VOLUME - 14, ISSUE - 09, SEPTEMBER - 2025 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

COMPARATIVE EVALUATION OF TUBERCULOUS AND MALIGNANT PLEURAL EFFUSIONS: A CROSS-SECTIONAL ANALYSIS OF DEMOGRAPHICS AND PLEURAL FLUID PARAMETERS.

Dr. Rohit Kasat — Assistant Professor, Department Of General Medicine, Government Medical College, Jalna

Dr. Priyanka Chandak* — Assistant Professor Department Of Pathology Government Medical College, Jalna *Corresponding Author

ABSTRACT

Background: Pleural effusion is a common clinical problem, with tuberculosis and malignancy being among the most frequent causes. Differentiating tuberculous pleural effusion (TPE) from malignant pleural effusion (MPE) is often challenging due to overlapping cytological and biochemical profiles. Accurate and timely diagnosis is essential for guiding appropriate management. **Materials & Methods:** The present cross-sectional study was done in tertiary care teaching hospital on 140 diagnosed pleural effusion cases. Sociodemographic profiles like age, gender, weight, symptoms, personal habits, co-morbid conditions were noted. Pleural fluid was analysed for Pleural fluid pH, LDH, TLC, ADA, glucose, protein. Mean with standard deviation & frequency, percentages were calculated using of SPSS software trial version 21. Association between two variables was denoted by calculating P value by chi square test. **Results:** TPE was more common in younger adults (<40 years), while MPE predominated in older patients (>61 years) ($p<0.001$). Underweight status was more frequent in TPE, while overweight was more common in MPE ($p=0.041$). Smoking and biomass fuel exposure were significantly associated with MPE, while alcohol use was more frequent in TPE. TPE cases had significantly higher ADA (62.02 vs. 12.62 U/L, $p<0.000001$) and leukocyte count (977 vs. 423 cells/cumm, $p=0.026$), while glucose was lower (60 vs. 86 mg/dL, $p=0.002$). **Conclusion:** Younger age, underweight status, fever, and elevated ADA strongly favoured tuberculosis. Older age, smoking, biomass exposure, haemoptysis, hoarseness of voice, and higher pleural fluid glucose were more consistent with malignancy. A combination of demographic, clinical, and pleural fluid parameters significantly aided in differentiating TPE from MPE.

KEYWORDS : Pleural effusion, biomarkers, tuberculosis, malignancy.

INTRODUCTION:

Pleural effusion, defined as the abnormal accumulation of fluid in the pleural space, is a common clinical problem encountered worldwide. The aetiology of pleural effusion varies significantly, with tuberculosis (TB) and malignancy being among the leading causes, particularly in developing countries like India where TB is endemic, and where cancer incidence is steadily rising.[1,2] Differentiating between tuberculous pleural effusion (TPE) and malignant pleural effusion (MPE) is crucial, as management strategies and prognostic implications differ substantially.

Tuberculous pleural effusion is usually characterized by a lymphocyte-predominant exudate, often with elevated adenosine deaminase (ADA) levels, reflecting a hypersensitivity reaction to Mycobacterium tuberculosis antigens in the pleural space[3]. In contrast, malignant pleural effusion results from tumor infiltration or obstruction of pleural lymphatics, leading to fluid accumulation. These effusions are also lymphocytic in many cases, making differentiation from TPE challenging based solely on cytology or cell count[4].

Demographic characteristics such as age, sex, and comorbidities may provide additional clues. TPE is more common in younger populations, especially in regions with high TB prevalence, whereas MPE is frequently seen in older individuals with risk factors such as smoking or a history of malignancy[5]. Despite these patterns, significant overlap exists, warranting a systematic approach that combines pleural fluid biochemical, cytological, and clinical parameters.

