

# An Evaluation of the Efficacy of Thoracoscopic Lung Biopsies in Pediatric Patients.

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## Abstract

**Background:** Thoracoscopic lung biopsy (TLBx) is readily available in most pediatric centers. The procedure has proven safer than open thoracic biopsy, but TLBx's impact on treatment is less well-defined. The aim of this study is to determine the current frequency at which TLBx changes clinical treatment.

**Methods:** Consecutive TLBxs performed on patients at Phoenix Children's Hospital between January 2006 and May 2011 were retrospectively reviewed. Data collected included demographic and disease-related data, such as imaging results and tissue pathology.

**Results:** Thirty patients (mean age 9 years  $\pm$  6 years, 33% female) underwent 32 thoracoscopic biopsies (78% immunocompromised; 72% diffuse lung disease). The only complication was persistent air leak (6%). Conversion to thoracotomy occurred in 19% of procedures (all immunocompromised patients). The biopsies resulted in meaningful treatment changes in 97% of cases.

**Conclusions:** TLBxs remains highly effective at providing information which guides therapy. Complications are infrequent, but conversion to open biopsy was necessary in a significant number of immunocompromised patients.

## Background

Thoracoscopic lung biopsy was first used in children by Rogers and his colleagues in the 1970's.<sup>3</sup> Since this first application, there have been advancements in optical equipment and anesthesia techniques. Thoracoscopic equipment has also been adapted for use in children. These reasons have led to a greatly increased application of thoracoscopic lung biopsy in the pediatric population.<sup>3</sup> Currently, the procedure is utilized at the physician's discretion for the diagnosis of various diseases including interstitial lung disease and lung tumors.<sup>3,4</sup>

With the increased availability of thoracoscopic lung biopsy, there has been significant research into the safety of the procedures. Several studies have shown that thoracoscopic lung biopsies pose a minimum risk.<sup>5,6</sup> There is also research showing that thoracoscopic lung biopsies are effective in providing adequate tissue sample for histological diagnosis.<sup>1,7</sup> Initial research by Rothenberg and colleagues, as well as research by Gluer and colleagues, suggest that thoracoscopic lung biopsies meaningfully impact the treatment protocol in pediatric patients.<sup>1,2</sup> The aim of this study is to assess the current impact of TLBx on changes in therapy in the pediatric population and to determine if TLBx continues to play a role in guiding therapy.

## Methods

A retrospective study of consecutive TLBxs was conducted in children who had undergone thoracoscopic surgery at Phoenix Children's Hospital between January 2006 and May 2011. The study sample excluded patients that underwent a thoracoscopic procedure other than TLBxs, such as mediastinal mass biopsies, blebectomies, and fistula repairs. Demographic data (age, gender, and race) as well as clinical data (indications for biopsy, radiology results, pathology, complications from procedure, and follow up information) were collected and reviewed. Data were summarized using descriptive statistics, with Fisher's exact test for comparisons when necessary. Statistical significance was set at alpha of 0.05, with two-sided alternative hypotheses. Analysis was performed using SPSS Statistics (Chicago, Illinois).

**Table 1: Indications for thoracoscopic lung biopsies**

Pulmonary lesion in cancer patients	47%	15
Neutropenic fever in cancer patients	25%	8
Worsening respiratory status	13%	4
Incidental pulmonary lesion	9%	3
Pulmonary lesion with other organ system dysfunction	6%	2

**Table 2: Incidence of complications and conversions in thoracoscopic lung biopsies**

Persistent air leak	6%	2
Diffuse disease	9%	2
Focal disease	0%	0
Immunocompetent patients	14%	1
Immunocompromised patients	4%	1
Conversion to thoracotomy	19%	6
Focal pulmonary disease	33%	3
Diffuse pulmonary disease	13%	3
Immunocompromised patients	24%	6
Immunocompetent patients	0%	0

**Table 3: Diagnosis from thoracoscopic lung biopsies**

Infection	41%	13
Fungal		8
Viral		2
No organism identified		3
Malignancy	28%	9
Ewing		2
Osteosarcoma		2
Lymphoma		1
Hepatoblastoma		1
Neuroblastoma		1
Wilms' tumor		1
AML		1
Lymphoid tissue (no malignancy)	6%	2
Cystic pulmonary airway malformation type 1	6%	2
Bronchiolitis obliterans organizing pneumonia	3%	1
Sarcoidosis	3%	1
Juvenile xanthogranuloma	3%	1
Churg-Strauss vasculitis	3%	1
Extralobar sequestration	3%	1
Normal lung parenchyma	3%	1

