Long-Term Outcome after Pneumonectomy at Siriraj Hospital

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ABSTRACT

Objective: The purpose of this study is to identify predictors of long term survival following pneumonectomy and compare New York Heart Association (NYHA) functional classification and ECOG performance status before and after surgery at Siriraj Hospital.
Methods: All fifty three patients having a pneumonectomy between 1998 and 2009 were retrospectively studied. We compared each patient's status before and after surgery. The parameters of survival were tested by univariate analysis, the Kaplan-Meier method, and differences in survival were determined by log-rank analysis.
Results: There were 35 males (66%) and 18 females (34%) with a mean age (standard deviation) of 51±17 years (range 0.7-82 years). The majority of patients were lung cancer (77%) and destroyed lungs from infectious (12%) diseases. The mean follow-up time was 33 months, median 22 months, standard deviation 24 months, ranging between 0 and 131 months. Post-operative complication occurred in 11% of patients (bronchopleural fistula, bleeding, cardiac herniation and recurrent laryngeal nerve injury). Hospital mortality occurred in 7.5% (4 deaths). Late death occurred in 52.8% (28 deaths) including metastasis 30% (16 patients), pneumonia 19% (10 patients), and miscellaneous causes 3.7% (2 patients). Using univariate analysis, non lung cancer (P = 0.035) and the slow growing lung cancer (P = 0.007) were independent predictors of long term survival. The decrease in NYHA functional classification and ECOG performance status after surgery was not significant.
Conclusion: Long-term survival after pneumonectomy for lung cancer occurred in 20% and non lung cancer in 60% of patients. Non lung cancer and the slow growing lung cancer were independent predictors of long term survival. Decreases in NYHA functional classification and ECOG performance status after pneumonectomy were not significant.

Keywords: Outcome, pneumonectomy, functional classification

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INTRODUCTION

Cancer remains the leading cause of death in Thailand. Data regarding the incidence of cancer in Thailand from the National Cancer Institute, Department of Medical Services, Ministry of Public Health[1] reported that the 5 most common cancers which are liver cancer, lung cancer, cervical cancer, colon cancer and breast cancer respectively. Complete surgical resection is the treatment of choice for patients with early and selected locally advanced stage lung cancer. In 1933, Graham and Singer[2] reported the first successful one stage pneumonectomy. Afterwards, the standard operation for lung cancer became pneumonectomy with the technique of individual hilar ligation of the pulmonary vessels and suturing of the bronchus. In 1950, Churchill[3] reported his experience of lobectomies with hilar dissections. As lobectomy has become the standard form of curative resection for lung cancer, pneumonectomy is reserved for patients with centrally located lung cancer that cannot be completely resected using bronchoplastic procedures. Pneumonectomy is performed in nearly 10% of patients with lung cancer.[4] Surgical mortality and morbidity rates are higher than in lobectomy, mortality rates being between 5-10%.[5] Post-operative complication rates are between 40-60%[6] including cardiovascular complications, pneumonia, bronchopleural fistula, delayed extubation, and pulmonary embolus. Pneumonectomy has been documented as extremely harmful in terms of quality of life due to a greater

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TABLE 1. New York Heart Association (NYHA) Functional Classification.[8]

NYHA Class	Symptoms
I	No symptoms and no limitation in ordinary physical activity, e.g. shortness of breath when walking, climbing stairs.
II	Mild symptoms (mild shortness of breath and/or angina) and slight limitation during ordinary activity.
III	Marked limitation in activity due to symptoms, even during less-than-ordinary activity, e.g. walking short distances (20-100 m). Comfortable only at rest.
IV	Severe limitations. Experiences symptoms even while at rest. Mostly bedbound patients.

