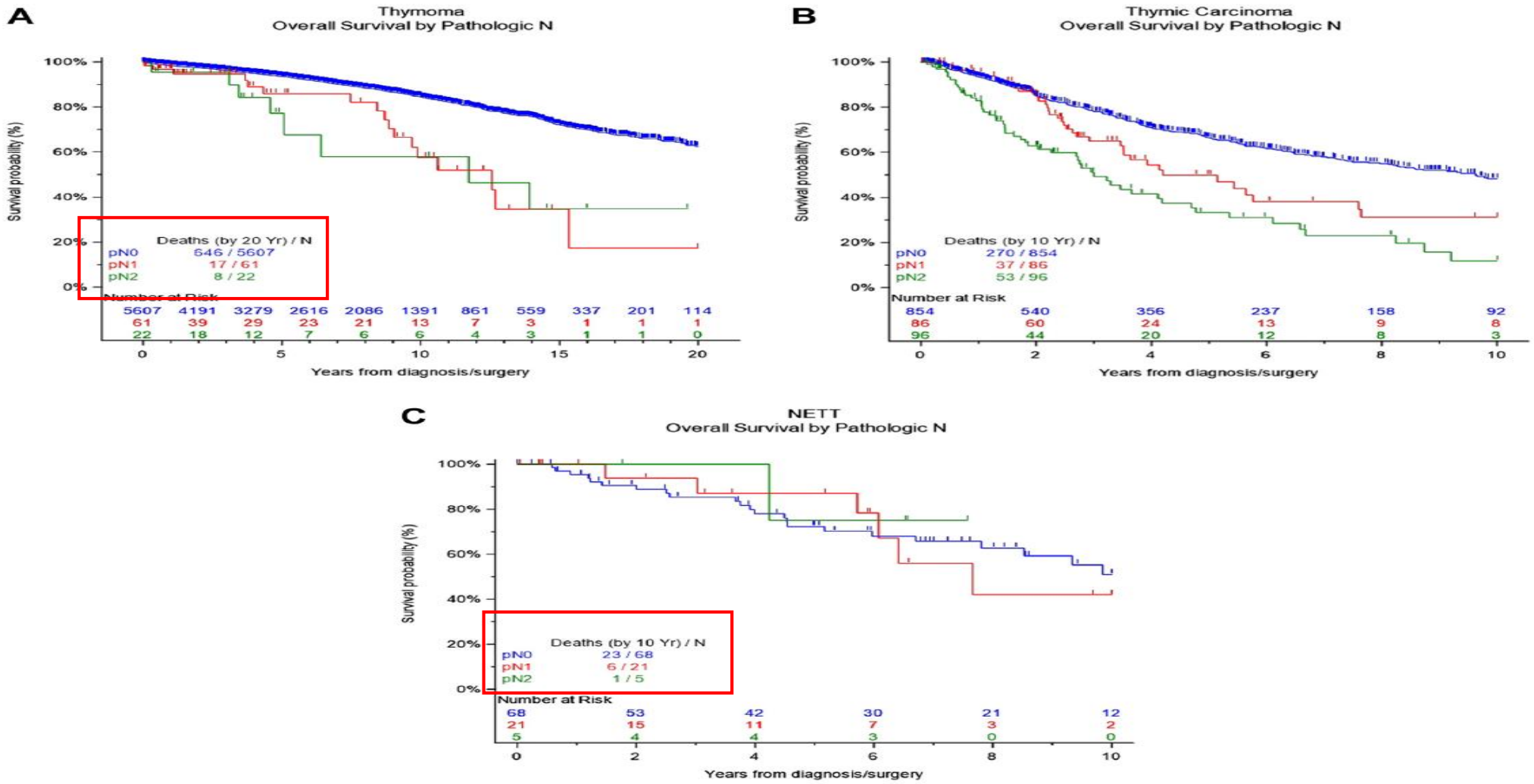


Figure 3. Overall survival by pathologic N in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