**Table 4: Outcomes of thoracoscopic lung biopsies**

Change in treatment	97%	31
Guided antimicrobial therapy		13
Guided chemotherapy or radiation		10
Steroids or immunosuppressants started		3
Therapeutic resection		3
Therapy stopped or transferred to hospice		2
Died		2
No change in treatment	3%	1

**Table 5: Outcomes of thoracoscopic lung biopsies in different patient groups**

	Diffuse disease (23)	Focal disease (9)
Change in treatment	96% 22	100% 9
No change in treatment	4% 1	0% 0
	Immunocompromised (25)	Immunocompetent (7)
Change in treatment	96% 24	100% 7
No change in treatment	4% 1	0% 0

## Results and Discussion

This study reviewed 32 thoracoscopic lung biopsies that were performed in 30 pediatric patients (33% female, ages ranging from 5 months to 19 years) at Phoenix Children's Hospital from January 2006 to May 2011. All but one (97% of biopsies) provided diagnostically usable lung tissue, confirming the effectiveness of thoracoscopic lung biopsy to provide adequate samples for tissue diagnosis. More importantly, all of the 31 adequate lung biopsies providing a diagnosis lead to a change in treatment. The impact was seen in all groups (100% in focal disease, 96% in diffuse disease, 100% in immunocompetent patients, and 96% in immunocompromised patients). Thus, TLBxs appear to play an important role in treatment in pediatric patients regardless of extent of pulmonary disease or immune system status.

For those patients that underwent biopsy, complications were infrequent. The only major complication encountered was persistent air leak in 6% of cases. The difference in persistent air leak in diffuse disease versus focal disease (9% versus 0%,  $p=0.51$ ) and immunocompromised patients versus those with normal immune function (14% versus 4%,  $p=0.35$ ) did not reach statistical significance, but sample sizes were relatively small for these subgroups. The slight increased risk of persistent air leak in diffuse disease likely reflects the widespread damage of lung parenchyma making the lung parenchyma less likely to compress solidly or hold staples in its diseased state. Thus, while TLBx in patients with diffuse disease may carry a slightly higher risk of complication, the overall risk remains low.

Nineteen percent of TLBxs were converted to thoracotomies. While not statistically significant, conversion was more common in focal (33%) compared to diffuse (13%) disease ( $p=0.16$ ), and among immunocompromised (24%) versus immunocompetent (0%) patients ( $p=0.20$ ). Conversion to thoracotomy in immunocompromised patients appears to have been due to difficulties in locating the focal target lesion. For these patients undergoing a minimally invasive procedure, thoracotomy may represent a significant setback in terms of pain and length of stay. The availability of image-guided localization may provide an opportunity to decrease conversion in patients with focal disease.

## Conclusions

As currently applied, the vast majority of TLBxs at our center are done for immunocompromised patients. Thoracoscopic lung biopsy offers adequate tissue samples, meaningfully alters treatment plans, and can be done with a low risk of complications in both focal and diffuse disease. The most common complication is persistent air leak, but need for reoperation is uncommon. Conversion to thoracotomy in immunocompromised patients with focal lesions due to difficulty locating the target lesion does not appear to be uncommon and may represent an opportunity to improve care.

## References

1. Rothenberg S, Wagner J, Chang J, and Fan L. The safety and efficacy of thoracoscopic lung biopsy for diagnosis and treatment in infants and children. *Journal of Pediatric Surgery*. Vol 31 No 1, January 1996; 100-104.
2. Gluer S, Schwert N, Reismann M, Metzelder M, Nustede R, Ure B, and Gappa M. Thoracoscopic biopsy in children with diffuse parenchymal lung disease. *Pediatric Pulmonology*. Vol 43, 2008; 992-996.
3. Bradley R. The role of thoracoscopy in pediatric surgical practice. *Seminars in Pediatric Surgery*. Vol 12 No 1, February 2003; 62-70.
4. Gamba P, Midrio P, Betalli P, Sniijders D, and Leon FF. Video-assisted thoracoscopy in compromised pediatric patients. *Journal of Laparoendoscopic and Advanced Surgical Techniques*. Vol 20 No 1, 2010; 69-71.
5. Bensard D, McIntyre R, Waring B, and Simon J. Comparison of video thoracoscopic lung biopsy to open lung biopsy in the diagnosis of interstitial lung disease. *Chest Journal*. Vol 103 No 3, March 1993; 765-766.
6. Lawal T, Gosemann JH, Kuebler J, Gluer S, and Ure B. Thoracoscopic versus thoracotomy improves mid-term musculoskeletal status and cosmesis in infants and children. *The Annals of Thoracic Surgery*. Vol 87, 2009; 224-228.