RESULTS, DATA ANALYSIS AND DISCUSSION

Study included 50 consecutive patients of pleural effusion which fulfilled all inclusion and exclusion criteria. Amongst the patients, 13 were females and 37 were males. The age distribution was from 12 years to 80 years.

TABLE 1 – GENDER DISTRIBUTION OF STUDY POPULATION

Gender	No. of patients	Percentage
Males	37	74 %
Females	13	26 %
Total	50	

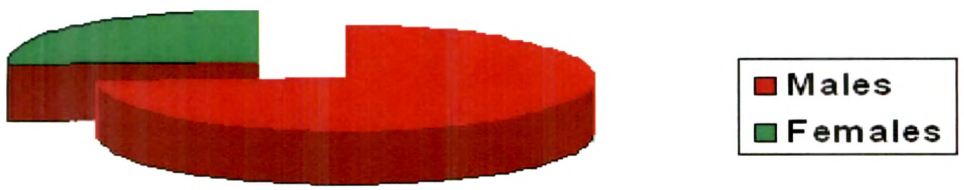


TABLE 2 : AGE DISTRIBUTION OF STUDY POPULATION

Age range (in yrs)	Number of patients	Percentage
0-20	6	12 %
20-40	17	34 %
40-60	20	40 %
>60	7	14 %

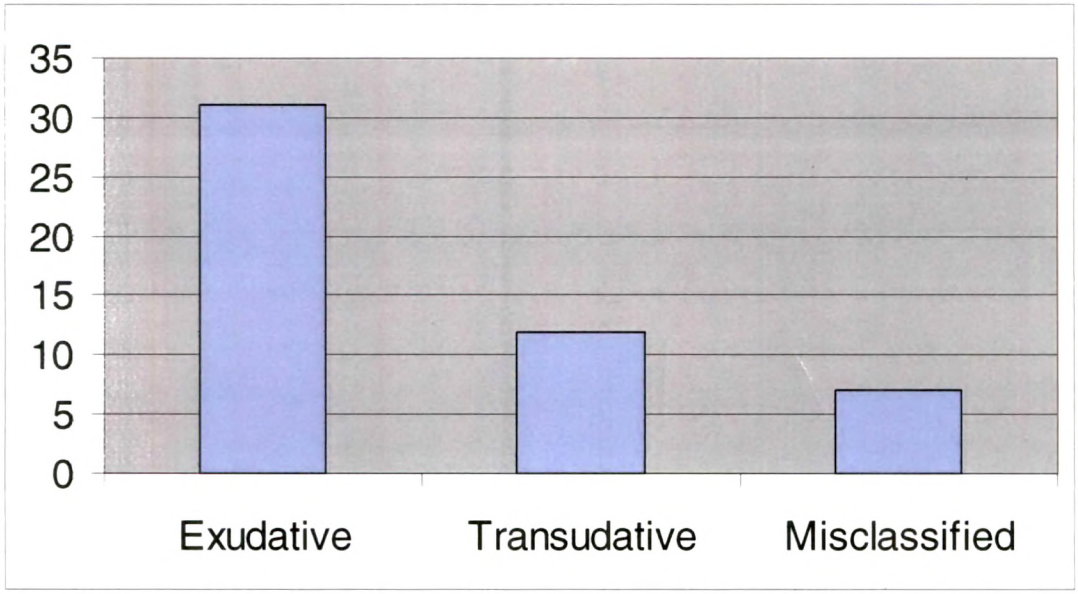
In the study population, the major proportion (74%) were in the middle age group ranging from 20 to 60 years. Only 6 patients (12 %) were under the age of 20 years while 7 patients (14 %) were over 60 years of age.

While tuberculosis was the most common cause of pleural effusion in the young and middle age groups, the study included 3 cases of malignancy which were above 50 years of age.

respectively. Using unpaired 't' test, all these values had statistically significant difference in both groups ($p<0.001$).

CLASSIFICATION ON THE BASIS OF LIGHT'S CRITERIA:

The study population was classified as transudative or exudative pleural effusions using the Light's Criteria (on the basis of pleural fluid protein content)



Taking the pleural fluid protein content cut-off value as 3.0 g/dl, 7 cases (14 %) were falsely distributed into these categories out of which 6 were transudative and 1 was exudative.

FLUID PROTEIN	EXUDATIVE	TRANSUDATIVE	TOTAL
≥ 3 g/dl	31	6	37
< 3 g/dl	1	12	13
TOTAL	32	18	50

Interpreting the above data:

