

# What is the Prevalence of a “Nontherapeutic” Thymectomy?

Michael S. Kent, MD,\* Thomas Wang, PhD,\* Sidhu P. Gangadharan, MD, and Richard I. Whyte, MD

Division of Thoracic Surgery and Interventional Pulmonology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston; and Department of Economics, Harvard University, Cambridge, Massachusetts

**Background.** Thymectomy is often performed on the basis of computed tomography scan findings that are suspicious for thymoma. However, the final diagnosis may be a condition such as thymic hyperplasia or lymphoma for which thymectomy is not therapeutic. The present analysis was undertaken to determine the prevalence of a “nontherapeutic” thymectomy.

**Methods.** The Nationwide Inpatient Sample from 2000 through 2009 was queried to identify patients who underwent a thymectomy. Only adult patients who underwent a total thymectomy without other associated procedures were analyzed. Patients with a diagnosis of myasthenia were excluded. A nontherapeutic thymectomy was defined as a patient who underwent thymectomy with an International Classification of Diseases, Ninth Revision diagnosis code of lymphoma, thymic hyperplasia, thymic cyst, or other benign diseases of the thymus.

**Results.** A total of 1,306 patients were identified. Overall, 72.2% (n = 943) of thymectomies were

therapeutic and 27.8% (n = 363) were nontherapeutic. The most common diagnosis in the nontherapeutic group was thymic hyperplasia (n = 174). Mortality (0.32% versus 0%;  $p = 0.083$ ) and overall complication rates (25% versus 17%;  $p < 0.001$ ) were higher in the therapeutic group. Patients in the nontherapeutic group were younger (median age, 41 versus 56 years;  $p < 0.001$ ) and more likely to undergo a video-assisted thoracoscopic surgery thymectomy (28% versus 19%;  $p = 0.085$ ).

**Conclusions.** In this study, 27.8% of thymectomies were nontherapeutic, and most patients underwent an open approach. The most common benign diagnosis was thymic hyperplasia, a condition for which magnetic resonance imaging has a high predictive value. Consequently, further studies are warranted to determine the optimal evaluation of patients undergoing thymectomy for presumed thymoma.

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The evaluation of a thymic mass can be challenging. The differential diagnosis is broad, and includes both benign and malignant conditions. Computed tomography (CT) is considered the imaging test of choice; however, there is considerable overlap of findings between benign conditions, such as thymic hyperplasia, and malignant disease [1, 2].

Thymectomy is often undertaken on the suspicion of thymoma [3]. Despite the low specificity of CT, many authors recommend thymectomy for patients with “small, anterior mediastinal masses that are clinically thought to be thymomas” [3, 4]. Indeed a recent survey of members of the European Society of Thoracic Surgeons reported that “the radiologic features of a chest CT scan are diagnostic, especially for early-stage lesions” [5]. In the same survey, additional imaging modalities were not

routinely used, and 91% of centers recommended thymectomy without a biopsy if thymoma was suspected.

However, the final pathologic diagnosis may be a condition such as thymic hyperplasia or lymphoma, for which a thymectomy is not therapeutic. Although a thymectomy can be performed with minimally invasive techniques and very low mortality, a “nontherapeutic” thymectomy is associated with the potential for morbidity and increased utilization of health care resources [6]. The present study was undertaken to determine the incidence of a nontherapeutic thymectomy using a large, administrative database.

## Material and Methods

### Data Source

Data for this study were extracted from the Nationwide Inpatient Sample (NIS). This database was developed by the Healthcare Cost and Utilization Project and has been maintained by the Agency for Healthcare Research and Quality [7].

The NIS represents a 20% sample of inpatient admissions from the 45 states that participate in the Healthcare Cost and Utilization Project. Data are drawn from 1,051 participating hospitals and contain a core set of clinical

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\*Drs Kent and Wang contributed equally to this manuscript.

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Address correspondence to Dr Kent, 185 Pilgrim Rd, Deaconess 201, Beth Israel Deaconess Medical Center, Boston, MA 02215; e-mail: [mkent@bidmc.harvard.edu](mailto:mkent@bidmc.harvard.edu).

and nonclinical information on all patients, regardless of payer, including persons covered by Medicare, Medicaid, private insurance, and the uninsured. More than 100 clinical and nonclinical variables are abstracted, including principal and secondary diagnoses, principal and secondary procedures, admission and discharge status, patient demographics, expected payment source, total charges, and length of stay. The NIS also provides statistical weights that allow estimates of national case volumes to be extrapolated.

This study was approved by the institutional review board of the Beth Israel Deaconess Medical Center (2013P-000006) and conforms to the data-use agreement for the NIS from the Healthcare Cost and Utilization Project.

