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Original Article

Microbiology Section

Diagnostic Yield of Closed Pleural Biopsy Using Cope's Needle in the Diagnosis of Exudative Pleural Effusion

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ABSTRACT

Introduction: The aetiology of pleural effusion may be difficult to diagnose based on the pleural fluid cytology, biochemical and microbiological study. Pleural biopsy using Cope's needle may help in such cases where definitive diagnosis can not be achieved with the help of cytology.

Aim: To make aetiological diagnosis of undiagnosed exudative cases using Closed Pleural Biopsy (CPB) and to determine the diagnostic yield of CPB taken by Cope's needle in aetiologically confirmed exudative pleural effusion.

Materials and Methods: This prospective observation study was conducted in Department of Pulmonary Medicine at Burdwan Medical College and Hospital, Burdwan, West Bengal, India, from April 2021 to March 2022 among 52 patients. Under local anaesthesia, diagnostic and therapeutic thoracocentesis were done. The pleural fluid was sent for complete biochemical, microbiological analysis, and cytology. Later, pleural biopsy was also done using Cope's pleural biopsy needle. The variables studied were age, gender, pleural fluid cytology, pleural fluid for acid fast bacilli, Gram stain, and culture and pleural biopsy histopathology.

Results: Out of 52 patients, 34 (65.4%) were males and 18 (34.6%) were females. The majority of the patients (41, 78.8%) had a right-sided pleural effusion. The mean value of lymphocytes and polymorphs count was 57.7% and 32.7%, respectively. Histopathology showed granulomatous inflammation compatible with tuberculosis in 18 (34.6%) patients, non-specific inflammation in 17 patients (32.7%), and 5 (9.6%) patients as adenocarcinoma. Squamous cell carcinoma was seen in 4 (7.7%), 2 (3.8%) showed undifferentiated carcinoma, while 6 (11.5%) samples had inadequate tissue for opinion. In 6 (11.5%) cases pleural tissue was inadequate to give any opinion. 5 (9.6%) cases showed adenocarcinomas, 2 (3.8%) cases showed squamous cell carcinoma and 4 (7.7%) cases showed undifferentiated carcinoma. The true positives were 18 and 11 for tuberculous and malignant pleural effusion, respectively. The diagnostic yield of pleural biopsy was found to be 75% in case of tubercular pleural effusion and 78.6% for malignant pleural effusion.

Conclusion: This study suggests that tuberculosis and malignancy are the two common aetiologies for exudative pleural effusion. Pleural biopsy plays an additional role in histopathological confirmation of aetiologically diagnosed exudative pleural effusion.

Keywords: Closed biopsy, Malignancy, Tuberculous effusion, Undiagnosed effusion

INTRODUCTION

Pleural effusion is defined as the accumulation of fluid in the pleural cavity [1]. The initial approach to diagnosis is to perform a thoracentesis and analyse pleural fluid biochemically and cytologically. In cases of undiagnosed thoracentesis and in the presence of exudative pleural effusion, a definitive diagnosis can be established by histopathological analysis of samples obtained by Closed Pleural Biopsy (CPB) [2]. In 1955, DeFrancis N et al., first reported use of CPB in the diagnosis of pleural effusion [3,4].

The sensitivity of blind closed pleural biopsy is less than 60% and hence, in some countries, use of CPB for diagnostic purposes is becoming obsolete [2]. Tape TG et al., reported that around 98% of practicing Pulmonologists in the United States routinely performed this procedure in the 1990's [5]. Thoracoscopic biopsy is currently recommended in patients with undiagnosed pleural effusion [6]. Although thoracoscopy has better yield, but such recommendation is not possible due to scarce infrastructure and availability of thoracoscope in our country [5].