Overall survival by clinical M

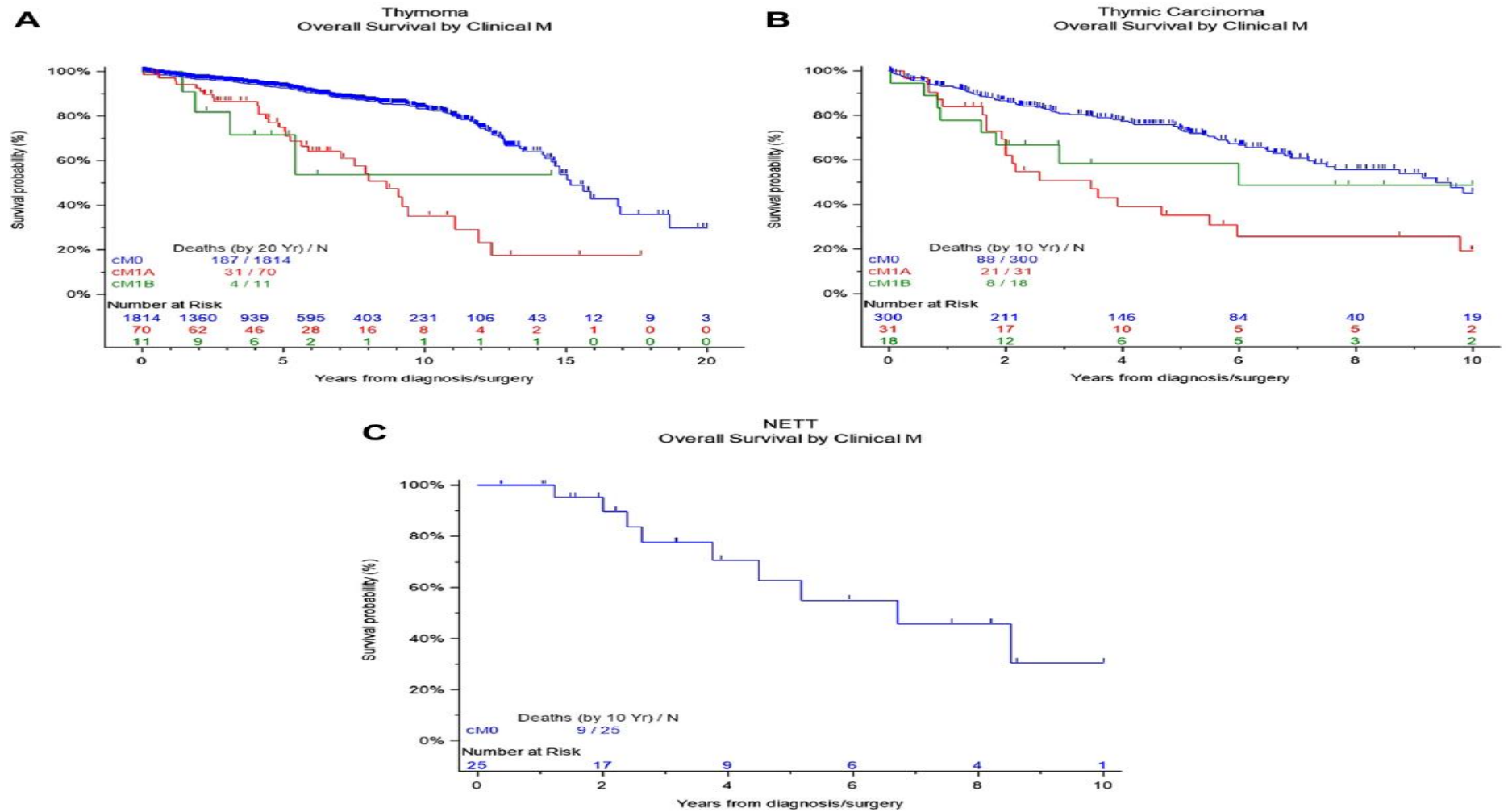


Figure 5. Overall survival by clinical M in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