### Patient Selection

Patients 18 years or older who underwent a thymectomy were identified. Only patients who underwent a total thymectomy without other associated procedures were analyzed. Patients with a diagnosis of myasthenia were excluded. A nontherapeutic thymectomy was defined as a patient who underwent thymectomy with an International Classification of Diseases, Ninth Revision (ICD-9) diagnosis code of lymphoma, thymic hyperplasia, thymic cyst, or other benign diseases of the thymus (Table 1).

Patients who underwent any cardiac surgical procedure (35.xx through 39.xx) or an associated endocrine procedure (thyroidectomy: 06.3, 06.31, 06.39, 06.4, 06.5, 06.50, 06.51, 06.52; or parathyroidectomy: 06.8, 06.81, 06.89) were specifically excluded. We also excluded patients who underwent a transcervical thymectomy (07.99), under the assumption that this operation would be performed for patients with myasthenia gravis without evidence of a thymoma.

### Data Collection

Data collected for each patient admission included age at the time of admission, sex, patient comorbidities, in-hospital complications, in-hospital mortality, length of stay (LOS), and discharge status, as well as the ICD-9 diagnosis related to the thymus. The surgical approach

(open, thoracoscopic, or robotic) was also recorded. However, the codes for thoracoscopic and robotic approaches were only used from 2007 and the fourth quarter of 2008, respectively (Appendix Table).

Morbidity rates were calculated using a panel of 19 cardiovascular, pulmonary, infectious, and intraoperative complications based on a prior publication using NIS data [8]. Additional outcome measures included the proportion of patients with a prolonged LOS (>14 days) and a discharge other than routine. Patient comorbidities were recorded using a modification of the Elixhauser comorbidity index [9]. The range of this comorbidity scale is from -19 to +89. In addition, cost-to-charge ratios provided by the NIS were used to estimate the cost of care for patients undergoing thymectomy.

### Study Objectives and Statistical Analysis

The primary objective of this study was to determine the proportion of patients without myasthenia gravis who underwent a nontherapeutic thymectomy. Secondary objectives included a comparison of the morbidity, mortality, cost, LOS, and use of minimally invasive techniques between the therapeutic and nontherapeutic groups.

Statistical analysis was performed using Stata 12.1 (StataCorp, College Station, TX). Patient characteristics and outcome measures were compared using Wilcoxon rank-sum tests for continuous variables and either Fisher's exact or  $\chi^2$  tests for categorical variables. Probability values of 0.05 or less were considered statistically significant.

### Results

A total of 2,510 adult patients who underwent a total thymectomy without associated procedures were identified from 2000 through 2009. Among these patients 1,095 carried an ICD-9 diagnosis code of myasthenia gravis and were excluded. An additional 109 patients had a diagnosis code that was in the “other category” and were also excluded from analysis. The most common diagnoses in this “other” category were 786.6 (swelling, mass, or lump in chest,  $n = 41$ ) and 759.2 (anomaly of endocrine glands,  $n = 10$ ).

Therefore 1,306 patients who underwent thymectomy formed the basis for this study. A thymectomy was considered therapeutic in 72.2% ( $n = 943$ ) of cases and nontherapeutic in 27.8% of cases ( $n = 363$ ; Table 2). The most common diagnosis in the nontherapeutic group was thymic hyperplasia ( $n = 174$ ; 13% of the overall cohort).

Patients in the nontherapeutic group were significantly younger (median age, 41 years versus 56 years;  $p < 0.001$ ) and more likely to be female (70% versus 54%;  $p < 0.001$ ) than those in the therapeutic group (Table 3). The comorbidity index was also higher in the therapeutic group (2.72 versus 2.00;  $p = 0.012$ ).

The proportion of cases that were nontherapeutic was similar among urban teaching, urban nonteaching, and academic hospitals. Thymectomies were performed at 531 institutions, with a range of 1 to 12 thymectomies per year

Table 1. International Classification of Diseases, Ninth Revision, Codes Used to Identify Patients Undergoing a Therapeutic or Nontherapeutic Thymectomy

Major Group	ICD-9 Code	Category
Thymic neoplasms	164.0, 209.22, 212.6, 209.62	Therapeutic
Endocrine cancer	193, 226, 227.1, 194.1	Therapeutic
Other cancer	140.0x–195.99	Therapeutic
	197.0x–199.99	
	209.0x–239.99	
Lymphoma	200.xx–208.xx	Nontherapeutic
Benign disorders of the thymus	254.0, 254.1, 254.8, 254.9	Nontherapeutic
Other	All other codes	Not assigned

ICD-9 = International Classification of Diseases, Ninth Revision.

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