Very few studies have reported the diagnostic yield of closed pleural biopsy and most of the studies have been done using Abram's needle and trucut biopsy needle. The diagnostic yield of CPB using trucut biopsy needle was 65.2%, as reported by Koegelenberg CFN et al., and Gouda M et al., reported that the diagnostic yield of CPB for tuberculous pleural effusion using cope's needle was 85% and there was no difference in the diagnostic yield in TB pleurisy when done using Cope's needle and Abram's needle [7,8]. There is paucity of information regarding how this percentage varies if done using cope's needle. Hence, this study aimed to study aetiological diagnosis of undiagnosed exudative cases using CPB and to determine the diagnostic yield of CPB taken by Cope's needle in aetiologically confirmed exudative pleural effusion.

MATERIALS AND METHODS

This prospective observation study was conducted in Department of Pulmonary Medicine at Burdwan Medical College and Hospital, Burdwan, West Bengal, India, from April 2021 to March 2022. The permission was obtained from Institutional Ethics Committee (BMC-IEC-038). All 52 consecutive patients presenting with pleural effusion were included in the study population after obtaining written informed consent.

Inclusion criteria: Patients who were haemodynamically stable, who gave informed consent for the study and were in age group ranging from 18-80 years were included in the study.

Exclusion criteria: Patients with transudative effusion, terminally ill patients, pregnant and lactating mothers, patients with abnormal coagulation profile, patients with encysted pleural effusion were excluded from the study.

Procedure

Under local anaesthesia, the diagnostic and therapeutic thoracocentesis were performed, and the pleural fluid was sent

for complete biochemical, microbiological analysis and cytology. Pleural biopsy was done later using Cope's pleural biopsy needle.

Procedure of pleural biopsy: The procedure of pleural biopsy was done on the patient in the sitting position and after confirming the effusion side by Chest X-ray, biopsy site was selected. The area was cleaned thoroughly with betadine solution and then 10 mL of 1% lignocaine (local anaesthetic) was infiltrated at the biopsy site. Pleural fluid aspiration was done to confirm the presence of free fluid. Now a 0.5 cm size incision was made just above the upper border of the rib of that site and Cope's pleural biopsy needle [Table/Fig-1] was introduced through it. Five to six pieces of parietal pleura were taken by multiple passes and then the incision site was sutured with a single stitch using 2-0 Ethilon suture. Postbiopsy X-ray was taken to rule out any complication. Pleural tissue was placed in two vials, one with formalin and sent for histopathological examination, second in normal saline, and sent for Acid Fast Bacilli (AFB) smear, gram stain and culture and Cartridge Based Nucleic Acid Amplification Test (CBNAAT) and culture for mycobacterium tuberculosis. Post procedure, patients were kept under close observation for any deterioration of vital signs for 24 hours. Any adverse events related to the procedure were recorded.

[Table/Fig-1]: Cope's pleural biopsy needle (A: Outer needle 11G with an adjustable needle stop; B: Inner needle C: stylet D: Inner 13G biopsy trocar which has a hook shape for pleural biopsy sample collection).

STATISTICAL ANALYSIS

The data was cleaned, edited and checked for completeness in Microsoft excel (2021) and then exported to Statistical Package for Social Sciences (SPSS) version 26.0 (IBM) and was analysed using descriptive statistics.

RESULTS

The mean age of patients was 49±18.608 years. Out of 52 patients, 34 (65.4%) were males and 18 (34.6%) were females [Table/Fig-2]. Pleural fluid cytology was lymphocyte predominant in 30 patients (57.7%) followed by neutrophilic in 17 (32.7%) cases. Total 21 cases (40.3%) were tuberculous among lymphocytic while 9 (17.3%) cases were malignant effusion [Table/Fig-3]. Majority of the cases (24, 46.2%) were found to be tubercular pleural effusion, followed by malignancy (14, 26.9%) as shown in [Table/Fig-4].

Pleural biopsy done using Cope's needle showed 18 (34.6%) patients as granulomatous inflammation with caseous necrosis, followed by 17 (32.7%) patients as non specific inflammation, and 5 (9.6%) patients as adenocarcinoma. Squamous cell carcinoma was seen in 2 (3.8%), 4 (7.7%) showed undifferentiated carcinoma, while 6 (11.5%) samples had inadequate tissue for opinion [Table/Fig-5].

The sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of pleural biopsy for tuberculous pleural effusion were 75%, 93%, 90% and 82% respectively while the same for malignant pleural effusion were 78.5%, 90%, 73% and 92% respectively [Table/Fig-6].

There were only 2 (3.84%) cases who developed local site infection at the biopsy site. Apart from that, all patients complained of local

Variables	n, %
Gender	
Male	34 (65.4%)
Female	18 (34.6%)
Age (years)	
0-25	7 (13.5%)
26-50	17 (32.7%)
51-75	26 (50%)
>75	2 (3.8%)
Side of pleural effusion	
Right	36 (69.2%)
Left	18 (30.8%)

[Table/Fig-2]: Demographic characteristics (N=52).

Final diagnosis	n, %
Tubercular pleural effusion	24 (46.2%)
Malignant pleural effusion	14 (26.9%)
Parapneumonic effusion	9 (17.3%)
Empyema	5 (9.6%)

[Table/Fig-3]: Pleural fluid cytology outcome (N=52).

Pleural fluid predominant cell		n, %
Lymphocytic (n=30)	Tuberculous	21 (40.3%)
	Malignancy	9 (17.3%)
Neutrophilic (n=17)	Tuberculous	3 (5.8%)
	Parapneumonic effusion	9 (17.3%)
	Empyema	5 (9.6%)
Mesothelial cells		3 (5.8%)
Metastatic deposits of adenocarcinoma		2 (3.8%)

[Table/Fig-4]: Final diagnosis based on pleural fluid analysis (n=52).

Pleural biopsy finding	n, %
Nonspecific inflammation	17 (32.7%)
Granulomatous inflammation with caseous necrosis	18 (34.6%)
Adenocarcinoma	5 (9.6%)
Squamous cell carcinoma	2 (3.8%)
Undifferentiated carcinoma	4 (7.7%)
Inadequate tissue for opinion	6 (11.5%)

[Table/Fig-5]: Pleural biopsy finding (N=52).

Tests for diagnosis	Cases diagnosed by cytology (n)	Cases not diagnosed by cytology (n)	Test
Tuberculous pleural effusion			
Cases diagnosed by pleural biopsy	18	2	Sensitivity: 75% Specificity: 93% PPV: 90% NPV: 83%
Cases not diagnosed by pleural biopsy	6	28	
Malignant pleural effusion			
Cases diagnosed by pleural biopsy	11	4	Sensitivity: 78.5% Specificity: 90% PPV: 73% NPV: 92%
Cases not diagnosed by pleural biopsy	3	38	

[Table/Fig-6]: Diagnostic yield of pleural biopsy (Cope's) for Tubercular and Malignant pleural effusion (N=52).

pain at the biopsy site which subsequently subsided after 5-7 days of oral analgesics treatment.

DISCUSSION

Pleural effusion is one of the most common diseases which is encountered by the Pulmonologists and accounts for approximately 4% of the total attendance to chest out patient department [9]. It indicates the presence of a disease which may either be pulmonary, pleural or extrapulmonary/systemic [10]. Common causes of an exudative pleural effusion are Tuberculosis (TB), malignancy, empyema, parapneumonic effusion, connective tissue disorders, and acute pancreatitis [10]. In the diagnostic work-up of pleural effusion, by doing only biochemical and microbiological analysis, diagnosis can be attained in cases of empyema, parapneumonic effusion and transudative effusion [3]. In this study also, all 14 cases of empyema (five cases) and parapneumonic effusion (nine cases) were identified by pleural fluid biochemical and microbiological analysis. But in cases of empyema also, tuberculosis needs to be excluded by pleural fluid AFB and sputum smear, mycobacterium culture, CBNAAT, and pleural biopsy as they may have a similar pleural fluid picture.

