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ORIGINAL ARTICLE

# Results of surgical resection for patients with thymoma according to World Health Organization histology and Masaoka staging

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**Summary** *Objectives:* Thymomas are relatively rare tumors. In this study, we investigated the clinical features of patients who underwent surgical resection for thymoma.
*Patients and methods:* This study clinicopathologically evaluated 54 consecutive patients who underwent a surgical resection of thymoma in our department between 1994 and 2006.
*Results:* A complete resection was performed in 52 patients, while two patients underwent an incomplete resection due to pleural dissemination. Combined resection with adjacent organs was performed for the lung ($n = 6$), pericardium ($n = 5$), and large vessels (brachiocephalic vein in three, superior vena cava in two). The concomitant autoimmune diseases were observed in 20 patients (37%), and they included myasthenia gravis in 17 patients, macroglobulinemia in one, pemphigus vulgaris in one, and stiff person syndrome in one patient. The histologic types of the World Health Organization classification diagnosed as type A in four patients, type AB in 14, type B1 in eight, type B2 in 15, and type B3 in 11. There were 27, 17, eight, and two patients with Masaoka stages I, II, III, and IV, respectively. Four patients died, and the causes of death included recurrence of thymoma in two, gastric carcinoma in one, and respiratory failure due to myasthenia gravis in one patient. The overall survival rate at 10 years was 94.6% in patients with stages I and II disease and 77.1% in patients with stages III and IV disease.

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*Conclusions:* Long-term survival can be expected not only for patients at early stages, as well as for patients with stages III and IV disease if surgical resection is completed macroscopically.


## 1. Introduction

Thymoma is a relatively rare tumor, with an incidence of 0.15 cases per 100,000. The neoplasm arises from thymic epithelial cells.[1] The site of predilection for thymoma is usually in the thymus at the anterior mediastinum. This location accounts for 20%—40% of mediastinal tumors and is the most common tumor in the anterior mediastinum.[2,3] It is normally a slow-growing tumor, but it shows a locally invasive growth pattern. In addition, it sometimes leads to the development of pleural dissemination and distant metastasis.[4] Surgery is the treatment of choice for this disease, and complete resection is the most important prognostic factor.[4,5,6] The staging of thymomas is commonly performed based on the Masaoka classification, and the clinical staging also predicts the prognosis.[7] However, no optimal treatment strategy has yet been established. In this study, we retrospectively reviewed the clinicopathologic characteristics of 54 consecutive patients who underwent surgical resection for thymoma.

## 2. Patients and methods

The hospital records of 54 consecutive patients who underwent a surgical resection of thymoma in the Second Department of Surgery, University of Occupational and Environmental Health (Kiatkyushu, Japan) between 1994 and 2006 were reviewed. The preoperative assessments included chest roentgenography and computed tomography (CT) of the chest, upper abdomen, and brain. Patient records, including clinical data, preoperative examination results, details of any surgeries, histopathologic findings, and Masaoka staging system classification were also reviewed.[7] The histologic findings were classified according to the World Health Organization (WHO) criteria of cell types.[8]

Follow-up information was obtained from all patients through office visits or telephone interviews, either with the patients, with a relative, or with their primary physicians. The patients were evaluated every 3 months by chest roentgenography, and chest CT scans were performed every 6 months for the first 2 years after surgery and annually thereafter.

The Kaplan-Meier method was used to estimate the probability of survival, and survival differences were analyzed by the log-rank test. The categorical variables were compared using the chi-square test or Fisher's exact test. Differences were considered to be statistically significant for $p < 0.05$. The data were analyzed using the StatView software package (Abacus Concepts, Inc., Berkeley, CA, USA).

## 3. Results

There were 26 men and 28 women studied who had a mean age of 60.5 years and an age range of 19—79 years (Table 1). Fifty-two patients underwent complete resection, and two patients had pleural dissemination that resulted in an incomplete resection. Among the patients who underwent a complete resection, combined resection with adjacent organs was performed for the lung ($n = 6$), pericardium ($n = 5$), and vessels (brachiocephalic vein in three, superior vena cava in two). The histologic types based on the WHO classification included four patients with type A (7.7%), 14 with type AB (26.9%), eight with type B1 (15.4%), 15 with type B2 (28.8%), and 11 with type B3 (21.1%). The histologic types of two patients were not determined because the subjects had received preoperative radiation. In the Masaoka staging system, 27 patients (50.0%) were diagnosed to have stage I disease, 17 with stage II (31.5%), eight with stage III (14.8%), and two with stage IVa (3.7%). The youngest patients (a woman aged 19 years) was diagnosed at Masaoka stage III, and a complete resection was performed with combined resection of brachiocephalic vein.

The correlation between Masaoka stage and WHO classification was revealed in Table 2. The patients with Masaoka stage I and II was classified into one of the five histologic types of WHO classification. However, the thymomas at Masaoka stage III and IVa corresponded to either B2 or B3 subtype, indicating more aggressive histology. The higher prevalence of early stages (Masaoka stages I and II) was observed in A and AB-type thymomas (18/18), while the proportion of Masaoka stages I and II was 76.5 % (26/34)

**Table 1** Characteristics of the thymoma patients with/without MG.

| | All | Without MG $n = 37$ | With MG $n = 17$ |
|---|---|---|---|
| Average of age, y (range) | 60.5 (19—76) | 63.1 | 54.1* |
| Sex: male/female | 26/28 | 19/18 | 7/10 |
| WHO histologic classification | | | |
| A | 4 | 3 (9) | 1 (6) |
| AB | 14 | 10 (29) | 4 (24) |
| B1 | 8 | 6 (17) | 2 (12) |
| B2 | 15 | 7 (20) | 8 (53)** |
| B3 | 11 | 9 (26) | 2 (12) |
| Masaoka stage | | | |
| I | 27 | 17 (46) | 10 (59) |
| II | 17 | 12 (32) | 5 (29) |
| III | 8 | 6 (16) | 2 (12) |
| IVa | 2 | 2 (5) | 0 |

MG = myasthenia gravis.
*$p = 0.019$, the average age of patients with MG was significantly lower than that of patients without MG.
**$p = 0.043$, the prevalence of MG was observed significantly in type B2 thymoma compared with that in other types of thymoma.