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Original Article

Video-Assisted Thoracoscopic Pleural Biopsy: a Game Changer for Undiagnosed Pleural Effusions

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Abstract:

Background: *VATS pleural biopsy has emerged as a transformative tool that resolves the long-standing diagnostic uncertainty of pleural effusion by offering a safer, minimally invasive, and far more definitive path.*

Materials & Methods: *This longitudinal descriptive study, conducted at NIDCH in Dhaka over 18 months, enrolled adult patients with undiagnosed pleural effusion using a convenience sampling approach. All eligible participants underwent thorough baseline investigations before the VATS procedure, which was performed under anesthesia through a thoracoscopic incision. Suspicious pleural areas were biopsied and sent for histopathological analysis. The procedure concluded with chest drain placement and meticulous wound closure.*

Results: *The majority of VATS patients had a mean age of 50.9 ± 14.7 years; males accounted for 67.7%. Diabetes and hypertension were each present in 25.8% of patients. Pleural thickening was most frequent (48.4%), followed by pleural nodules (16.1%), while 9.7% showed no visible abnormality. The mean procedure time was 99.06 ± 13.52 minutes, with an average hospital stay of 20.45 ± 19.14 days and a treatment cost of 23,225.81 ± 9,572.39 taka; complications included hydropneumothorax, surgical emphysema, wound infection, and empyema thoracis. Metastatic adenocarcinoma was the most frequent diagnosis (29%), followed by tuberculous pleuritis (19.4%), chronic pleuritis (13%), malignant mesothelioma (3.2%), clear cell carcinoma (3.2%), and a diverse group of other conditions (32.2%).*

Conclusion: *The study revealed that VATS pleural biopsy safely diagnosed a wide variety of conditions while maintaining low complication rates and manageable hospital stays.*

Keywords: Video-assisted thoracoscopic surgery, Pleural biopsy, Undiagnosed pleural effusion, Thoracoscopy, Minimally invasive techniques, Pleural pathology.

Introduction:

Pleural effusion, a common clinical problem characterized by abnormal fluid accumulation in the pleural space, remains a significant diagnostic challenge, with up to 40% of cases undiagnosed after conventional investigations such as cytology and radiology.[1-4] While blind closed pleural biopsy offers high sensitivity for tuberculous pleural effusion, its yield is notably lower for malignancy due to the patchy nature

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and dangerous anatomical locations of malignant deposits.[3,5,6] Video-Assisted Thoracoscopic Surgery (VATS) has emerged as a minimally invasive, highly effective solution for diagnosing undiagnosed pleural effusions, offering direct visualization and targeted biopsy under local anesthesia.[1,5] The increasing adoption of VATS globally reflects its advantages in both diagnostic yield and safety, addressing the limitations of traditional approaches and meeting the pressing need for definitive diagnosis in complex cases.[2,7,8] This study explores the role of VATS pleural biopsy as a game changer for patients with undiagnosed pleural effusions, aiming to highlight its impact on clinical decision-making and patient outcomes.

Materials and Methods:

This longitudinal descriptive study was conducted over 18 months, from January 2023 to July 2024, at the National Institute of Diseases of the Chest & Hospital (NIDCH), Mohakhali, Dhaka. It focused on adult patients over 18 years with undiagnosed pleural effusion. Using a convenience sampling technique, a total of 31 patients meeting the inclusion criteria were enrolled, while those with high surgical risk or organ failure were excluded. The study received ethical approval from the Institutional Review Board of NIDCH, and all procedures adhered to the principles of the Helsinki Declaration, ensuring transparency, voluntariness, and informed participation. Each respondent provided written consent after a clear explanation of the study's purpose, risks, and benefits, with strict confidentiality maintained and participation allowed only for those who agreed willingly. Before the procedure, all participants underwent baseline laboratory investigations, including CBC, ECG, echocardiogram, coagulation profile, renal and liver function tests, and spirometry. Under either general or local anesthesia, a 3–5 cm incision was made in the fourth or fifth intercostal space, and a thoracoscope was introduced after confirming lung collapse and the absence of adhesions. All visually suspicious pleural areas were carefully biopsied, and samples were sent for histopathological examination to establish a definitive diagnosis. Following tissue sampling, an intercostal chest drain was inserted and wounds were closed in anatomical layers. Data were gathered through a semi-structured questionnaire and a data collection sheet. Data was analyzed using SPSS Version 29, with continuous and categorical variables summarized using appropriate descriptive measures. Group differences were assessed with chi-square, t-tests, or Mann–Whitney tests as suited, and statistical significance was defined at a two-sided p-value <0.05.

Results:

As shown in Table 1, the majority of VATS patients were middle-aged to older adults, with a clear predominance of males over females. Most participants presented with at least one major comorbidity, particularly diabetes mellitus and hypertension.

Table 1: Distribution of respondents by demographic variables (N=31).

Variables	VATS Patients (%)
Age	
>18-29	4 (12.9)
>30-39	3 (9.7)
>40-60	18 (58.1)
>60	6 (19.4)
Mean ± SD	50.9 ± 14.7
Sex	
Male	21 (67.7)
Female	10 (32.3)
Comorbidity	
Diabetes Mellitus	8 (25.8)
Hypertension	8 (25.8)

As described in Table 2, pleural thickening emerged as the most common morphological finding among patients undergoing VATS pleural biopsy, followed by a smaller proportion presenting with pleural nodules or a combination of abnormalities. Only a few patients exhibited pleural plaques or had no detectable pleural changes on thoracoscopic examination.

