Awake Versus Intubated Uniportal VATS Pleural Biopsy for the diagnosis Exudative Pleural Effusion: A prospective Single tertiary center study

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Abstract

Background: Using pleural fluid cytology and additional biochemical criteria, pleural effusion is typically diagnosed. The diagnostic utility of pleural fluid cytology is very high. Exudative effusions linked to TB or cancer are the most often misdiagnosed. For these reasons, targeted pleural biopsy using both awake and intubated uniportal video-assisted thoracoscopic surgery (VATS) is the basis for a definitive diagnosis.

Objectives: In order to diagnose exudative pleural effusion, this study compares the safety and effectiveness of awake video-assisted pleural biopsy (AVATS) with video-assisted thoracoscopic surgery (VATS).

Patients and methods: This prospective study was conducted at Menoufia University Hospital's Cardiothoracic Surgery department. Sixty patients who had an undetected exudative pleural effusion were included in the study. Group A: Awake Uniportal VATS (AVATS) and Group B: Uniportal Intubated VATS (Control Group) were the two randomly selected groups into which the patients were placed. Medical histories, clinical examinations, laboratory tests, and radiographic investigations were all performed on the patients. Age, gender, comorbidities, procedure safety, length of hospital stay, operation duration, and necessity for additional surgical procedures were also compared.

Results: Operation time differed significantly between groups ($p<0.001$), while hospital stay was shorter in the AVATS group but not statistically significant ($p=0.06$).Neither surgery was linked to any deaths, and there was no statistically significant difference in the rates of complications between the two groups ($p=0.556$).

Conclusion: For the evaluation of an undetected exudative pleural effusion, uniportal AVATS and VATS pleural biopsies are equally effective and safe.

Keywords: AVATS; Biopsy; Pleural effusion; VATS.

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Introduction

A pleural effusion refers to the excessive accumulation of fluid within the space between the layers of the pleura surrounding the lungs. Pleural effusion may indicate a variety of underlying medical conditions. Most of the time, pleural fluid cytological analysis and additional biochemical parameters can be used to determine the etiology. Despite diagnostic testing, about 20% of cases are still undiagnosed**(Light, 2006).** Pleural effusions that still undiagnosed frequently provide a challenging diagnostic conundrum, necessitating further surgical procedures to determine the source **(Ali et al., 2019).**

Early diagnosis and the facilitation of therapy with minimally invasive surgery are the primary objectives of evaluating undiagnosed pleural effusion. For the treating physician, the typical appearance of many pleural effusion causes, each with a unique treatment, presents a clinical conundrum or dilemma. Even after closed needle pleural biopsy and biochemical, bacteriological, and cytological analysis of the pleural fluid, about 30 to 40 percent of patients are still undiagnosed **(Rahman et al., 2010).** According to a study conducted by Chernow B. and San S. A., malignant pleural effusion served as the first indicator leading to a cancer diagnosis in 46% of patients **(McDonald et al., 2018).**

The mean diagnostic accuracy of pleural fluid cytology is approximately 60% **(Hallifax et al., 2014).** Obtaining a second fluid sample may improve the detection rate by an additional 27%; however, this approach is of limited practical benefit **(Dhooria et al., 2014).** Varied populations have varied causes of exudative effusions, and the majority of unexplained exudative effusions are linked to tuberculosis or cancer **(Rodriguez et al., 1989)**. pleural effusion has been documented in 15% of patients who passed away from cancer. The identification of exudative effusions is crucial for these reasons. The final diagnosis depends on targeted pleural biopsy performed by video-assisted thoracoscopic surgery (VATS) or conscious or awake thoracic surgery **(Jacobaeus, 1913).**

In order to treat pulmonary tuberculosis, Swedish physician Hans Christian Jacobius performed the first awake thoracoscopic surgery (AT) in the early 1900s using a cystoscope **(Michaud et al., 2010).** Despite being the most widely used word, awake thoracoscopy (AT) is also referred to by a number of other names, including medical thoracoscopy, non-intubated thoracoscopy, and local anesthetic thoracoscopy. Under conscious sedation and local anesthesia, a pulmonologist or surgeon can do AT in the operating room (OR), clean bronchoscopy unit, or endoscopy **(Kern et al., 2015).** This method uses a disposable flexible trocar and places the patient in the lateral position. Using a thoracoscope, pleural drainage and biopsy are performed **(Irons et al., 2017).** A thoracic surgeon performs VATS in the operating room while under general anesthesia, necessitating single-lung breathing **(Klijian et al., 2014).** Using a rigid scope, pleural biopsy and drainage are performed. Following clear view of the whole pleura, both methods enable targeted pleural biopsies. Both methods have been shown in the literature to produce similar outcomes for diagnosing undetected exudative pleural effusions, particularly malignant pleural illness **(Irons et al., 2016).** For patients with significant comorbidities who are at risk and not appropriate candidates for single-lung ventilation or general anesthesia, AT offers an alternate

diagnostic technique. **(Bedetti et al., 2018; Pompeo, 2014)**.

