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Complication Rates of Medical Thoracoscopy under Local Anesthesia: A Multicenter Study

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ABSTRACT

Background: To determine the complication rates and diagnostic yield of medical thoracoscopy under local anesthesia across multiple tertiary care centers.

Methods: This prospective observational study included 71 adult patients undergoing diagnostic medical thoracoscopy at three tertiary care hospitals over 12 months. Baseline demographics, procedural details, intraoperative findings, complications, and hospital course were recorded using standardized forms. Complications were categorized as immediate or early (within 72 hours). Statistical analysis included Chi-square and t-tests, with a p-value <0.05 considered significant.

Results: The mean age was 54.2 ± 12.7 years, with 59.2% male patients. Suspected malignant pleural effusion was the most common indication (53.5%). Pneumothorax (12.7%), fever (9.9%), and minor bleeding (8.5%) were the most frequent complications. Serious adverse events were rare, with empyema occurring in 2.8% and re-expansion pulmonary edema in 1.4% of cases. No procedure-related mortality was observed. The overall diagnostic yield was 88.7%, with malignancy confirmed in 49.3% and tuberculosis in 25.4% of patients.

Conclusion: Medical thoracoscopy under local anesthesia demonstrates a low complication rate and high diagnostic yield across diverse tertiary care settings. Adherence to standardized protocols and widespread use of ultrasound guidance appear to contribute to procedural safety..

Keywords: Medical thoracoscopy, local anesthesia, complication rate, pleural effusion, multicenter study, diagnostic yield, pneumothorax.

1. INTRODUCTION

Pleural effusion is a common clinical presentation with a broad differential diagnosis, including malignancy, tuberculosis, parapneumonic infections, and less frequent benign causes. While initial evaluation typically involves thoracentesis with fluid analysis, a significant proportion of cases remain undiagnosed after routine biochemical, cytological, and microbiological testing. In such situations, direct visualization and biopsy of the pleura offer the highest likelihood of establishing a definitive diagnosis [1-3].

Medical thoracoscopy, also known as pleuroscopy, is a minimally invasive technique that allows direct inspection of the pleural cavity, targeted biopsies, and therapeutic interventions. The procedure can be performed under local anesthesia with

or without conscious sedation, making it suitable for patients who are unfit for general anesthesia. Over the past two decades, numerous studies have reported diagnostic yields exceeding 85% with low complication rates when performed by experienced operators [4]. Studies demonstrated that complication rates such as pneumothorax and bleeding are generally below 15%, with mortality being exceedingly rare [5-7].

In high tuberculosis prevalence regions such as South Asia, the role of medical thoracoscopy extends beyond malignancy to include the diagnosis of tuberculous pleuritis, which often presents with exudative effusion and non-diagnostic fluid cytology. Local studies from Pakistan and India have shown similar diagnostic yields to those in Western settings, but complication data are less extensively documented. Furthermore, multicenter data are scarce, and procedural practices including the use of rigid versus semi-rigid thoracoscopes, the choice of anesthesia, and ultrasound guidance may vary considerably between institutions [8-10].

Given this background, there is a need for robust, multicenter evidence describing the safety and diagnostic performance of medical thoracoscopy under local anesthesia in our regional context. This study was conducted to determine the complication rates, diagnostic yield, and procedural outcomes of medical thoracoscopy across three tertiary care hospitals, thereby providing real-world data to guide clinical practice and inform procedural standardization

2. METHODOLOGY

Study Design and Setting

This was a multicenter, prospective observational study conducted across three tertiary care hospitals DHQ teaching hospital MTI Bannu, Hayatabad Medical Complex Peshawar and Nishtar Medical University and Hospital Multan with established respiratory medicine units that routinely perform medical thoracoscopy. The study was carried out over a 12-month period, from Jan 2023 to Jan 2024 and followed a standardized protocol agreed upon by all participating centers. Each site designated a local principal investigator responsible for ensuring protocol adherence and data completeness.