Overall survival by pathologic M

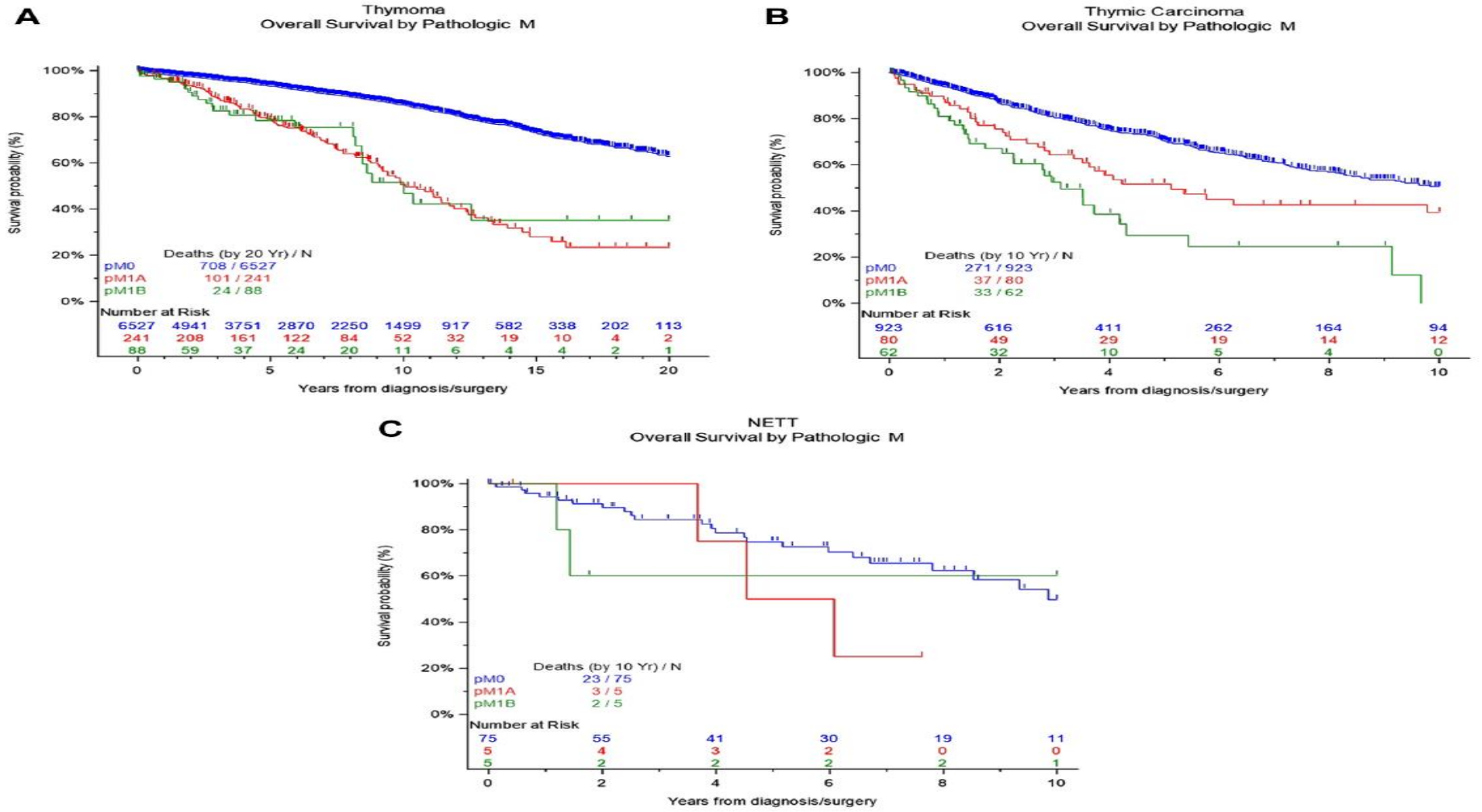


Figure 6. Overall survival by pathologic M in (*A*) thymoma, (*B*) thymic carcinoma, and (*C*) NETT. NETT, neuroendocrine thymic tumor.

Multivaiable Cox Regression Model for OS and FFR (pM staging)

Supplemental Table 4. Results from multivariable Cox regression modeling for Overall survival (OS) and Freedom from recurrence (FFR) by pathological M category, performed separately in thymoma and thymic carcinoma.

Outcome	Variable in Multivariable Cox Regression	n/N (%)	HR (95% CI)	P-value
OS in Thymic Carcinoma				
	pM1a (vs pM0)	66/693 (10%)	1.35 (0.91, 2.00)	0.133
	pM1b (vs pM1a)	38/693 (5%)	1.68 (0.99, 2.86)	0.053
	Age: 65+ (vs <65)	**243/693 (35%)**	**1.42 (1.09, 1.84)**	**0.009**
	Sex: Female (vs Male)	244/693 (35%)	0.77 (0.59, 1.01)	0.058
	Region: Asia/Australia (vs Europe/North America)	**561/693 (81%)**	**0.72 (0.53, 0.99)**	**0.040**
	Performance Status 2+ (vs. 0/1)	**25/693 (4%)**	**2.03 (1.08, 3.82)**	**0.025**
	Surgical resection: R0 (vs no surgery)	**495/693 (71%)**	**0.18 (0.11, 0.29)**	**<0.001**
	Surgical resection: R1 (vs no surgery)	**86/693 (12%)**	**0.36 (0.22, 0.61)**	**<0.001**
	Surgical resection: R2 (vs no surgery)	**73/693 (11%)**	**0.48 (0.29, 0.81)**	**0.005**
	Surgical resection: RX (vs no surgery)	4/693 (1%)	0.52 (0.07, 3.94)	0.517
OS in Thymoma				
	pM1a (vs pM0)	**185/5112 (4%)**	**3.23 (2.38, 4.55)**	**<0.001**
	pM1b (vs pM1a)	**44/5112 (1%)**	**0.39 (0.19, 0.79)**	**0.008**
	Age: 65+ (vs <65)	**1289/5112 (25%)**	**2.71 (2.29, 3.21)**	**<0.001**
	Sex: Female (vs Male)	**2726/5112 (53%)**	**0.77 (0.65, 0.90)**	**0.001**
	Region: Asia/Australia (vs Europe/North America)	**4086/5112 (80%)**	**0.43 (0.36, 0.53)**	**<0.001**
	Performance Status 2+ (vs. 0/1)	**193/5112 (4%)**	**2.98 (2.18, 4.08)**	**<0.001**
	Surgical resection: R0 (vs no surgery)	**4702/5112 (92%)**	**0.35 (0.19, 0.66)**	**<0.001**
	Surgical resection: R1 (vs no surgery)	250/5112 (5%)	0.57 (0.30, 1.08)	0.083
	Surgical resection: R2 (vs no surgery)	122/5112 (2%)	1.27 (0.68, 2.35)	0.456
	Surgical resection: RX (vs no surgery)	13/5112 (0%)	2.35 (0.78, 7.06)	0.118
FFR in Thymic Carcinoma				
	pM1a (vs pM0)	**13/227 (6%)**	**2.63 (1.33, 5.26)**	**0.004**
	pM1b (vs pM1a)	3/227 (1%)	1.11 (0.23, 5.44)	0.898
	Age: 65+ (vs <65)	76/227 (33%)	0.74 (0.46, 1.17)	0.194
	Sex: Female (vs Male)	82/227 (36%)	0.82 (0.51, 1.32)	0.422
	Region: Asia/Australia (vs Europe/North America)	190/227 (84%)	1.57 (0.79, 3.12)	0.196
	Performance Status 2+ (vs. 0/1)	5/227 (2%)	1.47 (0.19, 11.10)	0.707
FFR in Thymoma				
	pM1a (vs pM0)	**43/2855 (2%)**	**14.3 (9.09, 43.0)**	**<0.001**
	pM1b (vs pM1a)	9/2855 (0%)	1.13 (0.46, 2.76)	0.793
	Age: 65+ (vs <65)	789/2855 (28%)	0.82 (0.60, 1.13)	0.224
	Sex: Female (vs Male)	**1558/2855 (55%)**	**0.75 (0.58, 0.98)**	**0.036**
	Region: Asia/Australia (vs Europe/North America)	2453/2855 (86%)	1.04 (0.70, 1.54)	0.857
	Performance Status 2+ (vs. 0/1)	74/2855 (3%)	0.41 (0.10, 1.67)	0.200