For unidentified exudative pleural effusions, this study compares the safety and effectiveness of VATS and AVATS pleural biopsy.

Patients and methods

Sixty patients with an unexplained or undiagnosed exudative pleural effusion despite thorough clinical, laboratory, imaging, and pleural fluid evaluations presented to our hospital from May 2023 to May 2025 were included in this prospective study, which was carried out at the Department of Cardiothoracic Surgery, Menoufia University Hospital. The Menoufia University Research Ethics Committee granted ethical permission.

"According to Light's criteria **(Light, 2006),** exudative effusions were characterized by a pleural fluid protein/serum protein ratio greater than 0.5, a pleural fluid LDH/serum LDH ratio greater than 0.6, or pleural fluid LDH surpassing two-thirds of the upper normal serum LDH limit".

Eligibility criteria

Inclusion: Patients ≥18 years old with pleural effusion of unknown cause. **Exclusion:** Patients with hemodynamic instability, severe cardiac dysfunction, previous thoracic surgery, or bleeding diathesis were not considered eligible.

Data acquisition

After obtaining informed consent, eligible participants were subjected to the following:

A. History-taking – Comprehensive assessment of presenting symptoms, associated comorbidities, lifestyle habits (e.g., smoking, alcohol intake), and prior therapies. Comorbid diseases were documented for both groups and stratified according to the Charlson Comorbidity Index (CCI) **(Charlson et al., 1987).**

B. Clinical examination – General physical assessment, vital sign monitoring, and detailed chest examination.

C. Investigations –

- **Laboratory studies:** complete blood count (CBC), coagulation profile, liver and kidney function tests, and sputum smear analysis. Diagnostic thoracocentesis was carried out, and pleural fluid samples underwent biochemical, cytological, and bacteriological assessment, including protein, glucose, LDH, pH, leukocyte counts, Gram staining, aerobic/anaerobic culture, AFB smear, malignant cytology, and adenosine deaminase (ADA) activity.
- **Radiological imaging:** standard posteroanterior and lateral chest X-rays, in addition to computed tomography (CT) of the chest.

Study groups

Patients with undiagnosed exudative effusions were randomly allocated, using a computer-generated block randomization method, into two equal groups (n=30 each):

- **Group A (Awake Uniportal VATS; AVATS):** Pleural biopsies were performed single port under local anesthesia with lidocaine infiltration and mild sedation. Patients were positioned in supine position to enable easy intubation if needed.
- **Group B (Control – Uniportal Intubated VATS):** Pleural biopsies were obtained through single port under general anesthesia with single-lung ventilation. Patients were positioned in lateral position where operating side up .

The main outcome measures compared between the two groups were diagnostic yield, safety profile, operative duration, and length of hospital stay.

Follow-up

All patients underwent outpatient surveillance with serial chest radiographs over a 6-month period.

Ethical considerations

The study was ethically approved by the Research Ethics Committee, Faculty of Medicine, Menoufia University (Approval No. 5/2023 CARS 2-1), and written informed consent was obtained from every participant.

Statistical analysis

All statistical procedures were performed using SPSS software, version 20 (IBM Corp., Armonk, NY, USA). quantitative data as mean ± standard deviation and qualitative data as frequencies (n) and percentages. Chi-square (and when applicable Fisher's exact test) was used to compare the frequencies. P-values of less than 0.05 were considered as statistically significant.

Results

Sixty patients underwent pleural biopsy using AVATS or VATS (30 each). Both groups were similar demographically. Diagnostic adequacy was 96.6% for AVATS and 100% for VATS. Regarding final histopathological results malignancy was the most common finding in both groups. In group A there were 14 (46.67%) case with malignancy (metastatic adenocarcinoma mostly lung in 6 cases, metastatic adenocarcinoma mostly breast primary in 4 cases, metastatic carcinoma mostly ovarian primary in 3 cases and malignant mesothelioma in 1 case), granulomatous inflammation (pleural TB) in 8 (26.67%) cases, nonspecific inflammation in 7 (23.33%) cases and insufficient sample in 1 (3.33%) case. while in group B there were 16 (53.33%) case with malignancy (metastatic adenocarcinoma mostly lung in 10 cases, metastatic adenocarcinoma mostly breast primary in 4 cases and malignant mesothelioma in 2 cases), granulomatous inflammation (pleural TB) in 9 (30%) cases and nonspecific inflammation in 5 (16.67%) cases (**Table.1**).

