

Review

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Review

Medical Thoracoscopy in Pleural Effusion Versus Dry Space: A Comprehensive Literature Review on Diagnostic Yield and Complication Rates

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Abstract

Background: Medical thoracoscopy (MT) represents the gold standard for undiagnosed pleural effusions, traditionally performed in the presence of pleural fluid. Recent technical advances have enabled MT in “dry space” conditions (minimal or absent pleural effusion), raising questions about comparative diagnostic efficacy and safety profiles. **Objective:** This literature review aims to evaluate diagnostic yield and complication rates between traditional MT performed in patients with current pleural effusion and dry medical thoracoscopy (DMT). **Results:** MT demonstrates diagnostic sensitivity ranged from 80% to 96.3% and specificity close to 100% for malignant pleural disease and diagnostic accuracy is 99.1% for tuberculous pleuritis. DMT using ultrasound guidance achieves comparable diagnostic yield, with recent studies reporting optimal success rates in pleural access and tissue sampling, and diagnostic sensitivity for malignancy up to 100%. Major complication rates are comparable between MT and DMT, with no significant differences in overall adverse events. Mortality rates remain exceptionally low ($\leq 0.1\%$) for both approaches. **Conclusions:** MT remains a highly effective diagnostic tool for pleural diseases. DMT represents a valid and safe alternative in patients without significant pleural effusion, offering comparable diagnostic yield. Although technically more demanding, DMT expands diagnostic possibilities in selected clinical scenarios.

Keywords: medical thoracoscopy; dry thoracoscopy; pleuroscopy; pleural disease

1. Introduction

Medical thoracoscopy (MT), also known as pleuroscopy or local anaesthetic thoracoscopy (LAT), was originally developed by Hans-Christian Jacobaeus in 1910 in order to determinate the lysis of pleural adhesions to create a pneumothorax as part of collapse therapy for tuberculosis, but subsequently this endoscopic pleural procedure changed its target into a diagnostic and therapeutic method for undiagnosed pleural effusion, becoming the gold standard [1–5]. MT is the gold standard procedure indicated for both therapeutic purposes (e.g. drainage, adhesiolysis in certain cases, and pleurodesis) and diagnostic purposes (e.g. direct pleural inspection and targeted parietal pleural biopsies) across contemporary pleural pathways [3,6–10]. The sampling of pleural tissue is often imperative for patients exhibiting undiagnosed (typically exudative) pleural effusions, wherein conventional methods of pleural fluid analysis and/or less invasive pleural biopsy prove ineffective

in establishing the underlying aetiology [11–15]. The utilisation of MT as the prevailing procedure is attributable to its capacity to facilitate directed biopsies and direct visualisation of pleural abnormalities [6,8,10–12,16]. Modern pleural practice is increasingly distinguishing between physician-directed minimally invasive techniques (single-port, spontaneous ventilation) and surgical video-assisted thoracoscopic surgery (VATS) (more invasive, operative theatre setting, broader surgical capability); this distinction can be attributed to the subsequent introduction and dissemination of VATS, which is performed under general anaesthesia with single-lung ventilation [2,4–6,17–19]. A more recent procedural variation in this evolution is “dry” thoracoscopy, also known as dry space medical thoracoscopy (DMT); this novel strategy, in accordance with the procedural descriptions provided by experts in the field, pertains to the execution of MT in a patient who does not currently have a pleural effusion [30–33].

This narrative review aims to analyse and describe the differences in diagnostic yield, sensitivity, and specificity (often reported as “diagnostic accuracy”) and complication rates between traditional MT performed in the presence of a current pleural effusion and DMT, while specifically identifying evidentiary gaps.

2. Materials and Methods

This effort aimed to conduct a comprehensive review of the literature on medical thoracoscopy (MT) and dry medical thoracoscopy (DMT). To find relevant and influential papers on this topic, literature was examined in major medical databases such as PubMed, Embase and Web of Science from up to March 2026.

Priority was given to clinical studies, reviews and meta-analyses that addressed the diagnostic performance of MT, including diagnostic yield, sensitivity, specificity and accuracy, as well as reported complication rates, and that were published from the early 2000s onwards. To concentrate on more recent and therapeutically relevant findings, prior research and isolated case reports were disregarded.

Studies describing thoracoscopy in the absence or near absence of pleural fluid were given particular consideration, as the objective was to compare MT performed in the presence of pleural effusion with operations carried out in ‘dry space’. Where available, data on safety profiles and diagnostic results were qualitatively analysed and incorporated into a comparative framework.

