Thymic Epithelial Tumors: Prognostic Determinants Among Clinical, Histopathologic, and Computed Tomography Findings

Jung Won Moon, MD, Kyung Soo Lee, MD, Myung-Hee Shin, MD, Seonwoo Kim, PhD, Sook Young Woo, MS, Geewon Lee, MD, Joungho Han, MD, Young Mog Shim, MD, and Yong Soo Choi, MD

Department of Radiology, Kangbuk Samsung Hospital, and Departments of Radiology, Preventive Medicine, Pathology, and Thoracic Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul; Biostatistics Unit, Samsung Biomedical Research Institute, Samsung Medical Center, Seoul; and Department of Radiology, Pusan National University Hospital, Busan, Korea

Background. **The Masaoka-Koga staging system has been known as the strongest prognostic factor for both survival and recurrence of thymic epithelial tumor (TET). The purpose of our study was to find prognostic determinants among computed tomography (CT), histopathologic, and clinical features of TET.**

Methods. **Two radiologists reviewed retrospectively CT findings of 437 patients (male 242, female 195; mean age, 51 years) with TET. With medical record review, surgico-histopathologic results were subcategorized into Masaoka-Koga stages I through IV and World Health Organization histopathologic classifications A-B1, B2-B3, and carcinoma. Overall survival and progression-free survival were analyzed. Clinical, histopathologic, and CT features were correlated from each other.**

Results. **In all, 437 tumors were in Masaoka-Koga stage I (n = 147, 33.6%), stage II (n = 121, 27.7%), stage III (n = 76, 17.4%), or stage IV (n = 93, 21.3%); A and B1 (n = 114, 26.1%) and B2 and B3 TET (n = 223, 51.0%); and thymic carcinoma (n = 100, 22.9%). In multivariable analyses, age, Masaoka-Koga stage IV, thymic carcinoma, and CT stages III and IV were significantly correlated with overall survival ($p < 0.05$), whereas adjuvant treatment, Masaoka-Koga stages III and IV, World Health Organization B2 and B3, thymic carcinoma, R2 resection, CT size, and CT stage IV were significantly associated with progression-free survival ($p < 0.05$). Computed tomography stages showed moderate association with Masaoka-Koga stages ($K = 0.621$).**

Conclusions. **For TET, CT staging is effective in distinguishing both overall survival and progression-free survival, and patients with Masaoka-Koga stage IV or thymic carcinoma or CT stage IV have the worst prognosis.**

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In 2009, the International Thymic Malignancy Interest Group (ITMIG), together with the International Association for the Study of Lung Cancer and under the auspices of the Union International Contre le Cancer and American Joint Commission on Cancer, provided infrastructures for international collaboration in terms of common language, consistent definition, and international database especially for outcome measurement, surgical procedure, and staging system [1–3]. Regarding the prognosis of thymic epithelial tumor (TET), the ITMIG and associated groups reviewed current literature to identify prognostic determinants. They found that the strongest prognostic factor for both survival and recurrence is tumor stages determined by the Masaoka-Koga staging system in most studies. Complete resection was another fairly consistent prognostic factor for both survival and recurrence [2].

Imaging diagnosis and staging of TET would be useful and desirable for determining appropriate treatment modality. There have been studies investigating the association between imaging findings and prognosis [4–6]. Computed tomography (CT) findings may serve as predictors of postoperative recurrence or metastasis [4, 5]. The size of primary tumor, lobulated contour, and infiltration of surrounding fat on CT scan appeared to be factors that could help differentiate between Masaoka-Koga stages I and II and stages III and IV [6]. Although these studies showed the considerable potential of CT as a prognostic biomarker, the numbers of patients included were relatively small, and different studies did not show consistent results. Furthermore, the direct association between Masaoka-Koga and CT staging systems has not been fully studied and addressed. Thus, the purpose of our study was to find prognostic determinants among CT, histopathologic, and clinical features of TET.

Material and Methods

Patients and Treatment

We retrospectively reviewed the 17-year surgical database of the department of thoracic surgery at our

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Address correspondence to Dr Kyung Soo Lee, Department of Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, 50 Ilwon-dong, Gangnam-gu, Seoul 135-710, Korea; e-mail: kyungs.lee@samsung.com.