HR- Hazard Ratio, 95% CI- 95% Confidence Interval, P-value from Score Chi-Square Test in Cox Regression

Nodal Mapping System

N1 stage – Anterior Region

TABLE 2. Anterior Region (N1) (Anterior Mediastinal and Anterior Cervical Nodes)

Region Boundaries	Node Groups[14, 16]	Node Group Boundaries
Sup: Hyoid Bone Lat (Neck): Medial Border of Carotid Sheaths Lat (Chest): Mediastinal Pleura Ant: Sternum Post (Medially): Great Vessels, Pericardium Post (Laterally): Phrenic Nerve Inf: Xiphoid, diaphragm	Low Ant Cervical: Pretracheal, Paratracheal, Peri-thyroid, Precricoid/Delphian (AAO-HNS / ASHNS Level 6 / IASLC Level 1)	Sup: inferior border of cricoid Lat: common carotid arteries Inf: superior border of manubrium
	Peri-Thymic	Proximity to thymus
	Prevascular (IASLC Level 3a)	Sup: apex of chest Ant: posterior sternum Post: anterior SVC Inf: carina
	Paraaortic, Ascending Aorta, Superior Phrenics (IASLC Level 6)	Sup: line tangential to sup border of aortic arch Inf: inf border of aortic arch
	Supradiaphragmatic / Inferior Phrenics / Pericardial (along inferior poles of thymus)	Sup: inf border of aortic arch Ant: post sternum Post: phrenic nerve (laterally) or pericardium (medially) Inf: diaphragm

Region and node group boundaries adapted directly from definitions established by AAO-HNS, ASHNS, and IASLC.

AAO-HNS, American Academy of Otolaryngology—Head and Neck Surgery; ASHNS, American Society for Head and Neck Surgery; IASLC, International Association for the Study of Lung Cancer; sup, superior; ant, anterior; inf, inferior; lat, lateral; post, posterior; SVC, superior vena cava.

Table 1. Anterior Region (N1)—Prevascular Mediastinum and Anterior Cervical Lymph Nodes

Region Boundaries	Node Groups[a]	Node Group Boundaries
Superior: lower border of cricoid cartilage Lateral (neck): medial border of the carotid sheath/jugular vein Lateral (chest): mediastinal pleura Anterior: sternum Posterior (medially): great vessels, pericardium Posterior (laterally): phrenic nerve Inferior: xiphoid, diaphragm	Low anterior cervical: peritracheal, perithyroid, (AAO-HNS/ASHNS level 6/IASLC level 1)	Superior: lower border of the cricoid cartilage Lateral: common carotid arteries Inferior: superior border of the manubrium
	Peri-thymic	Proximity to the thymus
	Prevascular (IASLC level 3a)	Superior: apex of chest Anterior: posterior sternum Posterior: anterior SVC Inferior: carina
	Para-aortic, ascending aorta, superior phrenic (IASLC level 6)	Superior: line tangential to sup border of aortic arch Inferior: inferior border of aortic arch
	Supradiaphragmatic/inferior phrenic/pericardial (along inferior poles of thymus)	Superior: inferior border of aortic arch Anterior: post sternum Posterior: phrenic nerve (laterally) or pericardium (medially) Inferior: diaphragm

[a]Region and node group boundaries adapted directly from definitions established by IASLC[31] and AAO-HNS and ASHNS.[32]

AAO-HNS, American Academy of Otolaryngology—Head and Neck Surgery; ASHNS, American Society for Head and Neck Surgery; IASLC, International Association for the Study of Lung Cancer; SVC, superior vena cava.