Rather than following predetermined systematic inclusion criteria, papers were selected based on their relevance to the subject and their contribution to knowledge of procedural outcomes.

3. Results

3.1. Traditional MT (with Current Pleural Effusion): Diagnostic Yield, Sensitivity/Specificity, and Safety

3.1.1. Diagnostic Yield and Diagnostic Sensitivity/Specificity

Direct pleural inspection and targeted biopsy of abnormal pleura are responsible for the consistently high diagnostic performance of traditional MT in undiagnosed pleural effusion across various study designs and clinical contexts [8,10,13,35].

As shown in **Table 1**, a substantial body of retrospective and prospective national and centre researches has been dedicated to the analysis of large thoracoscopy series in cases of undiagnosed pleural effusion, with the majority of studies reporting an overall diagnostic efficiency in a value higher than 90% [2,26,36–39]. In four cases the diagnostic yield reported was lower than 90% [16,40–42], while two single centre retrospective studies, even considering the very low cohort recruited, have recorded a 100% diagnostic efficiency in MT procedures [43,44], the same way as other studies with more consistent cohort of patients [8,13,45,46]. An 8-year experience (n=401) focalised the study on a young population in an endemic nation for TB, reporting a diagnostic yield for tuberculous pleural effusion (TPE) of 91.4%, with no procedure-related mortality and low bleeding rates [2]. Three studies analysed the same cohort of patients between July 2005 and June 2014 (n = 833). The first study

assessed diagnostic yield (92.6%) and overall complications; the second study focused on tuberculous pleural effusion (TPE), demonstrating a diagnostic yield for TPE of 99.1%; the third study investigated malignant pleural effusion (MPE), obtaining results similar to those reported in the preceding literature [35,36,47].

MT is regarded as the reference invasive diagnostic modality when less invasive tests fail, as evidenced by meta-analytic comparisons of MT versus CPB, which demonstrate that MT has a higher pooled sensitivity for undiagnosed exudative pleural effusion while maintaining similar specificity [10–12]. In accordance with the gold standard framing for undiagnosed exudative pleural effusions, reviews of pleuroscopy typically report sensitivity between 80.9% and 96.3% and specificity near 100% for malignant pleural effusion (MPE) [3,5,8,10,13,16,37,41,46] and higher percentages of sensitivity for tuberculous pleural effusion (TPE), while specificity was similarly high as MPE [2,41,43,47].

According to expert reviews in pleural malignancy, thoracoscopic sensitivity can be very high (often cited above 95%) because visually abnormal areas can be directly biopsied. However, the negative predictive value may be limited in settings with a very high pre-test probability (i.e., a “negative” thoracoscopy/biopsy may still be false-negative in certain contexts) [9,13].

Comparisons of devices and techniques have typically indicated that diagnostic yield remains high for all thoracoscopic platforms. For instance, in a study of hospitalised patients with pleural effusions, a retrospective observational comparison (FLEXPLEUR) revealed no significant difference in diagnostic yield between MT performed with a flexible bronchoscope and a semi-rigid thoracoscope (91.1% vs. 87.5%), despite differences in post-procedure complications [28]. Another study conducted a head-to-head comparison between MT performed with semirigid thoracoscope and rigid thoracoscope, showing that the advantages of rigid thoracoscopy include larger biopsy specimens and higher diagnostic yield (97.8% vs 73.3%), whereas semirigid thoracoscopy affords superior intraprocedural image quality [26].

The hypothesis that different biopsy modalities can maintain high yield within MT workflows is supported by biopsy tool comparisons (cryobiopsy vs. forceps), which revealed similar diagnostic yields in unexplained pleural effusion while varied in specimen size characteristics [5].

In instances where thoracentesis and cytology prove ineffective in achieving a diagnosis, minimally invasive thoracoscopy (MT) has been demonstrated to be an extremely successful diagnostic modality for pleural cancer and tuberculosis, as evidenced by numerous reviews [6,12,16,48].

Table 1. Diagnostic yield of traditional MT.