A total of 71 consecutive adult patients who underwent medical thoracoscopy under local anesthesia were enrolled. All participants were referred for thoracoscopy following a diagnostic work-up for pleural effusion where initial investigations (including thoracentesis, pleural fluid biochemistry, and cytology/microbiology) failed to yield a definitive diagnosis, or where direct pleural visualization and biopsy were clinically indicated.

The sample size was determined based on an expected complication rate of 10–15% for medical thoracoscopy under local anesthesia, as reported in previous literature. Using a 95% confidence level and a 5% margin of error, the calculated minimum sample size was 68 patients. We recruited 71 patients to account for possible incomplete data and withdrawals, thereby maintaining adequate statistical power.

Inclusion Criteria

Age ≥18 years.

Presence of unilateral or bilateral pleural effusion requiring diagnostic thoracoscopy.

Ability to provide written informed consent.

Suitability for local anesthesia with or without conscious sedation.

Exclusion Criteria

Hemodynamic instability or severe respiratory compromise precluding the procedure.

Uncorrected coagulopathy (INR >1.5 or platelet count <50,000/mm³).

Extensive pleural adhesions known from prior imaging that would prevent thoracoscopic entry.

Known allergy or contraindication to local anesthetic agents.

Refusal to participate.

All patients underwent a standardized pre-procedure evaluation, including a detailed medical history, physical examination, baseline oxygen saturation, and performance status assessment. Laboratory investigations included complete blood count, coagulation profile, renal and liver function tests. Chest radiography and ultrasound of the pleural space were performed in all cases; CT scans were reviewed when available. The decision to use conscious sedation in addition to local anesthesia was individualized based on patient preference, tolerance, and comorbidity profile.

Medical thoracoscopy was performed in a dedicated procedure room or operating theatre under aseptic conditions. Patients were positioned in the lateral decubitus position with the affected side up. Local anesthesia was achieved using 1% lignocaine infiltration at the planned entry site, typically in the mid-axillary line between the 5th and 7th intercostal spaces. Conscious sedation, where applied, involved intravenous midazolam and/or fentanyl in titrated doses.

A rigid or semi-rigid thoracoscope was introduced through a small incision, and the pleural space was inspected systematically. Any adhesions were gently broken down, and targeted biopsies were obtained from abnormal pleural surfaces. The number of biopsies was determined by the operating physician, aiming for a minimum of four specimens. Pleural fluid was aspirated for cytology, microbiology, and biochemical analysis. At the conclusion of the procedure, an intercostal chest drain (20–24 Fr) was inserted and connected to underwater seal drainage.

Patients were monitored in the recovery area for at least two hours before transfer to the ward. Standard post-procedure care included chest radiography to check lung expansion and drain position, regular monitoring of vital signs, and assessment for pain or complications. The chest drain was removed once fluid output was minimal and there was no significant air leak.

A structured case report form was used to capture Demographic details (age, gender, BMI, smoking history, comorbidities). Procedural variables (indication, type of thoracoscope, anesthesia method, use of ultrasound guidance, duration of procedure, number of biopsies). Intraoperative findings (pleural appearance, fluid characteristics, adhesions). Complications (immediate and within 72 hours post-procedure). Hospital course (chest tube duration, length of stay, ICU admission if required). Final diagnosis and diagnostic yield.

Definitions of Complications

Minor bleeding: Oozing controllable without additional intervention.

Pneumothorax: Presence of air in pleural space post-procedure, confirmed radiologically, requiring or not requiring intervention.

Persistent air leak: Ongoing bubbling in the drainage system >48 hours post-procedure.

Re-expansion pulmonary edema: Clinical and radiological diagnosis within 24 hours of lung re-expansion.

Procedure-related mortality: Death occurring within 30 days attributed to the procedure.

To ensure consistency, all participating physicians attended a pre-study meeting to harmonize procedural steps, complication definitions, and data entry. Random cross-checks of case report forms were performed by the coordinating center. Missing data were clarified directly with the site investigator to minimize errors.