N2 stage – Deep Region

TABLE 3. Deep Region (N2) (Middle Mediastinal and Deep Cervical Nodes)

Region Boundaries	Node Groups[14, 16]	Node Group Boundaries
Sup: Level of lower border of cricoid cartilage Anteromedial (Neck): Lateral Border of Sternohyoid, Medial Border of Carotid Sheath Posterolateral (Neck): Anterior Border of Trapezius Ant (Chest): Aortic Arch, Aortopulmonary Window – Ant Border of SVC Post (Chest): Esophagus Lat (Chest): Pulmonary Hila Inf: Diaphragm	Lower Jugular (AAO-HNS / ASHNS Level 4)	Sup: Level of lower border of cricoid cartilage Anteromedial: lat border of sternohyoid Posterolateral: lat border of sternocleidomastoid Inf: clavicle
	Supraclavicular/Venous Angle: Confluence of Internal Jugular & Subclavian Vein (AAO-HNS / ASHNS Level 5b)	Sup: Level of lower border of cricoid cartilage Anteromedial: post border of sternocleidomastoid Posterolateral: ant border of trapezius Inf: clavicle
	Internal Mammary nodes	Proximity to internal mammary arteries
	Upper Paratracheal (IASLC Level 2)	Sup: sup border of manubrium, apices of lungs Inf: intersection of lower border of innominate vein with trachea; sup border of aortic arch
	Lower Paratracheal (IASLC Level 4)	Sup: intersection of lower border of innominate vein with trachea; sup border of aortic arch Inf: lower border of azygos vein, sup border of left main pulmonary artery
	Subaortic / Aortopulmonary Window (IASLC Level 5)	Sup: inf border of aortic arch Inf: sup border of left main pulmonary artery
	Subcarinal (IASLC Level 7)	Sup: carina Inf: upper border of lower lobe bronchus on the left; lower border of the bronchus intermedius on the right
	Hilar (IASLC Level 10)	Sup: lower rim of azygos vein on right, upper rim of pulmonary artery on left Inf: interlobar region bilaterally

Region and node group boundaries adapted directly from definitions established by AAO-HNS, ASHNS, and IASLC.

AAO-HNS, American Academy of Otolaryngology—Head and Neck Surgery; ASHNS, American Society for Head and Neck Surgery; IASLC, International Association for the Study of Lung Cancer; sup, superior; ant, anterior; inf, inferior; lat, lateral; post, posterior; SVC, superior vena cava.

Table 2. Deep Region (N2) (Visceral Mediastinum and Deep Cervical Nodes)

Region Boundaries	Node Groups[a]	Node Group Boundaries
Superior: level of lower border of cricoid cartilage Anteromedial (neck): lateral border of sternohyoid, medial border of carotid sheath/jugular vein Posterolateral (neck): anterior border of trapezius Anterior (chest): aortic arch, aortopulmonary window-anterior border of the SVC Posterior (chest): esophagus Lateral (chest): pulmonary hila Inferior: diaphragm	Perijugular (AAO-HNS/ASHNS level 4)	Superior: level of lower border of cricoid cartilage Anteromedial: medial border of the jugular vein and carotid artery Posterolateral: lateral border of sternocleidomastoid Inferior: clavicle
	Supraclavicular (AAO-HNS/ASHNS level 5b)	Superior: level of lower border of cricoid cartilage Anteromedial: posterior border of sternocleidomastoid Posterolateral: anterior border of trapezius Inferior: clavicle
	Internal mammary arteries	Proximity to internal mammary arteries
	Upper paratracheal (IASLC level 2)	Superior: superior border of manubrium, apices of lungs Inferior: intersection of lower border of innominate vein with trachea; superior border of aortic arch
	Lower paratracheal (IASLC level 4)	Superior: intersection of lower border of innominate vein with trachea; superior border of aortic arch Inferior: lower border of azygos vein, superior border of left main pulmonary artery
	Subaortic/aortopulmonary window (IASLC level 5)	Superior: inferior border of aortic arch Inferior: superior border of left main pulmonary artery
	Subcarinal (IASLC level 7)	Superior: carina Inferior: upper border of lower lobe bronchus on the left; lower border of bronchus intermedium on the right
	Hilar (IASLC level 10)	Superior: lower rim of azygos vein on right, upper rim of pulmonary artery on left Inferior: interlobar region bilaterally

[a]Region and node group boundaries adapted directly from definitions established by IASLC[31] and AAO-HNS and ASHNS.[32]

AAO-HNS, American Academy of Otolaryngology—Head and Neck Surgery; ASHNS, American Society for Head and Neck Surgery; IASLC, International Association for the Study of Lung Cancer; SVC, superior vena cava.