Although several biomarkers—including ADA, lactate dehydrogenase (LDH), and interferon-gamma—have been evaluated, there remains no single gold standard for differentiating between TPE and MPE[6]. Hence, studies analysing the diagnostic utility of pleural fluid characteristics along with demographic features of patients are needed to improve diagnostic accuracy and guide timely management.
This cross-sectional study aims to evaluate pleural fluid biochemical and cytological parameters along with patient demographics to differentiate malignant from tuberculous pleural effusions in our clinical setting.

MATERIALS & METHODS

The present cross-sectional study was done in joint venture of Department of General Medicine and Department of Pathology of Government Medical college Jalna, a tertiary health care centre during period January 2025 to June 2025. During this study period cases who were having pleural effusion on radiological examination & having diagnosis of malignancy or Tuberculosis were included.

Permission from the Institutional ethical committee was taken before the start of the study. Consent from patients were taken before enrolling them in the study. After a detailed physical, clinical examination & Cytological & CBNAAT, & TB Related investigations diagnosis of cases was made as tubercular & malignant pleural effusion. A predesigned pretested questionnaire was used for collection of data. Sociodemographic information like age, gender, weight, symptoms, personal habits, co-morbid conditions were noted. Plural fluid was analysed for Pleural fluid pH, LDH, TLC, ADA, glucose, protein.

Considering prevalence of plural effusion as 12.7 % by study done by Mohamed Farrag[7], considering confidence interval 95% with allowable error 10%, minimum sample size to achieve desired objectives came to be 42. Thus, in this study we studied total 140 study subjects.

Chest X ray was performed to confirm the Pleural effusion. Pleural Fluid was taken by thoracocentesis with the help of USG and Fluid was sent for routine analysis. Plural fluid was analyzed for pH, LDH, TLC, ADA, glucose, protein. Biochemical measurements on pleural fluid samples were carried out on discrete analyzers using standardized photometric methods. Specifically, pleural ADA activity was assessed with an automated ultraviolet kinetic test.

Data was entered in Microsoft excel & analysed for mean, standard deviation, frequency & percentages. Chi square test was applied for quantitative data for calculating p value using SPSS software trial version 21. Results were displayed in terms of Tables & charts. P value less than 0.05 was considered statistically significant at 95% confidence interval.

RESULTS:

Table No.1: Age Wise Distribution Of Study Subjects (n=140)

Age group (In years)	Diagnosis		Total
	Tuberculosis	Malignancy	
<30	26 (30.95%)	04 (7.14%)	30 (21.43%)
31–40	18 (21.43%)	00 (00%)	18 (12.86%)
41–50	18 (21.43%)	12 (21.43%)	30 (21.43%)
51–60	10 (11.90%)	10 (17.86%)	20 (14.28%)
>61	12 (14.29%)	30 (53.57%)	42 (30.00%)
Total	84 (100%)	56 (100%)	140 (100%)

(X^2=19.5, DF=4, P value=0.0006255)

In the present study, a total of 140 pleural effusion cases were evaluated. After confirmation of diagnosis, 60% (84 cases) were found to have tuberculous pleural effusion (TPE), while the remaining 40% (56 cases) were diagnosed with malignant pleural effusion (MPE).

Most patients with TPE were younger, with the majority under 40 years of age. In contrast, MPE cases were more frequent among older individuals, especially those above 61 years. The association between age and diagnosis was statistically significant.

Table No.2: Gender Wise Distribution Of Study Subjects (n=140)

Age group (In years)	Diagnosis		Total
	Tuberculosis	Malignancy	
Male	62 (73.80%)	32 (57.14%)	94 (67.14%)
Female	22 (26.20%)	24 (42.86%)	46 (32.86%)
Total	84 (100%)	56 (100%)	140 (100%)

(X^2= 2.115.5, DF=1, P value= 0.1459)

Overall, males constituted 67.14% (94 cases) of the study population. Male predominance was observed in both TPE (73.80%) and MPE (57.14%) groups. However, the association between gender and diagnosis was not statistically significant.