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range) depending on distribution. Categorical variables were presented as frequencies and percentages. Normality was assessed with the Shapiro–Wilk test. Between-center comparisons were made using the Chi-square or Fisher's exact test for categorical variables, and independent t-test or Mann–Whitney U test for continuous variables. A p-value <0.05 was considered statistically significant.

3. RESULTS

Among the 71 patients included in this multicenter analysis, the majority (69%) were aged 50 years or older, with a mean age skewing toward the sixth decade of life. Males were more frequently represented (59.2%) than females (40.8%). A smoking history was reported in 39.4% of participants, while the remainder had never smoked. Slightly more than half of the cohort had a BMI below 25 kg/m², and 62% had one or more comorbidities such as chronic respiratory disease, cardiovascular conditions, or diabetes. Statistical analysis revealed no significant differences in these baseline variables between centers ($p > 0.05$), indicating a broadly comparable patient mix across study sites.

Table 1: Demographic Characteristics of Patients Undergoing Medical Thoracoscopy (n = 71)

Variable	Category	Frequency (n)	Percentage (%)	p-value*
Age Group	<50 years	22	31.0	0.412
	≥50 years	49	69.0	
Gender	Male	42	59.2	0.236
	Female	29	40.8	
Smoking Status	Current/Former Smoker	28	39.4	0.153
	Never Smoker	43	60.6	
BMI	<25 kg/m²	37	52.1	0.288
	≥25 kg/m²	34	47.9	
Comorbidities	Present	44	62.0	0.119

	Absent	27	38.0	

*Chi-square test comparing distribution between centers.

Suspected malignant pleural effusion was the leading indication for thoracoscopy (53.5%), followed by tuberculous pleural effusion (26.8%) and parapneumonic/empyema cases (19.7%). Rigid thoracoscopes were utilized in 66.2% of procedures, while semi-rigid instruments were employed in the remainder. Local anesthesia alone was used in 43.7% of cases, whereas 56.3% received additional conscious sedation. Ultrasound guidance was applied in most cases (81.7%), with significant variability between centers ($p = 0.016$). Indication distribution also differed slightly across sites ($p = 0.041$), likely reflecting regional differences in disease prevalence and referral patterns.

Table 2: Procedural Characteristics of Medical Thoracoscopy Cases (n = 71)

Variable	Category	Frequency (n)	Percentage (%)	p-value*
Indication	Suspected Malignancy	38	53.5	0.041
	Tuberculous Pleural Effusion	19	26.8	
	Parapneumonic/Empyema	14	19.7	
Thoracoscope Type	Rigid	47	66.2	0.083
	Semi-rigid	24	33.8	
Sedation	Local only	31	43.7	0.052
	Local + Conscious Sedation	40	56.3	
Ultrasound Guidance	Yes	58	81.7	0.016
	No	13	18.3	

*Chi-square test comparing distribution between centers.

The overall safety profile of medical thoracoscopy under local anesthesia was favorable. Pneumothorax was the most frequently observed complication (12.7%), followed by post-procedure fever (9.9%) and minor bleeding (8.5%). Subcutaneous emphysema occurred in 5.6% of patients, while persistent air leak was noted in 4.2%. Less frequent events included empyema (2.8%) and re-expansion pulmonary edema (1.4%). No procedure-related mortality was reported within 30 days. None of the complication rates demonstrated significant inter-center variation ($p > 0.05$), suggesting uniform procedural safety across participating hospitals.

Table 3: Complications Associated with Medical Thoracoscopy (n = 71)

Complication Type	Frequency (n)	Percentage (%)	p-value*
Minor Bleeding	6	8.5	0.482
Pneumothorax	9	12.7	0.336
Subcutaneous Emphysema	4	5.6	0.579
Fever	7	9.9	0.264
Persistent Air Leak	3	4.2	0.611
Empyema	2	2.8	0.714
Re-expansion Pulmonary Edema	1	1.4	0.822
30-day Mortality	0	0.0	—

*Chi-square test comparing rates between centers.