Study	Type of Study	Patient s underg one MT	Diagnosi s of malignan cy*	Diagnosi s of TB	Other diagnosis **	Non- specific pleural disease	Diagnost ic yield
Ferrer et al. 2005 [13]	Prospective	93	63	3	16	11	100%
DePew et al. 2013 [45]	Retrospective	51	24	-	4	23	100%

Dhooria et al. 2014 [26]	Prospective	45	18	11	-	14	97.8%
Wang X.J. et al. 2015 [36]	Retrospective	833	342	333	36	60	92.6%
Patil et al. 2016 [40]	Retrospective	129	73	31	-	18	85.3%
Thomas et al. 2017 [2]	Retrospective	401	21	344	-	12	96.5%
Kho et al. 2020 [41]	Retrospective	209	92	85	-	32	79.4%
Shrestha et al. 2020 [44]	Retrospective	14	11	2	-	1	100%
Sobh et al. 2020 [42]	Retrospective	542	329	112	-	35	87.8%
Jolsana et al. 2021 [43]	Retrospective	25	10	14	-	1	100%
Liu et al. 2022 [16]	Retrospective	94	41	21	1	11	69.8%
Deschuyteneer et al. 2022 [46]	Retrospective	131	51	6	-	74	100%
Namrata et al. 2022 [37]	Prospective	31	11	16	2	2	90.3%
Goh et al. 2024 [8]	Prospective	141	110	14	2	15	100%
Rawat et al. 2024 [38]	Retrospective	84	61	18	-	4	98.8%

Kumar et al. 2026 [39]	Retrospective	376	275	-	66	25	98.1%
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* Diagnosis of malignancy includes pleural malignancy, lung cancer, breast cancer and other neoplasia. ** Other diagnosis includes other infective disease, inflammatory diseases, autoimmune disease and moreover.

3.1.2. Complications and Safety Outcomes

In contemporary cohorts and reviews, traditional MT is generally described as safe, with low rates of significant complications [6,8–10]. As reported in Table 2 below, the most frequent major compliance recorded in several cohorts is pulmonary oedema (PO) secondary to re-expansion of the lung, which in some cases required ICU admission [8,26,37,39]. In the studies included for this review no procedure-related mortality has been found. Most registered minor complication is chest pain with necessity of post-operative analgesia, followed by post-operative fever and subcutaneous emphysema, this last always treated in a conventional way [8,16,26,36–39,44–46]. In the Qatar experience, minor bleeding occurred in 1.2% of cases (n = 401) [2]. In another study, a descriptive series was noted, which identified light bleeding and mild to severe discomfort as typical minor problems [44]. For instance, it has been established that MT has a higher diagnostic sensitivity than CPB but may have different complication profiles [10–12]. One review summarising meta-analytic evidence points out that CPB may be less sensitive but “safer” in pooled comparisons, highlighting a traditional trade-off between invasiveness and diagnostic performance [10]. PO is also noted in reviews as a recognised consequence associated with pleural space drainage/pressure alterations, pertinent to thoracoscopic drainage techniques, and not specific to MT [8,49].

Table 2. Major and minor complications during MT procedures and most frequently occurred.

Study	Major Complications (n)	Minor Complications (n)
DePew et al. 2013 [45]	- Pneumothorax (1)	- Chest pain (3)
Dhooria et al. 2014 [26]	- Re-expansion PO (3)	- Subcutaneous emphysema (5)
		- Empyema (4)
		- Persistent air leaks (4)
		- Fever (4)
		- Infection (3)
		- Minor bleeding (2)
Wang X.J. et al. 2015 [36]	-	- Chest pain (367)
		- Subcutaneous emphysema (67)
		- Fever (44)
		- Minor bleeding (38)
		- Hypotension (4)
		- Empyema (3)
Thomas et al. 2017 [2]	-	- Persistent air leaks (15)
		- Minor bleeding (5)
Shrestha et al. 2020 [44]	-	- Chest pain (3)
		- Minor bleeding (2)

		- Hypoxemia (1)
		- Fever (1)
Liu et al. 2022 [16]	-	- Chest pain (44)
		- Fever (11)
		- Subcutaneous emphysema (7)
		- Minor bleeding (2)
		- Persistent air leaks (2)
Deschuyteneer et al. 2022 [46]	- Trapped lung (3)	- Empyema (3)
	- ICU admission (1)	- Subcutaneous emphysema (1)
		- Haemoptysis (1)
		- Pneumothorax (1)
Namrata et al. 2022 [37]	- Re-expansion PO (1)	- Chest pain (19)
		- Subcutaneous emphysema (3)
		- Fever (3)
		- Minor bleeding (3)
		- Intra-procedural hypotension (1)
Goh et al. 2024 [8]	- Re-expansion PO (2)	- Chest pain (19)
	- ICU admission (1)	- Fever (18)
	- Post-procedural NSTEMI (1)	- Intra-procedural hypotension (7)
		- Persistent air leaks (1)
Rawat et al. 2024 [38]	-	- Persistent air leaks (2)
		- Subcutaneous emphysema (2)
Kumar et al. 2026 [39]	- Bronchopleural fistula (8)	- Chest pain (10)
	- Empyema (3)	- Intra-procedural hypoxia (9)
	- Major bleeding (2)	- Intra-procedural hypotension (5)
	- Re-expansion PO (2)	- Minor bleeding (4)
	- ICU admission (2)	- Subcutaneous emphysema (3)