Table No.3: Distribution Of Study Subjects According To BMI (n=140)

Weight	Diagnosis		Total
	Tuberculosis	Malignancy	
Underweight	34 (40.45%)	14 (25.00%)	48 (34.28%)
Normal	42 (50.00%)	32 (57.14%)	74 (52.85%)
Overweight	08 (9.52%)	10 (17.86%)	18 (12.85%)
Total	84 (100%)	56 (100%)	140 (100%)

(X^2= 6.381, DF=2, P value= 0.04115)

The majority of patients in both groups had normal weight (52.85%). Underweight status was more frequent among TPE cases (40.45%), while overweight was more frequent among MPE cases (17.86%). The association between weight status and diagnosis was statistically significant

Table No. 4: Distribution Of Study Subjects According To Symptoms (n=140)

symptoms	Diagnosis		Total (n=140)
	Tuberculosis (n=84)	Malignancy (n=56)	
Fever	78	16	94
Cough	66	42	108
Expectoration	22	12	34
Dyspnoea	62	52	114
Chest pain	46	36	82
Haemoptysis	00	10	10
Hoarseness of voice	00	10	10
Weight loss	60	34	94
Appetite loss	60	34	94
Malaise	20	04	24
Night sweats	16	00	16

The most common presenting symptoms overall were dyspnoea (81.43%), cough (77.14%), and fever (67.14%). In TPE cases, the predominant symptoms were fever (92.8%), cough (78.6%), dyspnoea (73.8%), weight loss (71.4%), and appetite loss (71.4%). In MPE cases, common symptoms included dyspnoea (92.8%), cough (75.0%), chest pain (64.3%), weight loss (60.7%), and appetite loss (60.7%). Notably, fever and night sweats were strongly associated with tuberculosis, while haemoptysis and hoarseness of voice were observed only in malignancy cases.

Table No.5: Distribution Of Study Subjects According To Diseases Present (n=140)

	Diagnosis		Total (n=140)
	Tuberculosis (n=84)	Malignancy (n=56)	
Diabetes	12	06	18
Hypertension	06	04	10
Past Pulmonary TB	06	00	06

The most frequent co-morbidity was diabetes mellitus (12.9%), followed by hypertension (7.1%). A history of past pulmonary tuberculosis was present in 4.3% of TPE patients.

Table No.6: Distribution Of Study Subjects According To Personal Habits (n=140)

personal habits	Diagnosis		Total (n=140)	P value
	Tuberculosis (n=84)	Malignancy (n=56)		
Non-Smoker	68 (80.95%)	32 (57.14%)	100(71.43%)	0.0007020
Smoker	14 (16.66%)	18 (32.14%)	32 (22.86%)	
Ex-Smoker	02 (2.38%)	06 (10.71%)	08 (5.71%)	
Tobacco Addiction				
Absent	38 (45.23%)	32 (57.14%)	70 (50.00%)	0.2345
Present	40 (46.61%)	20 (35.71%)	60 (42.85%)	
Ex-Tobacco Chewer	06 (7.14%)	04 (7.14%)	10 (7.15%)	
Alcohol Consumption				
Non-Alcoholic	52 (61.90%)	36 (64.28%)	88 (62.86%)	0.01585
Alcoholic	28 (33.33%)	12 (21.42%)	40 (28.57%)	
Ex-Alcoholic	04 (4.76%)	08 (14.28%)	12 (8.57%)	
Biomass Fuel Exposure				
Absent	76 (90.47%)	36 (64.28%)	112(80.00%)	0.00004406
Present	08 (9.52%)	20 (35.71%)	28 (20.00%)	

Smoking was reported by 71.43% of patients overall and was significantly more common in MPE than TPE (p=0.0007020). Alcohol consumption was reported more frequently among TPE patients (33.3%) than MPE (21.4%), and the difference was significant (p=0.01585). Biomass fuel exposure was significantly associated with MPE (35.7% vs. 9.5% in TPE, p<0.00001). Tobacco chewing did not show a significant association with diagnosis (p=0.2345).

