



Intraoperative chest tube removal following thoracoscopic lung biopsy results in improved outcomes[☆]



Nicole A. Nadlonek^a, Shannon N. Acker^{a,*}, Robin R. Deterding^b, David A. Partrick^a

^a Department of Pediatric Surgery, Children's Hospital Colorado, Aurora, CO 80045, USA

^b Department of Pediatric Pulmonology, Children's Hospital Colorado, Aurora, CO 80045, USA

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ABSTRACT

Background: Traditionally, chest tubes are left following video assisted thoracoscopic surgery (VATS) to treat a potential air leak or significant drainage. Recognizing the potential complications, our aim was to determine if intraoperative chest tube removal in children undergoing VATS lung biopsy is safe and if outcomes differ from when a chest tube is left in place.

Methods: We identified all children who underwent VATS lung biopsies from 2009 to 2013 and performed a retrospective review of the medical records. Pulmonary resection patients were excluded as were those with an air leak present in the operating room.

Results: A total of 90 VATS lung biopsies were performed. 41 children had a postoperative chest tube left in place (Group A), and 49 children had it removed intraoperatively (Group B). Mean age was 9 ± 6.4 years. One child in Group A and 2 children in Group B required replacement of a chest tube ($p = NS$). Group B patients had a lower postoperative pain score on day one, fewer postoperative chest X-rays, and a shorter length of postoperative stay.

Conclusions: These data suggest that intraoperative chest tube removal is safe and may be associated with improved outcomes following lung biopsy in children.

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Although the development of thoracoscopic surgery has led to improved patient outcomes [1], postoperative chest tubes continue to be associated with pain and the need for in hospital management [2]. Chest tubes are typically left in place following video-assisted thoracoscopic surgery (VATS) procedures, specifically after lung biopsies in children. The rationale for this is to drain any residual air leak from the biopsy site and prevent a pneumothorax or to drain excess fluid. However, once the lung is reinflated and there is no evidence of an air leak or significant drainage, the chest tube is no longer necessary [3,4].

In the pediatric population, there is heightened awareness of and concern for postoperative pain, particularly in patients with chest tubes [5]. Most children receive both narcotic and nonnarcotic pain medication to manage postoperative pain, both of which have their own associated side effects. Even in the setting of adequate pain control, the chest tube itself can cause other problems including difficulty with ambulation and splinting, leading to atelectasis. In an attempt to solve these issues, some groups have examined the change in outcomes with early postoperative chest tube removal. In the adult population, early removal of the chest tube, if no air leak is present,

has been shown to decrease both hospital stay and cost [4,6–10]. Furthermore, work by Ponsky et al. in the pediatric population has shown that early removal of chest tubes following thoracoscopic surgery is safe, and results in a low (0.3%) rate of reintervention [3]. Therefore, we hypothesized that intraoperative chest tube removal following VATS lung biopsy in children would be associated with decreased pain, decreased length of hospital stay, and a low risk of reintervention.

1. Methods

Following approval of the Colorado Multiple Institutional Review Board of the University of Colorado School of Medicine we identified all children who underwent VATS lung biopsy at Children's Hospital Colorado, a tertiary care referral center, between May 2009 and March 2013. Patients were identified based on the surgical case log. Patient data were obtained from a review of the medical record. All patients undergoing VATS lung biopsy were included in this study. Patients were excluded if they had a planned open lung biopsy or major lung resection, including lobectomy or segmentectomy, when chest tubes are routinely left in place. We also excluded patients undergoing mediastinal or pleural-based biopsy, Nuss bar placement, or other procedures not involving lung tissue resection. All patients underwent general anesthesia followed by VATS lung biopsy using standard technique with 3 port sites and 1–3 wedge resections. Wedge resections were performed either using 3.5 mm endostaplers, or

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* Corresponding author at: Pediatric Surgery, Children's Hospital Colorado, 13123 E. 16th Avenue, B-323, Aurora, CO 80045–7106. Tel.: +1 720 777 6571; fax: +1 720 777 7271.

E-mail address: Shannon.acker@ucdenver.edu (S.N. Acker).

Table 1
Patient demographics.

	Group A: Routine chest tube management (mean ± SD)	Group B: Intraoperative removal of chest tube (mean ± SD)	p value	Total (mean ± SD)
Number of patients	41	49		90
Age (years)	11.5 ± 6.0	7.0 ± 6.1	0.0008	9.0 ± 6.4
Sex	23 male, 18 female	30 male, 19 female	0.92	53 male, 37 female
ASA score, median (IQR)	3 (3–3)	3 (3–3)	0.97	3 (3–3)
Procedure time (minutes)	76 ± 41	58 ± 48	0.06	76 ± 41

ASA = American Society of Anesthesiologists.

endloop ligation of the lung tissue followed by sharp excision. The integrity of the biopsy site(s) was verified by reinflation of the lung under thoracoscopic visualization, and local anesthetic was infiltrated into the intercostal spaces. At the completion of the case all children had a chest tube placed at least temporarily (while still under anesthesia) to evacuate the pneumothorax and monitor for air leak or excessive bleeding. If neither air leak nor excessive drainage was present, the decision was made to either remove the chest tube prior to waking the patient, or leave it in place for subsequent removal postoperatively. This was entirely up to surgeon preference. All patients had a chest x-ray in the PACU and were admitted to the hospital for a minimum of overnight observation. We do not have an institutional policy regarding management of postoperative chest tubes and care is dictated by the attending surgeon, however, in general, postoperative chest tubes are managed with a trial of water seal in the morning of postoperative day (POD) 1 if no air leak is present and chest X-ray reveals no pneumothorax. Following four hours of water seal, an additional chest X-ray is obtained and tubes are removed if the X-ray is unchanged. Follow up chest X-ray is obtained at the discretion of the attending surgeon.