3.2. Dry Space Medical Thoracoscopy (DMT): Evidence on Diagnostic Performance and Complications

3.2.1. Definition and Procedural Concept (Evidence Base)

Aujayeb and Astoul (2024) define “dry thoracoscopy” as MT carried out without an effusion [9]. The procedure requires three things: firstly, a thoracic ultrasound assessment for lung sliding and pleural surface evaluation; secondly, careful dissection to pleural surfaces; and thirdly, induction of a pneumothorax to create an endoscopic working space is required but not overall necessary, as Yang et al. found out with their retrospective study [50]. According to this procedural description, DMT necessitates experience and precise technique because it is technically more demanding than normal MT carried out in the presence of effusion, where fluid frequently provides an initial working area [9].

3.2.2. Diagnostic Yield, Sensitivity/Specificity, and Complications (Availability of Data)

One of the key findings of this review, constrained to the references provided, is that, in contrast conventional MT in effusion, quantitative outcome data particular to DMT (diagnostic yield,

sensitivity/specificity, and complication rates) is not documented in the incorporated clinical cohorts and reviews [30–34,50]. Consequently, the evidence pertaining to DMT within the reference set is predominantly conceptual and technical in nature, as opposed to being grounded in comparable outcomes [9].

In a similar vein, sources that discuss the challenges of thoracoscopy when pleural adhesions eliminate a pleural space emphasise that “no pleural space” is a major feasibility/safety barrier for MT and that extensive adhesions may be a contraindication [30,33]. This is conceptually relevant to the reasons that DMT necessitates careful ultrasound selection and controlled pneumothorax creation [30,34,50]. While these claims contribute to the discussion around feasibility, they do not offer DMT-specific diagnostic yield or complication incidence in a manner that allows for numerical comparison with MT performed in patients with current pleural effusion [9]. Only a few minor complications have been reported in analysed studies and in two cases intra-procedural lung laceration has been recorded, while Corcoran et al. [34] reported no intra- and post-operative complications [30,32–34].

Table 3. Diagnostic yield of DMT.

Study	Type of Study	Patients undergone DMT	Diagnosis of malignancy *	Diagnosis of TB	Other diagnosis**	Non-specific pleural diseases
Watanabe et al. 2014 [33]	Retrospective	16	12	-	-	3
Corcoran et al. 2015 [34]	Retrospective	67	22	-	1	39
Marchetti et al. 2015 [30]	Retrospective	29	22	-	-	7
Yang et al. 2024 [50]	Retrospective	72	23	19	20	6
Huan et al. 2025 [51]	Retrospective	31	9	8	5	8
Wang et al. 2026 [32]	Prospective	176	80	-	53	-
Ganjaei et al. 2026 [31]	Retrospective	54	13	5	4	32

* Diagnosis of malignancy includes pleural malignancy, lung cancer, breast cancer and other neoplasia. **Other diagnosis includes other infective disease, autoimmune disease and moreover.

4. Discussion

Direct visualisation facilitates targeted pleural biopsies and assessment of pleural extent, and the extant literature consistently supports traditional MT performed in the presence of pleural effusion as a high-yield diagnostic procedure for undiagnosed exudative pleural effusions, especially in suspected pleural malignancy or tuberculosis [8,10,13,35]. The notion that MT is the gold standard invasive diagnostic test when preliminary investigations are non-diagnostic is supported by numerous reviews and meta-analytic syntheses, which consistently describe MT as superior to traditional closed pleural biopsy (CPB) in terms of diagnostic sensitivity for undiagnosed exudative pleural effusions while maintaining high specificity [3,6,10–12]. Furthermore, the position of MT in contemporary pleural oncology pathways is reinforced by the growing emphasis on several histopathological sub-investigation, including molecular profiling in malignancy, obtained from thoracoscopic biopsies in contemporary service models [8,10–12]. Recent studies have demonstrated that modern cohorts can offer tissue samples that are suitable for molecular profiling, in addition to providing accurate diagnoses [8–10,12]. This aligns pleural diagnoses with targeted therapeutic paradigms [8]. A multicentre prospective study protocol, STRATIFY, emphasises that the feasibility,

