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Thoracoscopic versus open resection for congenital cystic adenomatoid malformations of the lung

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Abstract

Purpose: This study evaluated the potential advantages of thoracoscopy compared to thoracotomy for resection of congenital cystic adenomatoid malformations (CCAM).

Methods: We conducted a retrospective chart review of consecutive cases of CCAM resection at University of California San Francisco Children's Hospital from January 1996 to December 2006.

Results: Thirty-six cases of postnatal CCAM resections were done over the past 10 years; 12 patients had thoracoscopic resections, whereas 24 patients had open resections. Patients in the thoracoscopic group had significantly longer operative time (mean difference of 61.3 minutes; 95% confidence interval [CI], 30.5-92.1) but shorter postoperative hospital stay (mean difference of 5.7 days; 95% CI, 0.9-10.4) and duration of tube thoracostomy (mean difference of 2.6 days; 95% CI, 0.7-4.5) and lower odds of postoperative complications (odds ratio of 9.0×10^{-4}; 95% CI, 8.0×10^{-6}-0.1). In the subgroup analysis of only asymptomatic patients, the thoracoscopy group still had a significantly shorter hospital stay (mean difference of 2.8 days; 95% CI, 0.7-4.8). There was also a pattern for reduced complications in the thoracoscopy group (OR, 0.13; 95% CI, 0.02-1.0; $P = .05$). The average hospital costs were similar in both groups. With a conversion rate of 33% (6/18), patients with a history of preoperative respiratory symptoms had a higher incidence of conversion than those who were asymptomatic (66.7% vs 0%, $P = .005$). These four patients had a history of pneumonia.

Conclusion: Minimally invasive resection of CCAM results in longer operative time but shorter hospital stay, potentially reduced complications, and no additional hospital costs. Thoracoscopic lobectomy in patients with a history of pneumonia is challenging and a risk factor for conversion to thoracotomy.

Minimally invasive surgery has emerged as the standard of care for many surgical procedures in the pediatric population [1,2]. The benefits of decreased length of hospitalization and postoperative pain and improved cosmesis have been suggested by observational studies. Thoracoscopy is used for diagnostic and therapeutic management of several pediatric disorders including empyema, interstitial lung disease, neurogenic tumors, metastatic cancer to the lung, thymoma, esophageal atresia, and cystic lung disease [3-10].

However, the outcomes of thoracoscopy have not been directly compared to thoracotomy for lobectomy in children and have only been reported in case series. In addition, although thoracoscopic resection has been shown to be feasible, there are no guidelines to select the appropriate patient for this technique. Congenital cystic adenomatoid malformations (CCAM), although rare, are the most common lung lesions in children that require lobectomy. The purpose of this study is to evaluate the factors associated

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with successful thoracoscopic lobectomy for CCAM and to determine whether the clinical outcomes after thoracotomy and thoracoscopy differ.

1. Methods

The study design was a retrospective chart review of all cases of lobectomy or wedge resection for CCAM at the University of California, San Francisco Children's Hospital, from 1996 to 2006. Eligibility for inclusion was determined by pathology of the surgical specimen. Patient-related variables included sex; age at time of operation; weight at time of operation; presence of preoperative symptoms (defined as pneumonia or respiratory distress); laterality of CCAM; location of CCAM in either upper, middle, or lower lobes of the lung; and the type of CCAM (macrocystic vs microcystic). Operation-related variables included duration of operation in minutes, thoracoscopy vs thoracotomy, and the need for conversion to thoracotomy. The technique of thoracoscopic lobectomy and wedge resection at our institution was previously described by Albanese et al [11]. Patients who underwent open resection had a formal posterolateral thoracotomy. Outcome variables included length of hospital stay in days, duration of postoperative tube thoracostomy in days, and postoperative complications (defined as respiratory complications, which included pneumonia, persistent pneumothorax, respiratory distress, pleural effusion, and asthma, and nonrespiratory complications). The hospital charges for each patient were adjusted to the year 2006 and included readmission for complications related to the operation. Financial data were available for only hospital admissions after 1998. The analysis on hospital charges and length of hospital stay excluded preterm neonates who required prolonged hospitalization owing to their prematurity rather than to their operations.

Statistical analysis was performed using STATA SE 9.0 (Stata Corp, College Station, TX). The bivariate analysis involved the Mann-Whitney *U* (Wilcoxon rank-sum) test for continuous variables with nonparametric distribution and 2 × 2 contingency tables and Fisher exact test for categorical variables. In addition, multivariate regression modeling was used to estimate the mean difference or odds ratio and 95% confidence interval (CI) between thoracoscopy vs thoracotomy and the outcome variables (length of hospital stay, operative time, duration of tube thoracostomy, hospital charges, and postoperative complications). Predictor variables that reached a significance level of less than 0.2 in a stepwise backward selection of the multivariate analysis were included in the final multivariate linear or logistic regression model for each outcome variable. Hypothesis testing was done with alpha level of 5%, and all *P* values were 2-tailed. Approval by the institutional review board was obtained for this study.

2. Results

Thirty-six cases of postnatal CCAM resections were done from 1996 to 2006 at the University of California, San Francisco Children's Hospital; 12 patients underwent successful thoracoscopy, whereas 24 patients underwent thoracotomy. Of the 36 patients, 8 were diagnosed postnatally secondary to respiratory distress at birth or recurrent pneumonia or asthma; the other 25 patients were diagnosed with prenatal sonography. Congenital cystic adenomatoid malformations occurred with equal frequency on the right and left side but were located in the lower lobe in two thirds of the patients. In addition, 2 patients had involvement of both upper and lower right lobes and underwent lower lobectomy and wedge resection of the upper lobe. Patients in the thoracoscopy group were all asymptomatic preoperatively, whereas 58.3% of those in the thoracotomy group had respiratory symptoms (Table 1). There were no significant differences in the average age and weight of the patients between the 2 groups. The median follow-up time was 48 days (range, 2-8.6 years).

2.1. Outcomes between successful thoracoscopic versus open lobectomy

There were 12 cases of successful thoracoscopic lobectomy and 24 cases of open lobectomy (Table 2). In the bivariate analysis, the thoracoscopic group had a significantly shorter hospital stay (median [range], 2 [1-3] vs 5 [2-30] days, $P = .0003$) and duration of postoperative tube

Table 1 Characteristics of patients who had thoracoscopy versus thoracotomy

Predictor variables	Thoracoscopy (n = 12)	Thoracotomy (n = 24)	*P*
	Median (range)	Median (range)	
Weight (kg)	8.2 (5.9-13)	6.0 (1.1-40)	.2 [a]
Age (months)	6.7 (0.1-131.8)	3.7 (4.2-17.8)	.1 [a]
	n (%)	n (%)	
Sex: female	5 (41.7)	14 (58.3)	.5 [b]
Preoperative respiratory symptoms	0	14 (58.3)	.001 [b]
Preoperative pneumonia	0	6 (25)	.08 [b]
Macrocystic (cysts > 5 mm)	5 (41.7)	14 (63.6)	.2 [b]
Laterality: right-sided	7 (58.3)	12 (50)	.7 [b]
Location of CCAM			
Upper only	1 (8.3)	10 (41.7)	
Middle only	0	1 (4.2)	
Lower only	10 (83.3)	13 (50)	
Upper and lower	1 (8.3)	1 (4.2)	.1 [b]

[a] Mann-Whitney *U* test for nonparametric distribution.
[b] Fisher exact test.