Table 1. Patients distribution according to final diagnosis

Diagnosis	AVATS Group (n=30)	VATS Group (n=30)	P value
Malignant	14	16	0.438
Granuloma	8	9	0.774
Nonspecific	7	5	0.518
Insufficient sample	1	0	0.50*
Total	30	30	

*Fisher's exact test

Complications occurred in 4 patients (13.3%) in the AVATS group and in 3 patients (10%) in the VATS group. The types of complications were mostly minor, and no deaths were reported. There was no significant difference in complication rates between the two groups (p=0.556), (**Table.2**).

Table 2. Patients distribution according to postoperative mortality and complications

Complication	AVATS Group (n=30)	VATS Group (n=30)	P value
Loculated effusion	1(3.3%)	1(3.3%)	0.754*
Air leak	2 (6.7%)	0 (0%)	0.492*
Empyema	1(3.3%)	0 (0%)	0.50*
Surgical emphysema	0 (0%)	1(3.3%)	0.50*
Arrhythmias	0 (0%)	1(3.3%)	0.50*
Mortality	0 (0%)	0 (0%)	*In#*
Total	4 (13.3%)	3 (10%)	0.556

*Fisher's exact test ; In#Inapplicable

AVATS showed a significantly shorter operation time than VATS ($p < 0.001$) and a slightly shorter, though insignificant, hospital stay ($p = 0.06$). Pleural decortication occurred only in two VATS cases, with no significant difference between groups ($p = 0.02$), (**Table.3**).

Table 3. Patients distribution according operation time and length of hospital stay.

Variables	AVATS Group (n=30)	VATS Group (n=30)	P value
Operation time (min)	25.19± 7.5	55.8±9.5	<0.001
Length of hospital stay (day)	2.71 ±0.72	2.9 ±1.3	0.06
Pleural decortication	0 (0%)	2 (6.7%)	0.02

Discussion

In patients with an undetected exudative pleural effusion, we discovered that the diagnostic efficacy of awake VATS pleural biopsies and single-portal VATS pleural biopsies is comparable. Both groups experienced few complications, and there was no discernible statistically significant variation in the rates of complications. This is in line with earlier research that shown that advanced age, comorbidities, and performance status increased the risk of problems for patients **(Agarwal et al., 2013; Page et al., 1989; Harris et al., 1995).**

Because of the common comorbidities linked to the hazards of general anesthesia, patients with pleural effusion are the best candidates for AVATS **(Peto, 2012; Alrawi et al., 2002)**.

Only local anesthesia and sedation were used for the AVATS method pleural biopsy in our study. Although the AVATS technique has been successfully used for several important thoracic procedures, the majority were carried out with paravertebral block or thoracic epidural anesthesia **(Gonzalez-Rivas et al., 2016; Tacconi et al., 2016).** In addition to being challenging to administer, thoracic epidural anesthesia carries a higher risk of spinal cord injury and dural puncture than lumbar

anesthesia **(Crawford et al., 1952).** Additionally, not all patients are candidates for thoracic epidural anesthesia; those with coagulation abnormalities, those undergoing anticoagulant therapy, those with local infections, or those who have had prior spinal surgery should not have this procedure.

The patient is positioned in the lateral decubitus position with the afflicted hemithorax up in the majority of AVATS pleural biopsy studies, which is nearly the same as the VATS posture **(Yeung et al., 2016).**

Alrawi et al. (2002) managed cases of pleural effusion using awake video-assisted thoracic surgery (AVATS) for pleural biopsy and fluid evacuation, performed with patients positioned supine under local anesthesia combined with conscious sedation.