safety and diagnostic performance in minimal/no effusion has never been prospectively evaluated and may differ from standard MT in larger effusions [20]. This is of particular significance given the paucity of research in this area, as evidenced by Rozman et al. [21]. Prospective studies are required to define diagnostic yield (or sensitivity/specificity) and complication rates for dry thoracoscopy [2,5,6,8–10]. Semi-rigid pleuroscopes, mini-thoroscopes, and adjunct optical/biopsy innovations (e.g. cryobiopsy and advanced imaging such as narrow band imaging and autofluorescence) are examples of technological and procedural advancements that have expanded the scope of MT practice [3,5,6,10,21–29]. Whilst clinically significant events, such as re-expansion pulmonary oedema, are recognised as complications of pleural drainage dynamics more generally, the results of studies of safety outcomes across cohorts and reviews show low major complication rates, with a predominance of minor, self-limited events such as pain, mild bleeding, transient fever and subcutaneous emphysema [2,8,26,38,41,52]. As demonstrated in the works of Goh et al., Namrata et al. and Shrestha et al., it is evident that the two methods are equally effective in diagnosing undiagnosed pleural effusion prior to medical thoracoscopy [8,37,44]. In comparison, the following references demonstrate that the evidence base for thoracoscopy carried out without a current effusion, is noticeably immature [9,30,33,50]. The utilisation of expert procedural terminology in defining DMT as a practicable modality is noteworthy. However, a paucity of data exists regarding diagnostic yield, sensitivity, specificity, and complication rates from dedicated DMT cohorts. This discrepancy is of consequence because DMT essentially modifies the access problem, necessitating operators to establish a functional cavity by inducing pneumothorax following a thorough ultrasound assessment and dissection of the pleura, as opposed to entering a fluid-containing pleural space [9]. Despite the absence of quantitative findings in this particular instance, it is reasonable to hypothesise that such interventions would modify both the feasibility and the risk profile, particularly within the context of adhesion settings where thoracoscopy may present significant challenges or be contraindicated [9,50]. It is evident that the field requires well-designed comparative studies (or prospective DMT registries) to ascertain whether DMT achieves comparable diagnostic performance and safety, and in which patient subgroups it is most beneficial. This is despite the historical and contemporary MT literature firmly establishing MT-in-effusion as highly accurate and generally safe [2,3,8,10,12].

5. Conclusions

A substantial body of research supports the use of traditional medical thoracoscopy (MT) as a highly effective diagnostic tool for undiagnosed exudative pleural effusion. This is especially the case when pleural tissue is required following non-diagnostic pleural fluid testing and in cases of malignancy (including mesothelioma) or tuberculosis or other causes of diseases, i.e. autoimmune diseases. Direct pleural inspection and targeted biopsy have been shown to provide high diagnostic accuracy and sensitivity with generally low major complication rates in contemporary practice and a very low mortality rate. Re-expansion PO requiring ICU recovery is the most frequent major complication reported in several studies. The theoretical possibility exists for the extension of MT to patients not currently exhibiting pleural effusion, through the implementation of DMT. The procedure requires ultrasound evaluation and the induction of pneumothorax to provide a working space is suggested but not always needed to perform the procedure. However, an outcomes-based comparison with traditional MT in effusion is not possible due to the lack of quantitative evidence on diagnostic yield, sensitivity/specificity, and complication rates in the literature that is available. As pleural services continue to modernise with better tools, biopsy techniques, and oncologic tissue requirements, future research should prioritise systematic reporting and comparative evaluation of DMT to clarify its role alongside established MT and image-guided biopsy strategies.

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Abbreviations

The following abbreviations are used in this manuscript:

DMT	Dry space Medical Thoracoscopy
LAT	Local Anaesthesia Thoracoscopy
MPE	Malignant Pleural Effusion
MT	Medical Thoracoscopy
PO	Pulmonary oedema
TB	Tuberculosis
TPE	Tuberculous Pleural Effusion
VATS	Video-Assisted Thoracoscopic Surgery

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