Boundaries of the anterior (N1) and deep (N2) lymph node levels (8th)

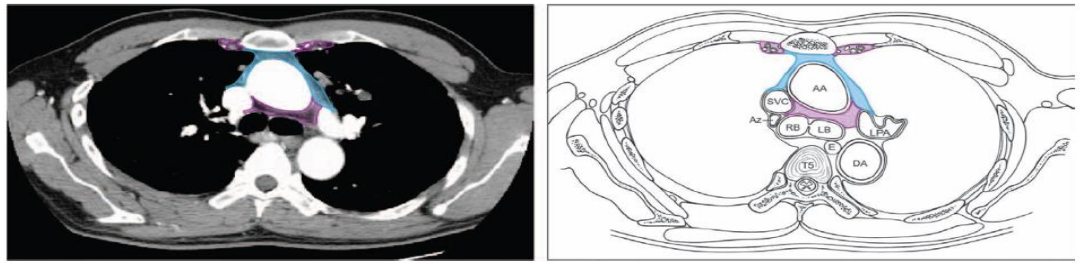


FIGURE 4. Aortopulmonary window level, axial section. Anterior region (*blue*) and deep region (*purple*). Note: deep region includes aortopulmonary window nodes. AA, ascending aorta; DA, descending aorta; LPA, left pulmonary artery; SVC, superior vena cava; Az, azygos vein; RB, right main bronchus; LB, left main bronchus.

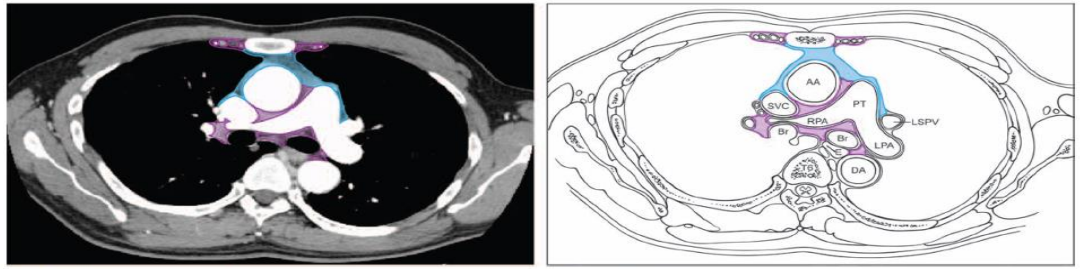


FIGURE 5. Carina level, axial section. Anterior region (*blue*) and deep region (*purple*). Note: deep region includes aortopulmonary window nodes. AA, ascending aorta; DA, descending aorta; PT, pulmonary trunk; LPA, left pulmonary artery; RPA, right pulmonary artery; SVC, superior vena cava; LSPV, left superior pulmona[제목 없음]bronchus; E, esophagus.

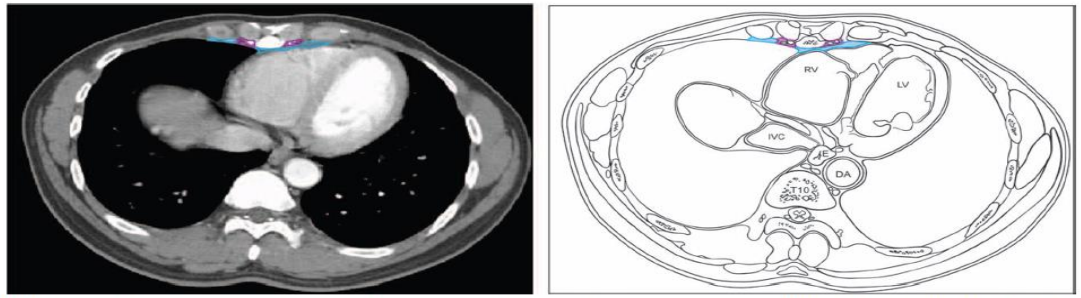


FIGURE 6. Diaphragm level, axial section. Anterior region (*blue*) and deep region (*purple*). RV, right ventricle; LV, left ventricle; IVC, inferior vena cava; DA, descending aorta; E, esophagus.

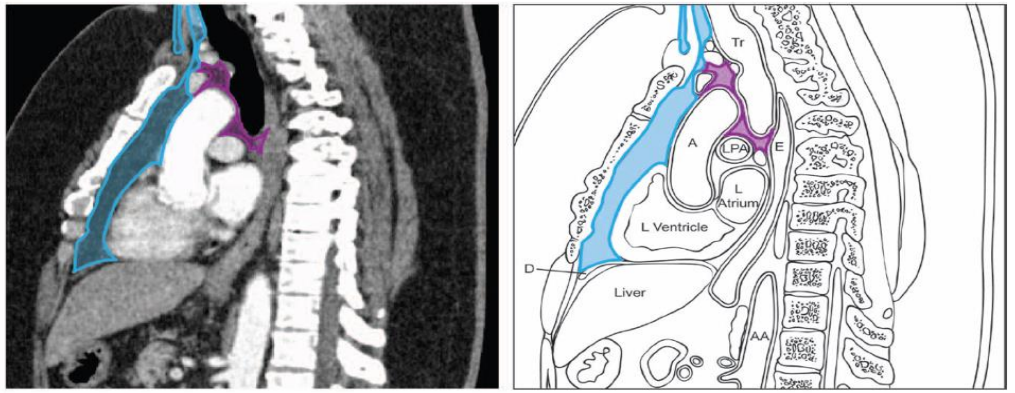


FIGURE 1. Mediastinum, sagittal section. Anterior region (*blue*) and deep region (*purple*). Tr, trachea; E, esophagus; LPA, left pulmonary artery; A, aorta; D, diaphragm.