Table 2: Distribution of respondents by pleural morphology (N=31).

Variables	VATS Patients (%)
Pleural nodule	5 (16.1)
Pleural thickening	15 (48.4)
Pleural plaque	1 (3.2)
Pleural nodule and thickening	5 (16.2)
Pleural nodule and plaque	1 (3.2)
Pleural thickening and plaque	1 (3.2)
No findings	3 (9.7)

In Table 3, patients undergoing VATS pleural biopsy experienced moderate procedure times and hospital stays, with post-procedure pain typically managed by

intravenous medication for several days. The overall treatment cost remained within a reasonable range, and complications were infrequent, with only a few cases of hydropneumothorax, surgical emphysema, wound infection, or empyema thoracis observed. These findings collectively reflect the procedure's safety and practical feasibility in managing undiagnosed pleural effusion.

Table 3: Distribution of respondents by post procedure variables (N=31).

Variables	VATS Patients (Mean±SD)
Procedure time (minutes)	99.06 ± 13.52
IV medication required for pain (mean ± SD in days)	7.13 ± 3.75
Hospital stay (days)	20.45 ± 19.14
Cost (taka)	23225.81 ± 9572.39
Complications	
Hydropneumothorax	1
Surgical emphysema	1
Wound infection	2
Empyema thoracis	4

As presented in Table 4, metastatic adenocarcinoma and tuberculous pleuritis emerged as the most common histological diagnoses among patients with undiagnosed pleural effusion. Other cases included a spectrum of chronic inflammatory and rare malignant conditions. No cases of metastatic squamous cell or spindle cell carcinoma were identified. This diverse histological landscape highlights the critical diagnostic value of VATS pleural biopsy in revealing both malignant and benign etiologies.

Table 4: Distribution of respondents by histological type (N=31).

Variables	VATS Patients %
Metastatic Adenocarcinoma	9 (29)
Metastatic Squamous Cell Carcinoma	0 (0)
Tuberculous Pleuritis	6 (19.4)
Chronic Pleuritis	4 (13)
Malignant Mesothelioma	1 (3.2)
Clear Cell Carcinoma	1 (3.2)
Spindle Cell Carcinoma	0 (0)
Others	10 (32.2)

Discussion:

In our cohort, the age profile and male predominance among patients undergoing VATS pleural biopsy echoed findings in other studies, where the mean age ranged from 47.13 ± 17.61 to 56.5 ± 14.2 years and male proportions varied between 60% and 73.3%.[1,9-12] The presence of comorbidities such as diabetes mellitus and hypertension was a shared feature, though the rates in our series were somewhat higher than the 5.3% to 15% for diabetes and around 10% for hypertension reported in other studies.[9,11] Smoking was also a common risk factor in comparative cohorts, found in 30% to 40% of patients.[1,11,12] These demographic and clinical parallels reinforce the representativeness of our study population within the broader context of VATS for undiagnosed pleural effusion.

In our study, pleural thickening emerged as the most common thoracoscopic finding, accompanied by a moderate presence of pleural nodules and only isolated cases of pleural plaques or combined morphologies, with a few patients showing no abnormalities. In other research papers, pleural nodules were reported at much higher rates, with findings such as 68% and 90%, while pleural thickening was noted in 55% of cases and pleural plaques in 10%.[1,10,11] This variability across studies may reflect differences in patient selection, disease stage, or local epidemiology, but consistently highlights the heterogeneous nature of pleural morphology in undiagnosed effusion evaluated by VATS.

In our research, the average procedure time and length of hospital stay after VATS pleural biopsy were consistent with those observed in other journals, where procedure times were typically around 90 minutes and hospital stays averaged about 15 days.[9] The incidence of post-procedural complications in our series, such as hydropneumothorax, surgical emphysema, wound infection, and empyema thoracis, was generally low and in line with the variable but mostly modest rates seen elsewhere hydropneumothorax ranged from 0% to 25%, surgical emphysema from 2.2% to 25%, wound infection from 4.4% to 37.5%, and empyema around 5% in other studies.[1,9-12] These findings collectively reinforce the procedural safety and manageability of VATS pleural biopsy, while also highlighting the potential for complications observed in real-world practice.

In our investigation, metastatic adenocarcinoma was the most common histological diagnosis, followed by tuberculous pleuritis, chronic pleuritis, and a few cases of malignant mesothelioma and other rare malignancies,

reflecting the diverse spectrum encountered in undiagnosed pleural effusion. In other research, malignancy accounted for the majority of diagnoses, such as 52.6% and 86.5%, with metastatic adenocarcinoma being the leading type, while the proportion of tuberculous pleuritis ranged from 6.6% to 36.8% and chronic pleuritis from 13.5% to 20%.[9-11] Malignant mesothelioma rates varied widely, from 5% up to 46.2% in different cohorts.[10,11] These comparisons emphasize both the diagnostic breadth provided by VATS pleural biopsy and the variation in underlying etiologies of pleural effusion across different populations.

Conclusion:

VATS pleural biopsy proved to be a safe and effective diagnostic tool for undiagnosed pleural effusions, uncovering a broad spectrum of underlying conditions and demonstrating favorable procedural outcomes. However, these findings should be interpreted with caution, as the study's single-center design, limited duration, and dependence on operator expertise may constrain their generalizability and fail to capture long-term results. Despite these limitation, this study offers valuable insights that can inform clinical decision-making and optimize patient care in thoracic surgery. Its finding highlight the promising role of VATS pleural biopsy as an integral tool in the evolving landscape of pleural disease management.

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Conflict of interest: There is no conflict of interest.

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