The average duration of chest tube placement was 3.4 days, with a mean hospital stay of 4.8 days. Diagnostic yield was high (88.7%), confirming the procedure's effectiveness in obtaining definitive histopathological results. Malignancy was the most common final diagnosis (49.3%), followed by tuberculosis (25.4%) and parapneumonic or other benign effusions (25.4%). Notably, diagnostic yield differed significantly between centers ($p = 0.047$), potentially due to differences in patient selection or procedural technique.

Table 4: Hospital Course and Outcomes (n = 71)

Variable	Mean ± SD / n (%)	p-value*
Chest Tube Duration (days)	3.4 ± 1.2	0.184
Length of Hospital Stay (days)	4.8 ± 2.1	0.139
Diagnostic Yield	63 (88.7%)	0.047
Final Diagnosis: Malignant	35 (49.3%)	—
Final Diagnosis: Tuberculosis	18 (25.4%)	—
Final Diagnosis: Parapneumonic/Other	18 (25.4%)	—

*Independent t-test or chi-square test comparing between centers.

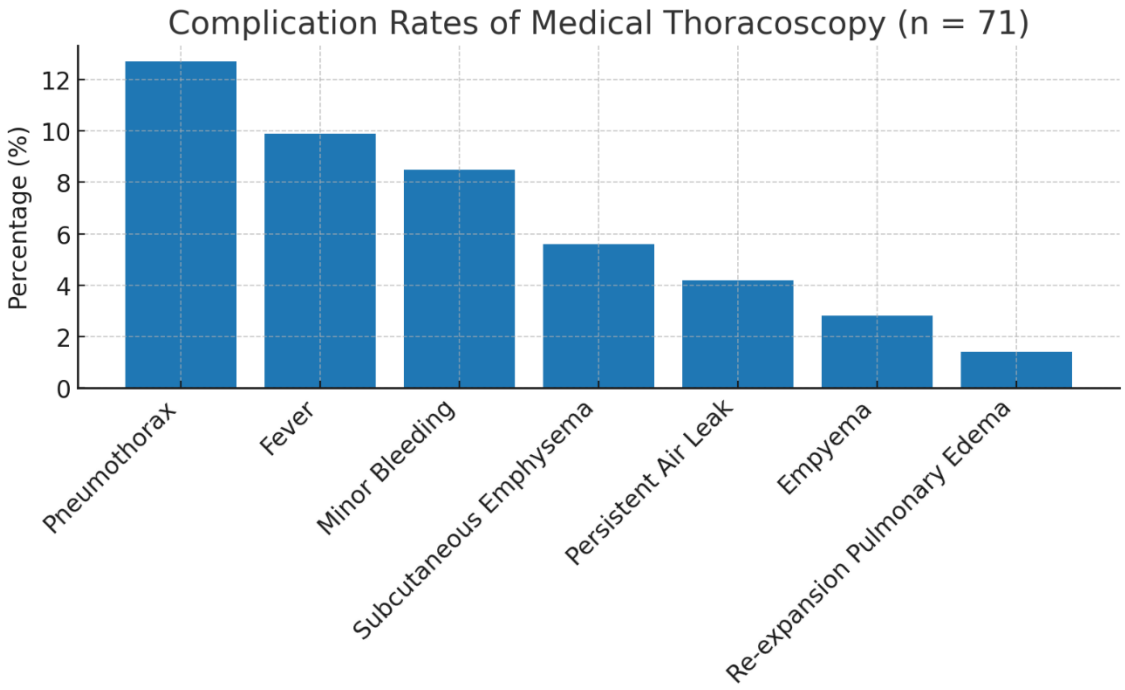

Figure 1: bar graph showing the complication rates from your multicenter medical thoracoscopy study.