Data were collected from the medical record regarding the postoperative course. Data collected included length of hospital stay, days with a chest tube in place, need for chest tube replacement or other intervention following chest tube removal, and pain scores on POD 1 and day of discharge, measured with a visual analog scale. These outcomes were compared between those children who had their chest tube removed intraoperatively and those who did not. Patients who had a chest tube in place postoperatively and the presence of an air leak that was evident before leaving the operating room were excluded from analysis to eliminate confounding associated with the presence of the air leak. Given the presence of an electronic medical record during the study period, no data were missing.

Data are presented as means ± standard deviation or median (interquartile range (IQR)) where appropriate. Statistical analysis was performed using a t-test, with significance defined as $p < 0.05$. Categorical data were compared using the Fisher's exact test or Mann Whitney test where indicated. All analysis was conducted in Prism 6.0b (by GraphPad Software, Inc. La Jolla, CA, USA).

2. Results

2.1. Patient demographics

A total of 90 VATS lung biopsies, which met inclusion criteria, ($n = 41$ with postoperative chest tube (Group A), $n = 49$ with no postoperative chest tube (Group B)) were performed during this time period by six different fellowship trained pediatric surgeons with one surgeon performing 53 (59%) cases including 42 (86%) of those in which the chest tube was removed intraoperatively. The remaining cases were relatively evenly distributed among the other five surgeons. There has been no noticeable change in a given surgeon's preference to leave or not to leave a chest tube postoperatively. Demographic characteristics including comparisons between the two groups are shown in Table 1. Mean age was 9.0 ± 6.4 years

(range 0–24), patients in Group B were significantly younger than those in the Group A. Fifty-three patients (59%) were male, this did not differ between the two groups. The median American Society of Anesthesiology (ASA) score was 3 (IQR 3–3), this did not differ between the two groups. Average operative time was 76 ± 41 minutes and was significantly shorter in Group B. Preoperative indication for lung biopsy was divided into two indications: to diagnose a diffuse lung disease (such as interstitial lung disease (ILD)) or to diagnose a localized process (such as a nodule suspicious for malignancy or infection). Thirteen patients (32%) in Group A and 34 patients (69%) in Group B ($p < 0.001$) had the biopsy performed to diagnose diffuse lung disease. Biopsies were more frequently performed with endloops in Group B than Group A (9.8% vs 40.8%, $p < 0.01$).

2.2. Outcomes

Despite the fact that a chest tube was left in place postoperatively, nine patients in Group A (22%) had a pneumothorax (Table 2). One of these patients (2.4%) required replacement of a chest tube after it had been removed. In contrast, two patients in Group B (4.1%) had a postoperative pneumothorax, both requiring placement of a pigtail catheter. Rate of reintervention did not differ between the two groups (2.4% vs 4.1%; $p = 1$). Other complications occurring in patients in Group A included 2 (4.9%) patients with severe postoperative pain, and 1 (2.1%) patient with a pleural effusion that did not require drainage. In Group B, 1 patient (2%) had stridor following extubation, 1 patient (2%) had pulmonary edema, and 1 patient (2%) required overnight monitoring for desaturation. There was one death prior to hospital discharge. This was a patient who underwent lung biopsy to attempt to determine a source of overwhelming sepsis. This patient died secondary to this overwhelming infection. There were no other infectious complications. No patients required conversion to an open procedure.

With regards to patient outcomes (Table 3), children in Group B had significantly fewer days with a chest tube (2.5 ± 2.9 versus 0.4 ± 1.4 , $p < 0.0001$), fewer postoperative chest x-rays (5.9 ± 4.2 versus 3.5 ± 3.5 , $p < 0.0001$), and a shorter median length of stay (5 vs 1 day; $p < 0.001$). Pain score on POD 1 was also lower in group B (3.8 ± 3.2 vs 2.3 ± 2.7 ; $p < 0.05$). At the time of discharge however, there was no difference in pain scores (Group A 1.5 ± 2.2 , Group B 1.2 ± 2.3 , $p = 0.32$).

3. Discussion

The results of the present study demonstrate that intraoperative chest tube removal in children undergoing VATS lung biopsy, when

Table 2
Major complications.

	Group A: Routine chest tube management	Group B: Intraoperative removal of chest tube	p value
Pneumothorax	9 (22%)	2 (4.1%)	0.02
Pleural effusion	1 (2.1%)	0 (0%)	0.46
Required replacement of chest tube	1 (2.1%)	2 (4.1%)	1

Bold type indicates statistically significant findings.

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