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Management of the pediatric spontaneous pneumothorax: is primary surgery the treatment of choice?

Monica E. Lopez, M.D.*, Sara C. Fallon, M.D., Timothy C. Lee, M.D., J. Ruben Rodriguez, M.D., M.M.Sc., Mary L. Brandt, M.D., Mark V. Mazziotti, M.D.

Division of Pediatric Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, TX, USA

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Abstract

BACKGROUND: Surgery as the primary management strategy for pediatric primary spontaneous pneumothorax is controversial. This study aims to evaluate the outcomes and effectiveness of management approaches for pediatric spontaneous pneumothorax.

METHODS: Outcomes of pediatric patients undergoing initial nonoperative treatment versus video-assisted thoracoscopic surgery with blebectomy and mechanical pleurodesis were compared via a retrospective review.

RESULTS: We identified 96 patients with 108 pneumothoraces. Of 98 pneumothoraces with initial nonoperative management, 37% had surgery during their initial hospitalization for persistent air leak. Of those discharged home without video-assisted thoracoscopic surgery, 40% recurred. Initial nonoperative management resulted in more total hospital days (median: 11 vs 5 days, $P < .001$). No significant predictors of recurrence were identified on multivariate analysis. Sixty-three percent of all patients ultimately required surgery.

CONCLUSIONS: Fewer than 40% of primary spontaneous pneumothorax patients are definitively treated with nonoperative management. A prospective study is needed to determine whether primary surgery with blebectomy/mechanical pleurodesis is a more effective treatment strategy.

Primary spontaneous pneumothorax (PSP) is a relatively rare condition in the pediatric population, found in 3.4 per 100,000 children.[1] The disease most commonly occurs in tall, thin teenage men, with a 4:1 male predilection.[1,2] Children with connective tissue disorders and asthma are at an increased risk for developing PSP.[2] Initial management typically consists of supplemental oxygen with timely evacuation of the PSP with needle aspiration, percutaneous placement of a drainage catheter, or tube thoracostomy. Hemodynamic compromise is rare as part of the initial presentation.

The initial management of a first episode of a pediatric spontaneous pneumothorax is a matter of controversy. Historically, all patients were managed nonoperatively

* Corresponding author. Tel.: +1-832-822-3135; fax: +1-832-825-3141.
E-mail address: melopez@texaschildrens.org
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with supplemental oxygen and tube thoracostomy, reserving surgical management via an open thoracotomy for recurrent or refractory cases. However, with the advent of video-assisted thoracoscopic surgery (VATS), definitive operative management of this disease can be achieved with decreased pain, length of hospital stay, and morbidity.[3] As recurrence rates in the pediatric population are reported to be higher than 50%, some surgeons advocate for early VATS aiming for definitive disease resolution and earlier resumption of usual daily activities.[4,5] Others recommend reserving surgery for those who fail nonoperative management because of either persistent communication with the pleural space or recurrent disease to avoid unnecessary surgery in a proportion of patients.[6,7]

The purpose of this study was to evaluate whether primary or delayed surgery is the preferable treatment for the pediatric patient with a spontaneous pneumothorax regarding complications after surgery, recurrence rates, total number of days of hospitalization, and cost of treatment. We hypothesize that in children with spontaneous pneumothorax, primary VATS blebectomy with mechanical pleurodesis is a more effective management strategy than nonoperative treatment, leading to lower complication and recurrence rates, as well as decreased total duration of hospitalization.

Methods

Patient population

After institutional review board approval at Baylor College of Medicine (H-29248), patients diagnosed with a PSP at our institution from 2005 to 2011 were included in the study. All the patients were initially diagnosed with a chest radiograph. Patients with a pneumothorax secondary to underlying lung parenchymal disease (cystic fibrosis), trauma, iatrogenic injury, or infection were excluded. Contralateral pneumothoraces were treated as distinct events. Charts were reviewed for data concerning demographics, initial management, imaging (computed tomography) use, operative details, complications, hospital course, and recurrence rates.

Patient management

The non-VATS approach consisted of administration of supplemental oxygen, insertion of percutaneous catheter, or tube thoracostomy. Percutaneous catheters were placed in the emergency department under conscious sedation. All tube thoracostomies were performed in the operating room. Chest computed tomography (CT) scan was obtained in some patients based on previous history of pneumothorax or physician preference. These were reviewed for the documented presence of unilateral or bilateral blebs. Operative management consisted of VATS, apical blebectomy, and mechanical pleurodesis. Chemical pleurodesis was reserved for management of persistent air leaks. Persistent air leak was defined as persistent bubbling of air within the Pleur-Evac water chamber upon eliciting positive pressure lasting for more than 4 days. Synchronous bilateral VATS, during the same anesthetic event, with therapeutic or prophylactic blebectomy took place for those presenting with bilateral disease in the form of either active bilateral pneumothoraces or unilateral disease with blebs detected contralaterally on CT scan.

Study design

The primary outcomes in this retrospective study were the recurrence rate, the surgical complication rate, the cumulative hospital length of stay, and the variable direct cost of treatment. Direct measurement of variable costs incurred, as opposed to charge-based or reimbursement-based accounting, was chosen as the most accurate measure of cost related to the 2 surgical treatment strategies.[8,9] We compared patients who had a recurrence with those who did not based on demographic characteristics and initial management, which included supplemental oxygen only, tube thoracostomy, pigtail catheter, or primary surgery. A recurrent pneumothorax was defined as the presence of a new ipsilateral pneumothorax on chest radiograph after complete resolution of the previous pneumothorax episode. Complications after surgery were defined as a recurrence, a persistent air leak (>4 days) treated with surgery, wound infection, or empyema.

Chi-square and Student *t* tests were used to compare normally distributed data between these groups. Mann–Whitney *U* tests were used for nonparametric data. A time to event analysis using a Kaplan–Meier survival curve with a log rank test was performed to evaluate for factors influencing the time to recurrence. A logistic regression analysis was performed to assess for independent predictors of recurrence. Clinically relevant determinants of recurrence were included as variables in the multivariate model independently of reaching statistical significance in univariate analyses. All analyses were performed using SPSS Statistics for Windows, Version 19.0 (IBM Corp, Armonk, NY).

Results

During the study time period from 2005 to 2011, 96 patients had 108 pneumothoraces. The majority of patients were male (79%; $n = 76$), with a median age of 16.4 years (range 8.5 to 20.9) and median body mass index (BMI) of 18.8 (range 14.4 to 34.7). Associated comorbidities were noted in 13% ($n = 12$) and included asthma, pectus excavatum, Marfan syndrome, and immunosuppression. Smoking history was not routinely recorded in the medical records. The median initial length of hospital stay was 5.0 days (range 1 to 43), and the cumulative number of hospital days was 7.0 (range 1 to 57).