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Primary vs delayed surgery for spontaneous pneumothorax in children: which is better?

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Abstract

Background: Controversy exists regarding the timing of surgery for spontaneous pneumothorax (SP), which can be performed either after the first development of pneumothorax or after a recurrent spontaneous pneumothorax has occurred. Treatment after recurrence is often adopted because of the purported low recurrence of SP treated nonoperatively and the historical morbidity of open surgery. However, the effectiveness of VATS (to video-assisted bullectomy and pleurodesis) has raised the possibility of performing primary VATS (PV) in all patients. The authors therefore hypothesized that PV is safe and effective for SP and sought to perform a cost-benefit analysis of PV vs secondary VATS (SV).

Methods: After institutional review board approval, consecutive patients with SP (1991-2003) and no comorbidities were retrospectively divided into PV vs SV. Demographics, recurrent pneumothorax after VATS, length of stay, and costs were compared by Student's t test/χ^2. The predicted incremental cost of PV was (cost of PV) − {[cost of nonoperative treatment × (1 − recurrence rate)] + cost of SV × recurrence rate}. Data are means ± SEM.

Results: There were 54 spontaneous pneumothoraces in 43 patients (11 bilateral), of whom 3 were excluded because of open thoracotomy. Of 51 pneumothoraces, nonoperative treatment was attempted in 37, of whom 20 recurred and thus required SV. Primary VATS was performed in 14. Both groups had similar age, sex, weight, height, admission heart rate, and room air oxygen saturation. Total treatment length of stay was significantly shorter for PV vs SV (7.1 ± 0.96 vs 10.5 ± 1.2, $P = .04$). However, morbidity from recurrent pneumothorax after VATS occurred more frequently after PV than SV (4/14 vs 0/20 $P < .05$). Based on the observed recurrence rate of 54%, performing PV on all patients with SP would increase cost by $4010 per patient and require a recurrence rate of 72% or more to financially justify this approach.

Conclusions: Contrary to the hypothesis, the increased morbidity and cost do not justify a strategy of PV blebectomy/pleurodesis in children with SP. Instead, secondary treatment is recommended.

Surgery for spontaneous pneumothorax (SP) includes resection of apical blebs and pleurodesis to adhere the lung to the chest wall [1,2]. Controversy exists regarding the timing of surgery for SP, which can be performed either after the

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Table 1 Demographics of 43 patients presenting to Children's Hospital of Pittsburgh with pneumothorax over a 12-year period

Demographic variable	Value
Males (%)	81
Mean age (y)	15.9 ± 0.3 (5-15)
Right/left (%)	46:54
Smoker (%)	12
LOS/admission (d)	5.6 ± 0.3

first episode (ie, primary surgery) or after a recurrent pneumothorax has occurred (delayed surgery) [1,3]. The later strategy is often adopted because of the purported low incidence of recurrence after initial nonoperative treatment and the historical morbidity of open surgery [4-7]. However, the effectiveness of video-assisted thoracoscopic blebectomy and pleurodesis has raised the possibility of performing primary video-assisted bullectomy and pleurodesis (VATS) in all patients, particularly for the initial episode of SP [8-12]. The argument against performing PV in all patients after the initial SP is that a significant number of patients will not develop a recurrence, resulting in overtreatment of a number of patients [13,14]. We attempted to determine the most effective clinical management strategy for the management of SP and tested the hypothesis that PV is safe and effective for patients with SP. Furthermore, we sought to perform a cost-benefit analysis of PV vs SV.

1. Materials and methods

After approval of the institutional review board at the Children's Hospital of Pittsburgh, the medical records of children with primary SP (1991-2003) were reviewed. For the purpose of this paper, the term *VATS* refers to video-assisted bullectomy and pleurodesis. Patients were retrospectively divided into 2 groups based on their management; those that underwent VATS at the first presentation of the pneumothorax (primary VATS, or PV) and those that underwent primary nonoperative management followed by delayed VATS when the pneumothorax recurred (secondary VATS, or SV). Demographic and clinical data were collected including age, sex, weight, height, vital signs, history of smoking, primary and associated diagnosis, and comorbidities. Patients who underwent computed tomography of the chest were identified and reviewed for presence of apical blebs. All pathology reports were assessed for evidence of blebs in the resected specimens. Outcome measures including complications, length of stay (LOS), and total hospital costs were determined.

To compare the predicted cost of performing PV on all patients that had pneumothorax with the cost of performing SV on only those patients that developed recurrent pneumothorax, the following formula was used: (cost of PV) − {[cost of nonoperative treatment × (1 − recurrence rate)] + cost of SV × recurrence rate}. This equation takes into account the proportion of patients that do not recur after initial nonoperative treatment and therefore predicts the cost derived from patients that would be unnecessarily subjected to a VATS procedure.

Individual measures were compared by χ^2 or Student's t test as appropriate and statistical significance was accepted for $P < .05$. Data are means ± SE.

2. Results

2.1. Demographics

Between 1991 and 2003, there were 54 spontaneous pneumothoraces in 43 patients that presented to the Children's Hospital of Pittsburgh. Bilateral pneumothoraces occurred in 11 patients. Three patients underwent open thoracotomy and were excluded from the study. The demographics of the patients are shown in Table 1. No patient presented with a tension pneumothorax and only 20% of patients requiring supplemental oxygen. Only 5 (12%) patients underwent computed tomography of the chest, and apical blebs were identified in all 5 patients.

2.2. Patient management

Of 51 spontaneous pneumothoraces, nonoperative treatment was attempted in 37 with placement of chest tube in 31 cases. Of these 37 cases, 20 pneumothoraces recurred and required SV. The recurrences occurred at a mean of 4.6 ± 3.7 months after the initial presentation (range, 1-12 months). Primary VATS was performed in 14 cases. Both groups (PV and SV) were similar with respect to age, sex, weight, height, admission heart rate, and room air oxygen saturation (Table 2). Total treatment LOS was significantly shorter for patients undergoing PV as compared with those undergoing SV. However, morbidity from recurrent pneu-

Table 2 Comparison between patients with SP managed by primary vs secondary surgery

Factor	PV	SV	Significance
Age (y)	15.9 ± 0.35	16.1 ± .4	NS
Sex (M/F)	13:1	17:3	NS
Weight (kg)	60.5 ± 2.8	60.1 ± 2.1	NS
Height (cm)	176.1 ± 3.1	174.1 ± 7.1	NS
Heart rate (bpm)	82.5 ± 4.3	79.1 ± 18.3	NS
Room air oxygen saturation (%)	98 ± 1	98 ± 1	NS
Length of stay after VATS (d)	5.4 ± 1.1	4 ± 0.4	NS
Overall treatment charges ($)	23,712 ± 3149	29,724 ± 3678	NS
Recurrence after VATS (recurrences/ total patients)	4/14	0/20	$P = .02$
Blebs on pathology	12/14	15/20	NS
Total LOS (d)	7.1 ± 0.96	10.5 ± 1.2	$P = .04$