TABLE 2. The Eastern Cooperative Oncology Group score (ECOG).[9]

Grade	ECOG
0	Fully active, able to carry on all pre-disease performance without restriction.
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work.
2	Ambulatory and capable of all self care but unable to carry out any work activities. Up and about more than 50% of waking hours.
3	Capable of only limited self care, confined to bed or chair more than 50% of waking hours.
4	Completely disabled. Cannot carry on any self care. Totally confined to bed or chair.
5	Dead

incidence of dyspnea and a decrease in physical functions when compared with patients undergoing fewer resections.[7] The long term outcome after pneumonectomy in Thailand remains controversial due to the fact that post-pneumonectomy patients are treated multi-departmentally lacking serial data. The purpose of this study was to identify predictors of long term survival following pneumonectomy and to compare functional status before and after surgery at Siriraj Hospital.

MATERIALS AND METHODS

This study was approved by the Siriraj Institutional Review Board Ethical Committee on September 27th 2010, (EC No. 360/2553). A retrospective study was conducted from the Siriraj Registry Database on all patients who underwent a pneumonectomy at our institute between January 1998 and December 2009. Patients were evaluated for demographic, pre-operative findings, operative findings, post-operative data and pathological report. The follow up was conducted by regular clinic visits. We compared patient's status before and after surgery by use of the New York Heart Association (NYHA)[8] functional classification and ECOG[9] performance (Table 1, 2). The parameters of survival were tested by univariate analysis, the Kaplan-Meier method, and differences in survival times were determined by log-rank analysis

RESULTS

From 1998-2009 (12 years) we performed 2,672 cases of thoracic procedures. Of these, 53 cases (1.98%) were pneumonectomy by the same surgical team for various diagnoses. They were 35 males (66.03%) and 18 females (33.96%) with a mean age (± standard deviation) of 50.74±17 years (range 0.7-82 years). Twenty eight patients were smokers (52.83%).

TABLE 3. Reason for pneumonectomy.

Diagnosis		Case number	%
Cancer group	Primary lung cancer	35	66.04
	Other cancer	6	11.32
Non cancer group		12	22.64
Total		53	100

Forty one patients were diagnosed with cancer and there were 12 non cancer cases. The mean follow-up time was 33 months, median 22 months, standard deviation 24 months, ranging between 0 and 131 months.

In the cancer group, there were 35 cases (66%) of primary lung cancer (Table 3 and 4). These comprised 16 patients (30.18%) with adenocarcinoma, 11 patients (20.75%) with squamous cell carcinoma and eight (15.09%) patients with carcinoid tumor (slow growing tumor). The other diagnoses were pulmonary metastasis, benign lung tumor, mesothelioma, mediastinal tumor, lung infection and chest trauma. The reasons for pneumonectomy in the non primary lung cancer group were that the patients had either massive hemoptysis or obstructive pneumonitis.

Pre-operatively, 30 patients were in class II of NYHA FC (56.60%) and 26 patients were in grade 1 of ECOG performance status (49.05%) (Fig 1). Twenty eight of the lung pathologies were located in the right lung (52.83%) and 25 lung pathologies (47.16%) were in the left (Fig 2).
The number of each staging for primary lung cancer has been shown in Figure 3, 20% for stage I, 30% for stage II, 30% for stage III and 10% for stage IV. The surgical margin of resection for primary lung cancer was free in 31 patients (88.57%) and not free in four patients (11.43%).

There were 6 patients with post-operative complications (11.32%), 3 cases for bronchopleural fistula, one of each for

TABLE 4. Differential diagnosis.

Diagnosis	N	%
Primary lung cancer, adenocarcinoma	16/53	30.18%
Primary lung cancer, squamous cell carcinoma	11/53	20.75%
Other primary lung cancer (carcinoid tumor)	8/53	15.09%
Pulmonary metastasis (ortho 3, colon 2, breast 1)	6/53	11.32%
Benign lung tumor (bronchial adenoma)	1/53	1.88%
Mesothelioma	1/53	1.88%
Mediastinal tumor (AVM, spindle cell CA, teratoma)	3/53	5.66%
Lung infection (TB 2, abscess 3, fungus 1)	6/53	11.32%
Chest trauma	1/53	1.88%