4. DISCUSSION

This multicenter prospective study demonstrates that medical thoracoscopy performed under local anesthesia has a favorable safety profile, with overall complication rates comparable to, or lower than, those reported in previous literature. In our cohort, pneumothorax (12.7%) was the most frequent complication, followed by fever (9.9%) and minor bleeding (8.5%). These findings align with a studies, which reported pneumothorax rates of 10–15% following thoracoscopic procedures, most of which were self-limiting and did not require additional intervention [11-13]. Similarly, studies observed that minor bleeding occurred in fewer than 10% of patients, consistent with our data [14].

Our use of local anesthesia, with or without conscious sedation, is noteworthy, as this approach avoids the risks associated with general anesthesia while maintaining diagnostic yield. Previous studies emphasized that local anesthesia thoracoscopy offers a high diagnostic success rate with minimal morbidity, particularly in resource-limited or high-risk surgical populations [15, 16]. The high diagnostic yield in our study (88.7%) is in line with the 85–95% range reported by studies, underscoring the value of this minimally invasive technique in suspected malignant and tuberculous pleural effusions [17].

Ultrasound guidance was used in more than 80% of cases, and this may have contributed to our low rate of major complications. A study have shown that pre-procedural ultrasound not only facilitates safe entry into the pleural space but also reduces the risk of injury to underlying lung tissue, particularly in cases with loculated effusions or adhesions. In our cohort, the variation in ultrasound use between centers ($p = 0.016$) may partially explain subtle differences in procedural safety metrics, though none reached statistical significance for specific complications [18].

Our findings also reflect the low incidence of serious events such as empyema (2.8%) and re-expansion pulmonary edema (1.4%). These are consistent with the rates of <3% reported by Grosu et al. (2014) and suggest that adherence to standardized protocols for post-procedure chest tube management and gradual re-expansion of the lung may be protective. Notably, we recorded no procedure-related mortality, supporting earlier observations by study that with appropriate patient selection and operator experience, mortality from medical thoracoscopy is exceedingly rare [19].

The most frequent indication for thoracoscopy in our study was suspected malignant pleural effusion (53.5%), followed by tuberculous pleuritis (26.8%). This mirrors the epidemiological patterns in both high tuberculosis prevalence regions, such as Pakistan and India, and in cancer-predominant settings in the West. Studies have noted that the spectrum of underlying diagnoses impacts procedural planning and complication risk; for example, extensive pleural thickening in TB may make the procedure technically more challenging. Our diagnostic yield remained high across all indications, demonstrating that the technique remains robust in diverse clinical contexts.[20]

The absence of significant inter-center variation in complication rates, despite differences in case mix and procedural preferences (e.g., rigid vs. semi-rigid scopes, anesthesia type), suggests that the standardized protocol implemented for this study helped maintain procedural safety. This supports earlier multicenter experiences, studies, which showed that uniform training and complication definitions improve both patient outcomes and the comparability of results across sites [21].

Strengths of this study include its prospective multicenter design, use of harmonized definitions for complications, and systematic data capture, which reduce the likelihood of underreporting. However, limitations must be acknowledged. The sample size, while adequate for descriptive analysis, may not have been large enough to detect small differences in complication rates between subgroups. Additionally, follow-up was limited to the early post-procedure period, and late complications may have been missed. Future research should aim for larger, multicenter registries with extended follow-up to better capture long-term safety outcomes.

5. CONCLUSION

Medical thoracoscopy under local anesthesia is a safe and effective diagnostic tool, with low rates of major complications and a high diagnostic yield. Pneumothorax, minor bleeding, and transient fever were the most common adverse events, none of which resulted in significant morbidity or mortality. The consistent safety profile across multiple centers highlights the value of standardized procedural protocols and the role of pre-procedure ultrasound guidance in minimizing risk. In settings where both malignant and tuberculous pleural diseases are prevalent, this technique provides a reliable means of establishing a diagnosis while avoiding the risks of general anesthesia.

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