Similarly, Klijian et al. (2014) reported on a series of 293 individuals who underwent AVATS procedures using local anesthesia with sedation, encompassing a wide range of thoracic interventions such as decortication, pleural sampling, pleurodesis, bullectomy, wedge resection, lobectomy, and creation of pleuropericardial windows. A little gel pad was positioned beneath the operation side while the patients were in the supine position **(Klijian et al., 2014).** The chest tube procedure lasted an average of 1.2 days. Thirty-three patients had pleural biopsies during their one-day hospital stay, while 68 patients received decortication during their 2.5-day hospitalization. Similarly, 96 patients between the ages of 80 and 104 had AVATS in a supine position while under local anesthetic and sedation **(Katlic et al., 2015).** Empyema drainage, pleural biopsy/effusion drainage, hemothorax, pleuropericardial window, chylothorax, lung biopsy, and pneumothorax were among the procedures performed, either with or without talc pleurodesis. The average operating time for empyema and pleural effusion was twenty-four minutes. No patient required nerve block analgesia, epidural, or intraoperative intubation.

To make intubation easier in the event of an emergency, our study found that AVATS patients preferred to be in the supine position. Additionally, a 10% decrease in cardiac output that can happen in the lateral decubitus position is avoided in the supine position, which may be especially crucial for patients with high cardiac risk.

In the current investigation, the AVATS group's procedure duration was 25.19± 7.5 minutes, which was statistically substantially less than that of the VATS group. The length of intubation for the VATS group's lateral decubitus position and single lung breathing is obviously to blame for this. Uniportal AVATS patients had shorter chest tube durations, which led to a comparatively shorter hospital stay (2.71 days ± 0.72), however there was no statistically significant difference.

Decortication should be added to the operation if there is a thick pleural peel during pleural biopsy with VATS **(Wulff, 1972).** Publications on AVATS have not made this condition explicit **(Lohser et al., 2015).** Since VATS enables pleural decortication by offering improved surgical maneuvers and a wider field of vision under a single lung ventilation, we performed pleural decortication in two patients in the VATS group **(Kocatürk et al., 2019; Schulze et al., 2001).**

Our study's uniportal AVATS and uniportal VATS diagnostic performance for exudative pleural effusion was comparable to those of other recent investigations. Enough tissue samples were collected for pathologic analysis in our

investigation. 29 out of 30 patients in the AVATS group (96.6%). The pathology results for the AVATS group showed that 23.3% of the inflammation was nonspecific, 26.7% was granulomatous, and 46.7% was malignant. One patient's biopsy samples were deemed insufficient, and the results of a follow-up biopsy were found to be malignant. This outcome unequivocally demonstrates the value of follow-up for individuals whose pleural biopsy results are insufficient and vague **(Shojaee et al., 2015; De Hoyos, 2009; Depew et al., 2014).**

Compared to patients who got general anesthesia, local awake operations have lower expenses, a shorter hospital stay, a shorter anesthetic duration, and a shorter operation duration (Davies et al., 2010). Increased lung ventilation, less respiratory issues, and a quicker recovery time are further benefits. Lastly, the immune system is not harmed by local anesthetic, allowing for a quicker recovery **(Pompeo et al., 2007).**

The biggest benefit of VATS is that, because it only requires one lung ventilation, it enables a thorough investigation of the hemithorax, which makes it possible to perform direct visualization biopsy on suspected pleural lesions and lung surface nodules **(Vanni et al., 2010).**

From our clinical experience, the Uniportal AVATS approach appears to be neither suitable nor safe for patients with minimal pleural effusion. This is mainly because inserting the port into the hemithorax is technically challenging in such cases, and there is an increased likelihood of injuring the lung parenchyma.

Study limitations: The study minimized bias by including only patients with undiagnosed exudative pleural effusion who underwent either AVATS or VATS biopsy. However, its single-center design, small sample size, and short follow-up limit the generalizability and reliability of the findings.

Conclusions

When evaluating undiagnosed exudative pleural effusion, uniportal AVATS and VATS pleural biopsies offer comparable diagnostic effectiveness and safety values. Single-port AVATS pleural drainage and biopsy have proven to be both safe and effective for managing and diagnosing unexplained exudative pleural effusions, especially in patients who are elderly or have significant comorbidities that make general anesthesia risky. Consequently, we propose that uniportal AVATS pleural biopsy could serve as a routine diagnostic and therapeutic approach for cases of exudative pleural effusion with an unclear cause.

List Of Abbreviations:

ADA Adenosine Deaminase
AFB acid fast bacilli
AT awake thoracic surgery
AVATS awake video-assisted thoracoscopic surgery
CBC complete blood count
CCI Charlson Comorbidity Index
CT computed tomography
etc et cetera (and other things)
LDH Lactate Dehydrogenase
OR operating room
PA posteroanterior
PH potential of hydrogen
SD standard deviation
TB Tuberculosis
SPSS Social Sciences Facts Package
VATS video-assisted thoracoscopic surgery

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