Table No.7: Distribution Of Study Subjects According To Plural Fluid Analysis (n=140)

	Diagnosis		Total (n=70)
	Tuberculosis (n=42)	Malignancy (n=28)	
Pleural fluid pH	7.46 ± 0.23	7.44 ± 0.26	0.7362

Pleural fluid LDH (IU/L)	849.73 ± 505.29	654.03 ± 611.73	0.1493
Pleural fluid glucose (mg/dL)	60 ± 28.58	86.28 ± 40.57	0.002206
Pleural fluid protein(g/dL)	4.72 ±1.17	4.58 ± 1.37	0.6485
Pleural fluid TLC (cells/cumm)	977.47±1408.26	422.82 ± 576.14	0.02611
Pleural fluid ADA	62.02 ± 19.53	12.62 ± 6.26	<0.0000001

Pleural fluid ADA was significantly elevated in TPE (mean 62.02 U/L) compared to MPE (12.62 U/L, $p<0.0000001$). Glucose levels were significantly lower in TPE (60 mg/dL) compared to MPE (86.28 mg/dL, $p=0.0022$). Total leukocyte count (TLC) was higher in TPE (mean 977.47 cells/cumm) than MPE (422.82 cells/cumm, $p=0.0261$). Pleural fluid LDH, protein, and pH values showed no significant difference between the two groups.

DISCUSSION:

In the present cross-sectional study, 70 patients with pleural effusion were evaluated, of which 60% had tuberculous pleural effusion (TPE) and 40% had malignant pleural effusion (MPE). The study aimed to differentiate these two common causes of exudative pleural effusion using demographic characteristics, clinical features, personal habits, and pleural fluid analysis.

Age distribution in our study showed that TPE occurred more frequently in younger individuals, with the majority of cases under 40 years of age, whereas MPE was predominant in patients above 50 years. This finding is consistent with studies by Valdés et al. (1998)[8] and Villena et al. (2010)[5], which reported that tuberculosis-related pleural effusion typically affects younger adults in endemic areas, while malignant effusions are more common in elderly populations. The association between age and etiology was statistically significant, highlighting its importance as a clinical clue.

Gender distribution showed a male predominance in both TPE and MPE groups, though the difference between diagnoses was not statistically significant. Similar patterns have been observed in earlier studies (Porcel & Light, 2006)[9,10], likely reflecting higher exposure to TB risk factors and smoking in males, as well as the overall male predominance of lung cancer incidence.

Nutritional status revealed that underweight was more common in TPE, while overweight and obesity were more often associated with MPE, with statistical significance. This is in agreement with findings that tuberculosis is associated with chronic weight loss and undernutrition, whereas malignancy patients may present with variable body habitus at diagnosis (Bhuniya et al., 2011).[11]

Clinical symptoms overlapped between TPE and MPE, with dyspnoea, cough, weight loss, and appetite loss being common in both. However, fever and night sweats were significantly more frequent in TPE, while haemoptysis and hoarseness of voice were seen only in malignancy. These findings align with previous reports (Valdés et al., 1998)[8], supporting the role of systemic symptoms like fever and night sweats in pointing toward tuberculosis.

Comorbidities such as diabetes and hypertension were found in both groups, though not statistically significant. Diabetes is a known risk factor for tuberculosis (Jeon & Murray, 2008)[12], which may explain its relatively higher occurrence in TPE patients.

Personal habits were significantly associated with diagnosis. Smoking and biomass fuel exposure were more common in MPE, reflecting known risk factors for lung cancer (International Agency for Research on Cancer, 2012)[13]. Alcohol consumption was more frequent in TPE cases, consistent with evidence that alcohol impairs immunity and predisposes to tuberculosis infection.