surgical bleeding, cardiac herniation and vocal cord paralysis. There were four hospital mortalities (7.54%), 2 patients with pneumonia, 1 patient with empyema thoracis and 1 patient with severe hypoxemia. The length of hospital stay was 0-77 days (mean 12.39±9 days, median 12 days). After long term follow up, the total number of deaths was 32 cases (60.37%), and the major cause of death were distant metastasis in 16 patients (30%) and pneumonia in 10 patients (18.86%) (Table 5). There was no significant difference in the patients' status before and after surgery by use of the New York Heart Association (NYHA) functional classification and ECOG performance (Fig 4). In figure 5 and 6 the Kaplan-Meier graph has shown the predictor of long term survival, which was 60% in the non cancer group and 20% in the cancer group with the p-value 0.03. There was significant difference in survival times between adenocarcinoma, squamous cell carcinoma, and slow growing lung cancer, and the p-value was 0.007 while the long term survival was not dependent on the staging of lung cancer, surgical margin or chemotherapy treatment.

Fig 1. Pre-operative functional class and ECOG score.

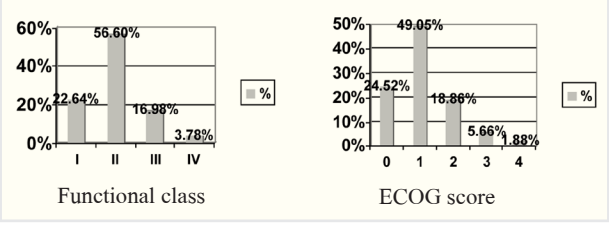


Fig 2. Lung pathology

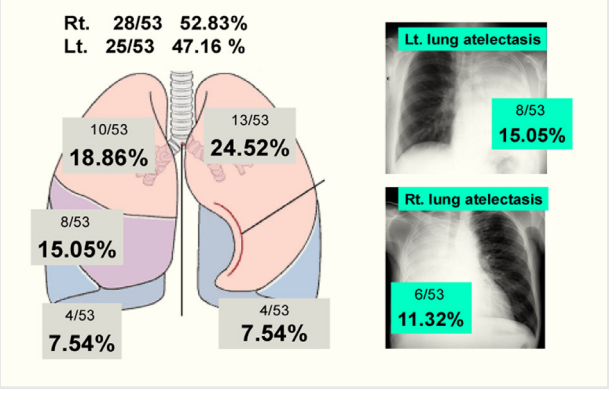


Fig 3. Staging for primary lung cancer.

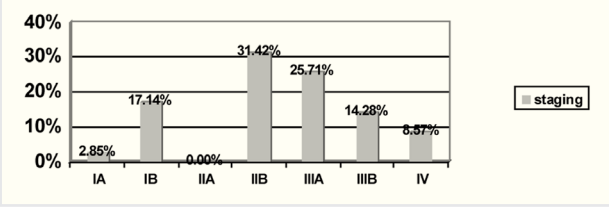


TABLE 5. Cause of death.

Cause of death	N	%
Distant metastasis	16/53	30.18%
Pneumonia	10/53	18.86%
Acute MI	2/53	3.77%
Massive hemoptysis	1/53	1.88%
CVA	1/53	1.88%
Empyema thoracis	1/53	1.88%
Hypoxemia	1/53	1.88%
Total	32/53	60.37%

DISCUSSION

The significant conclusions of this study are; (1) Long-term survival after pneumonectomy for lung cancer

Fig 4. Pre and post-operative NYHA functional class and ECOG score.