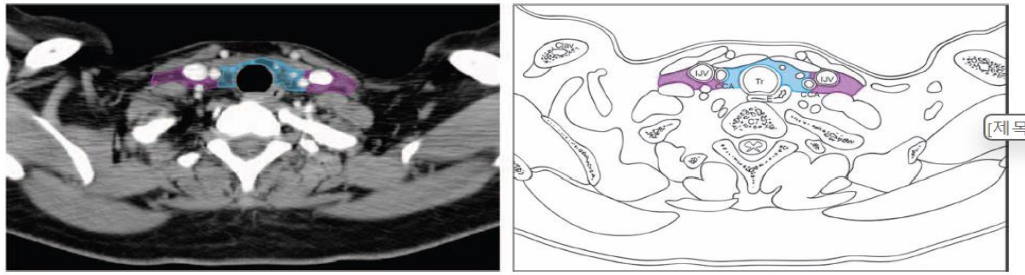


FIGURE 2. Thoracic inlet, axial section. Anterior region (*blue*) and deep region (*purple*). CCA, common carotid artery; IJV, internal jugular vein; Tr, trachea; Clav, clavicle; E, esophagus.

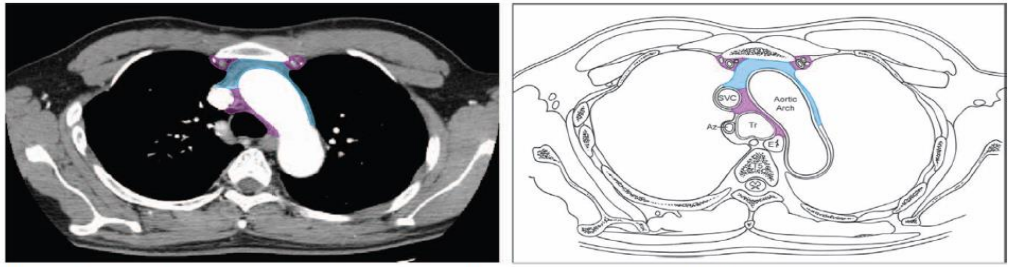


FIGURE 3. Paraaortic level, axial section. Anterior region (*blue*) and deep region (*purple*). SVC, superior vena cava; E, esophagus; Tr, trachea.

Boundaries of the anterior (N1) and deep (N2) lymph node levels (9th)