Pleural fluid analysis provided key differentiating features. In our study, ADA levels were markedly higher in TPE (mean 62.02 U/L) compared to MPE (12.62 U/L), with high statistical significance ($p<0.000001$). This corroborates multiple studies (Valdés et al., 1995; Porcel, 2009)[8,9] that have established ADA as a reliable biomarker for tuberculous pleural effusion, particularly in endemic regions. Pleural fluid glucose was significantly lower in TPE, while total leukocyte count (TLC) was higher, reflecting the inflammatory nature of tuberculous effusions. LDH and protein levels were elevated in both groups but were not discriminatory. Cytology, though not detailed in our dataset, remains the gold standard for diagnosing MPE when malignant cells are detected.

Taken together, our results emphasize that no single parameter alone is sufficient to differentiate between TPE and MPE. However, combining patient demographics (age), clinical presentation (fever, night sweats vs. haemoptysis, hoarseness), personal habits (smoking, biomass exposure), and pleural fluid analysis (ADA, glucose, TLC) significantly improves diagnostic accuracy.

Strengths of the study include comprehensive evaluation of both demographic and biochemical parameters in a single cohort. Limitations include a relatively small sample size, single-center design, and absence of advanced biomarkers such as interferon-gamma or nucleic acid amplification tests. Clinical implication of this study is, in resource-limited settings, where access to advanced diagnostics is constrained, routine pleural fluid analysis combined with simple demographic and clinical information can guide clinicians toward early differentiation of tuberculosis and malignancy.

CONCLUSION:

In conclusion, plural fluid biomarkers like ADA, TLC, glucose are non-invasive, and inexpensive methods, which can provide highly effective and reliable structures useful for discrimination between various diagnosis for plural effusion cases. The present study indicates that these biomarkers & Sociodemographic profile like age, weight & personal habits like smoking, alcohol consumption, biomass fluid exposure can provide high diagnostic success rates to assist in the diagnoses of pleural effusion in patients waiting for laboratory outcomes of pleural tissue, and for treatment planning.

REFERENCES

1. Light RW. Pleural effusion. N Engl J Med. 2013;368(8):740-751.
2. Porcel JM. Tuberculous pleural effusion. Lung. 2009;187(5):263-270.
3. Valdés L, Alvarez D, San José E, et al. Tuberculous pleurisy: a study of 254 patients. Arch Intern Med. 1998;158(18):2017-2021.
4. Porcel JM, Light RW. Diagnostic approach to pleural effusion in adults. Am Fam Physician. 2006;73(7):1211-1220.
5. Villena V, López-Encuentra A, García-Luján R, et al. Clinical implications of appearance of pleural fluid at thoracentesis. Chest. 2010;137(1):68-73.
6. Porcel JM. Biomarkers in the diagnosis of pleural diseases: a 2016 update. Ther Adv Respir Dis. 2016;10(6): 475–487.
7. Mohamed Farrag et al, Prevalence, causes, and clinical implications of pleural effusion in pulmonary ICU and correlation with patient outcomes, Egyptian Journal of Bronchology, Vol. 12 No. 2, April-June 2018, pg no.247-52
8. Valdés L, Alvarez D, San José E, et al. Tuberculous pleurisy: a study of 254 patients. Arch Intern Med. 1998;158(18):2017–2021.
9. Porcel JM. Tuberculous pleural effusion. Lung. 2009;187(5):263–270.
10. Porcel JM, Light RW. Diagnostic approach to pleural effusion in adults. Am Fam Physician. 2006;73(7):1211–1220.
11. Bhuniya S, Arunabha DC, et al. Comparative analysis of malignant and tubercular pleural effusion in a tertiary care hospital. Indian J Tuberc. 2011;58(4):163–167.
12. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review. PLoS Med. 2008;5(7):e152.
13. International Agency for Research on Cancer (IARC). Tobacco smoke and involuntary smoking. IARC Monogr Eval Carcinog Risks Hum. 2004;83:1–1438.