Studies by Poe RE et al., and Suri JC et al., showed that diagnostic yield of pleural biopsy in all cases of pleural effusion to be about 60 to 80% [11,12]. In the present study, overall diagnostic yield of pleural biopsy was 55.8 %. The reason for this low diagnostic yield was that in all the cases, pleural biopsy was done only once, while author's experience and available literature showed that repeat pleural biopsy increases the diagnostic yield of pleural biopsy by up to 89 to 100% [13].

Kettle LJ et al., reported that the diagnostic yield of closed pleural biopsy in tubercular pleural effusion ranges from 60 to 95% [13]. Tomlinson JR et al., and Christopher DJ et al., reported a diagnostic yield of 75% for tubercular pleural effusion [14,15]. The present study corroborated with the above findings and closed pleural biopsy yielded the diagnosis in 75% cases of tubercular pleural effusion with single pleural biopsy, and in 66.7% cases, diagnosis could be made by pleural biopsy itself.

Gouda A et al., did a comparison study between Cope's and Abram's needle and there was no statistical difference in the diagnostic yield in tuberculous pleural effusion with both needles. However, the overall sensitivity of Cope's needle in diagnosis of tuberculous pleural effusion was higher (85%) as compared to Abram's (57.6%) [8].

The diagnostic yield of pleural biopsy is less than the pleural cytology in diagnosing malignant pleural effusion. Loddenkemper R et al., reported a diagnostic yield of 44% for closed pleural biopsy and 62% for pleural fluid cytology in cases of malignant pleural effusion [16]. Tomlinson JR and Sahn SA, in their review reported a diagnostic yield of 57% for pleural biopsy in cases of malignant pleural effusion, and Christopher DJ et al., reported a diagnostic yield of 71% for pleural malignancy. In this study, the diagnostic yield of pleural biopsy was 78.6 % in the cases of malignant pleural effusion [14,15]. Pleural biopsy was the only diagnostic test in 64.2 % cases of malignant pleural effusion. Definite diagnosis of malignancy revealed by exfoliative cytology of pleural fluid in only two cases (3.8%). A high diagnostic yield of pleural biopsy (78.6 %) in malignant pleural effusion in this study further emphasises on the profound utility of this procedure in the diagnostic work-up of pleural effusion in developing countries like India. Another major advantage of pleural biopsy over pleural fluid cytology is that pleural biopsy subclassifies the malignant cell types, which is essential for further management of chemo sensitive malignancies.

Pneumothorax and haemothorax are known potential complications of closed pleural biopsy and studies have shown about 4 to 11 % incidence rate of pneumothorax [17]. In a study by Gowda A et al., the incidence of pneumothorax reported was 8% and 18% respectively using Abram's needle and Cope's needle [8]. However, in this study there were 2 (3.84%) cases of local site infections and no single case of pneumothorax, which in turn emphasises on the safety of the procedure.

Thoracoscopy provides a direct visualization of both parietal and visceral pleura and the diagnostic yield of thoracoscopic guided pleural biopsy increases up to 95% [16]. But due to high cost, lack of availability and dedicated labs and need for intensive training makes thoracoscopic procedure difficult to do in daily practice. It also requires chest tube drainage, which further increases the hospital stay and in turn increases the hospital expenses. Thoracoscopy should be reserved in those cases where diagnosis can not be made even with less costly procedures or where there is a contraindication to CPB.

Limitation(s)

The present study was a single-centre study and the sample size was small. Pleural biopsy was done single time in patients and hence, it does not depict the effectiveness of serial pleural biopsy in undiagnosed pleural effusions.

CONCLUSION(S)

A very high diagnostic yield is provided by closed pleural biopsy in the diagnosis of tubercular and malignant pleural effusions which are the two most important causes of exudative pleural effusion and hence, should be included in the diagnostic work-up of pleural effusion. Due to its low cost, easy availability, reduced hospital stays and very low complication rates, closed pleural biopsy still remains an important diagnostic tool in the hands of a trained Pulmonologist in countries like India.

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