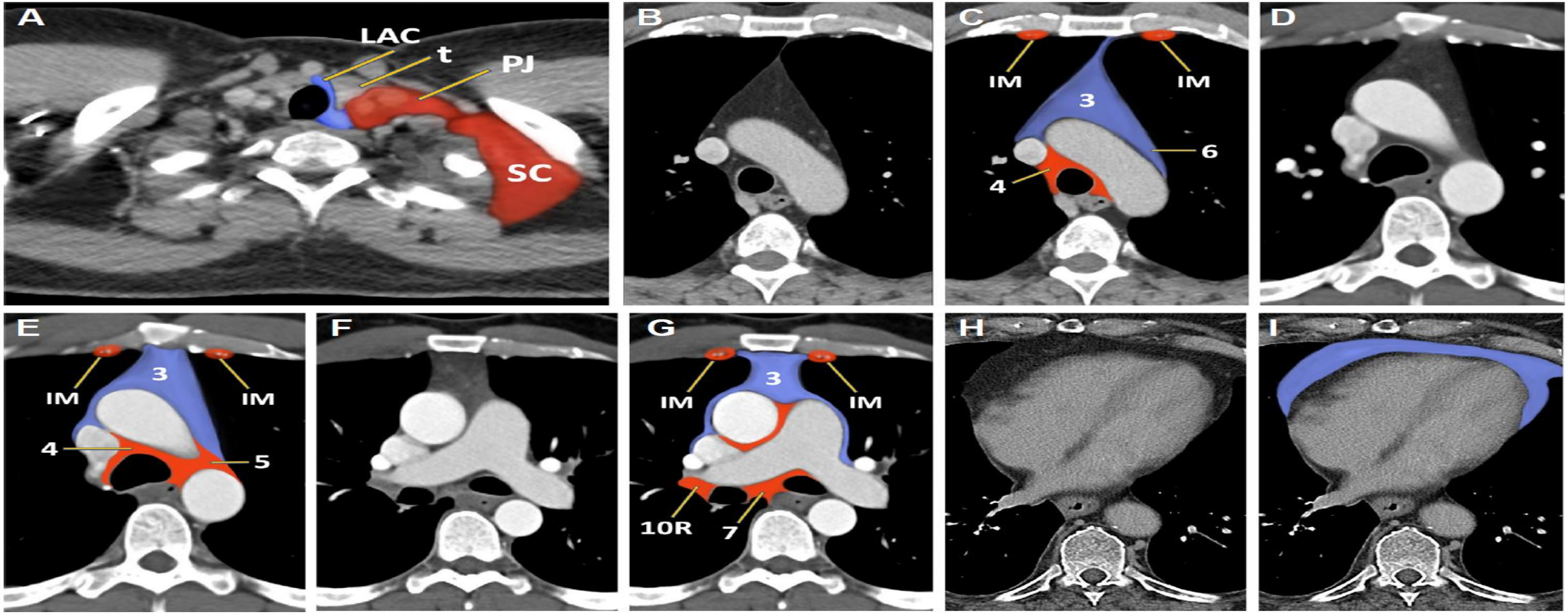


Figure 2. Native and annotated axial computed tomography images revealing the node groups, marking the boundaries of the anterior (N1) and deep (N2) lymph node levels at the levels of the (*A*) lower neck, (*B*, *C*) aortic arch, (*D*, *E*) aorto-pulmonary window, (*F*, *G*) main pulmonary artery, (*H*, *I*) and base of the heart. Boundaries of the anterior (N1) and deep (N2) level are shaded in blue and red, respectively. IASLC, International Association for the Study of Lung Cancer; IM, internal mammary; LAC, low anterior cervical; PJ, perijugular; SC, supraclavicular; t, thyroid gland. Numbers refer to IASLC node map used for lung cancer.[31] Courtesy of the International Association for the Study of Lung Cancer. Copyright 2023, Aletta Ann Frazier.

Summary of 9th TNM staging system

Table 1. Proposed T Categories for the Ninth Edition of the TNM Stage Classification

T	Description
T1	A tumor that is limited to the thymus with or without encapsulation or directly invades into the mediastinum alone or directly invades the mediastinal pleura but does not involve any other mediastinal structure T1a: 5 cm or less in its greatest dimension[a] T1b: larger than 5 cm in its greatest dimension[a] *(Level 1 structures—thymus, anterior mediastinal fat, mediastinal pleura)*
T2	Tumor directly invades the pericardium (either partial or full-thickness), the lung, or the phrenic nerve *(Level 2 structures—pericardium, lung, phrenic nerve)*
T3	Tumor directly invades any of the following: (1) brachiocephalic vein, (2) superior vena cava, (3) chest wall, or (4) extrapericardial pulmonary arteries or veins *(Level 3 structures—brachiocephalic vein, SVC, chest wall, hilar pulmonary vessels)*
T4	Tumor directly invades any of the following: (1) aorta (ascending, arch, or descending), (2) arch vessels, (3) intrapericardial pulmonary artery or veins, (4) myocardium, (5) trachea, or (6) esophagus *(Level 4 structures—aorta [ascending, arch, or descending], arch vessels, intrapericardial pulmonary artery or veins, myocardium, trachea, esophagus)*

Note: T categories are defined by "levels" of invasion; they reflect the highest degree of invasion regardless of how many other (lower level) structures are invaded.
[a]Irrespective of mediastinal pleura invasion. Mediastinal pleura invasion to be recorded as "Additional histologic descriptor."
SVC, superior vena cava.

- **Tumor size instead of capsular invasion**
  : T1a ≤ 5cm , T1b >5cm
- **Dropped for staging - Encasulation or not/mediastinal fat or pleural invasion (Recorded as an additional histologic descriptor)**
- **T3 structure (lung, phrenic nerve) -> T2 category**
- **N component -> No change**
- **M component -> No change**
- **Stage Groups -> No change**

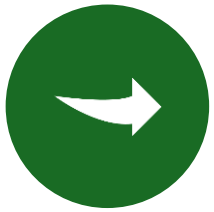
Limitations and Conclusion

1. Limited Prospective Data
2. Nodal Involvement
3. Imaging and Surgical Correlation
4. Rare Tumor Representation
5. Size and Invasion Clarification

Addressing these limitations requires continued data collection, particularly prospective studies, and further refinement of imaging techniques and surgical practices to enhance the accuracy and applicability of the TNM staging system for thymic epithelial tumors.

9th TNM Staging Proposal for Thymic Epithelial Tumors

1. PRECISE STAGING



2. SUBDIVISION OF NODAL INVOLVEMENT

3. DATA-DRIVEN APPROACH

4. GLOBAL STANDARDIZATION

5. IMPROVED PROGNOSTIC ACCURACY

6. PROMOTION OF MULTIDISCIPLINARY APPROACH

Pusan National University
Yangsan Hospital

양산부산대학교병원
Pusan National University Yangsan Hospital

경청해 주셔서 감사합니다.

Thank you for your attention