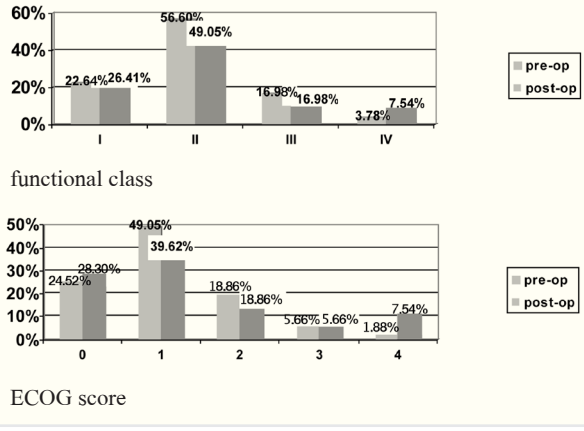


Fig 5. Predictor of long term survival for all of pneumonectomy patients.

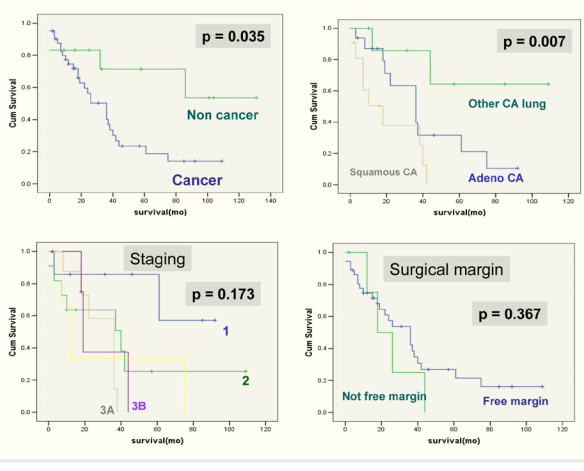
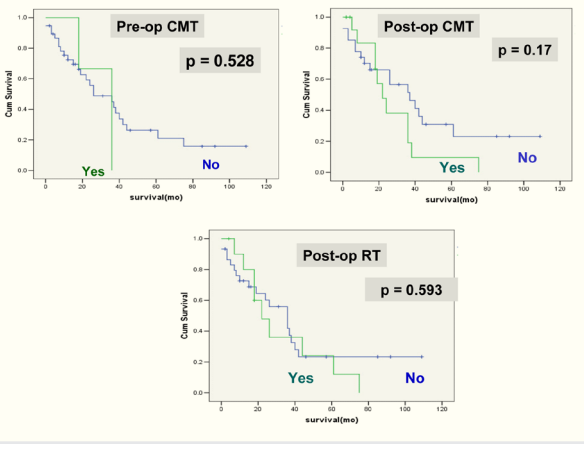


Fig 6. CMT and RT for cancer group patient.



occurred in 20% of patients and 60% in non-lung cancer patients; (2) Non lung cancer and the slow growing lung cancer were independent predictors of long term survival; and (3) Decreases in NYHA functional classification and ECOG performance status after pneumonectomy were not significant. Some research reported that thoracic surgeons will not perform pneumonectomy because they think that the post-pneumonectomy patient will have dyspnea symptom and cannot do their daily activity well. However, this study revealed that patient's functional classification was only worse in 12% of all the patients (Table 6) and there was one patient, a 52 years old male who underwent right pneumonectomy due to stage IIb lung cancer. He can do regular running exercise, 10 kilometers per day. There are limitations of this study due to a small number of pneumonectomy cases, so we included all patients that underwent pneumonectomy and because of being a retrospective study, we were able to collect only 28 cases (52.83%) of FEV1 data, so we excluded FEV1 data in this study. A few researches from Japan[5,6] reported that there was a significant decrease in FEV,1 but they did not mention about the functional classification or performance status in patients who underwent pneumonectomy. Pneumonectomy is reserved for patients with a centrally located lung cancer not suitable for bronchoplastic procedures. The surgical mortality and morbidity are higher than in lobectomy. However, pneumonectomy can offer an acceptable morbidity, mortality and long term survival with good quality of life.

TABLE 6. Pre-post operative ECOG and functional class.

NYHA Functional class (pre-post operation)	Not change	37	75.6%
	Better	6	12.2%
	Worse	6	12.2%
ECOG (pre-post operation)	Not change	26	49.1%
	Better	13	24.5%
	Worse	14	26.4%

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