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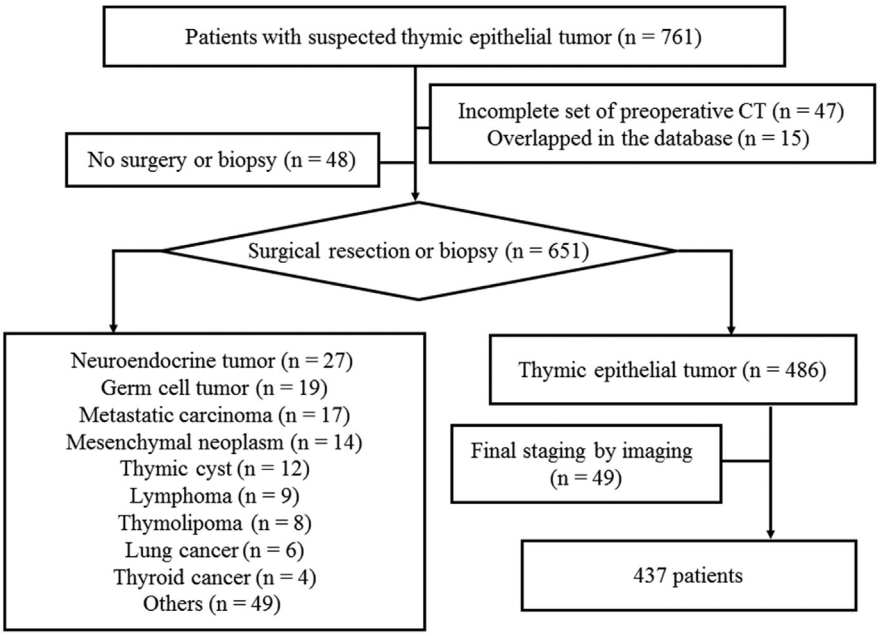

Fig 1. Patient selection flow sheet. (CT = computed tomography.)

institution between November 1994 and December 2010 to find patients referred for the surgical removal of suspected TET. Of 761 patients, 437 patients (242 men, 195 women; mean age, 51 years) were included in the final study group (Fig 1). From medical record review, chief complaint, presence of myasthenia gravis, and detailed treatments given to patients were evaluated. For treatments given, surgical technique and presence or details of additional adjuvant chemotherapy, radiation therapy, or concurrent chemoradiation therapy were evaluated.

Masaoka-Koga Stage, WHO Classification, and Completeness of Resection

We used the Masaoka-Koga system with ITMIG definition details for staging, based on the surgical and

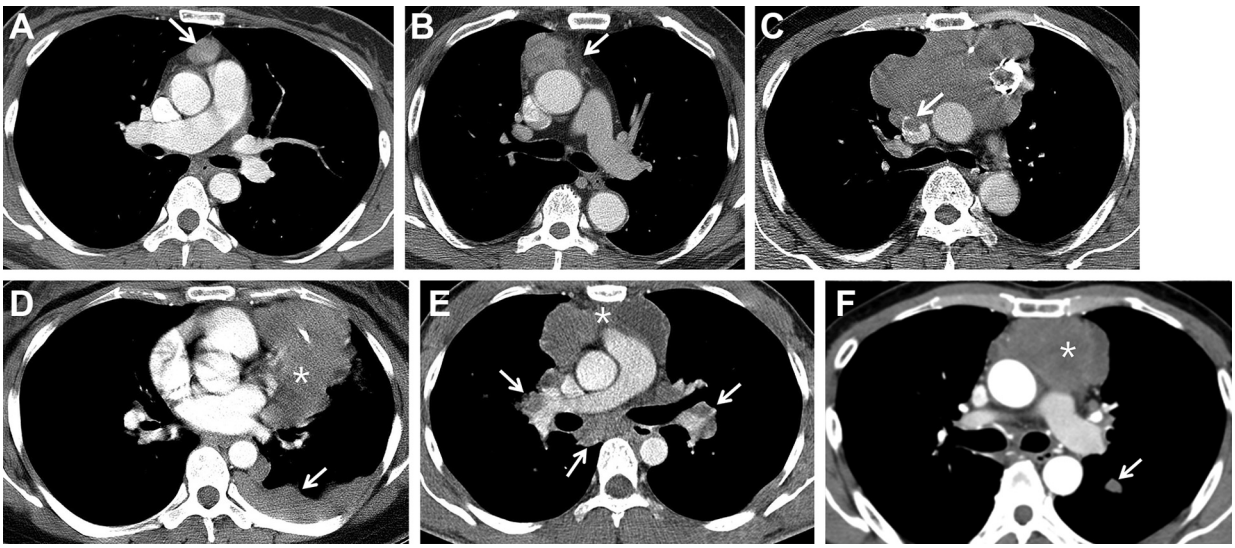

Fig 2. Various computed tomography (CT) stages of thymic epithelial tumors. (A) Stage I, well encapsulated thymic epithelial tumor (arrow) of World Health Organization (WHO) classification A and Masaoka-Koga stage I in a 37-year-old woman. (B) Stage II, tumor invasion into surrounding mediastinal fat (arrow) of WHO classification AB and Masaoka-Koga stage II in a 66-year-old man. (C) Stage III, tumor invasion into superior vena cava (arrow) of WHO classification B3 and Masaoka-Koga stage III in a 60-year-old man. (D) Stage IV, tumor pleural seeding (arrow) of thymic carcinoma (star) and Masaoka-Koga stage IV in a 34-year-old woman. (E) Stage IV, bilateral hilar and subcarinal lymph node metastases (arrows) of thymic carcinoma (star) and Masaoka-Koga stage IV in a 30-year-old man. (F) Stage IV, pulmonary metastases (arrow) of thymic carcinoma (star) and Masaoka-Koga stage IV in a 49-year-old man.

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