Sensitivity – 96.8 %

Specificity – 66.7%

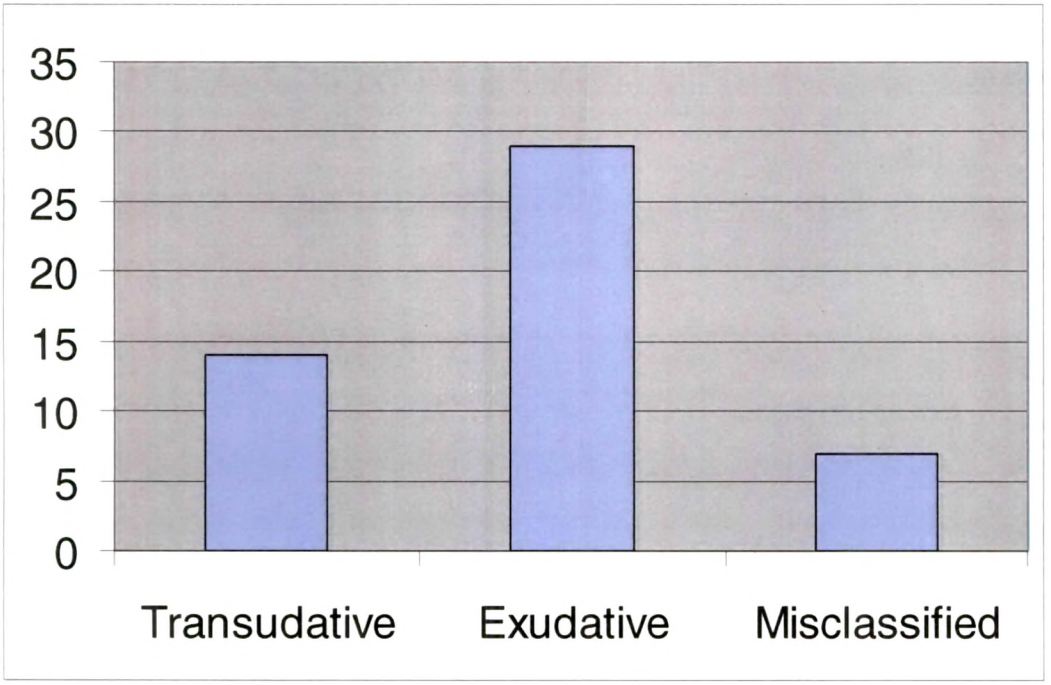
Positive Predictive Value – 83.8 %

Negative Predictive Value – 92.3 %

This analysis would mean that if a person had exudative pleural effusion, then there is a high chance (96.8%) that his pleural fluid protein concentration would be more than 3 g/dl. But, conversely, if the protein concentration is > 3 g/dl, then there is only 66.7 % chance that his etiology would be exudative.

CLASSIFICATION ON THE BASIS OF LACTATE DEHYDROGENASE (LDH) LEVELS :

The cut-off value for pleural fluid LDH level for classification into transudative and exudative was taken as 300 IU/L which is two-third of the upper limit of normal serum levels (0-450 IU/L) with the same kit. . Accordingly, 7 cases were misclassified out of which 2 were exudative and 5 were transudative.



FLUID LDH	EXUDATIVE	TRANSUDATIVE	TOTAL
≥ 450 IU/L	29	5	34
< 450 IU/L	2	14	16
TOTAL	31	19	50

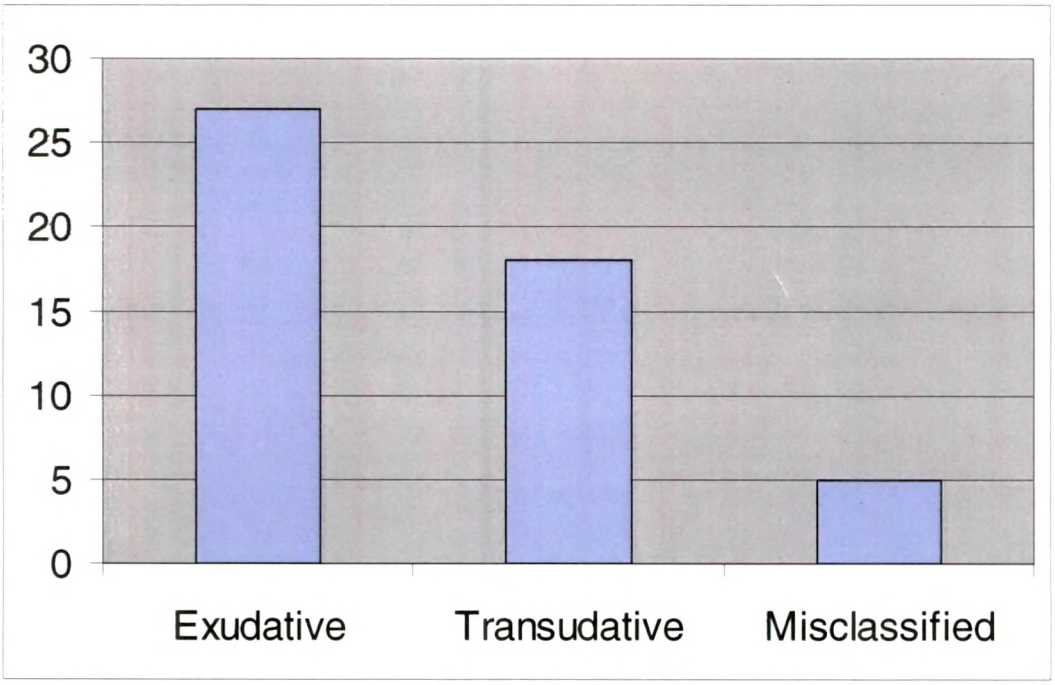
Interpreting the above data:

Sensitivity - 93.5 %
Specificity - 73.7 %
Positive Predictive Value - 85.3 %
Negative Predictive Value - 87.5 %

This analysis would mean that if a person had exudative pleural effusion, then there is a high chance (93.5 %) that his pleural fluid LDH concentration would be more than two-third of upper normal of serum levels. But, conversely, if the LDH concentration is more than two-third of upper limit of normal in serum, then there is only 73.7 % chance that his etiology would be exudative.

CLASSIFICATION ON THE BASIS OF PLEURAL FLUID CHOLINESTERASE LEVELS:

The cut-off value for pleural fluid cholinesterase level was taken as 766 IU/L, which is $1/10^{th}$ of the upper limit of serum cholinesterase[2,3] values obtained in our study. The following data was obtained on the basis of this:



In our study, 5 patients (10 %) were misclassified when they were classified according to pleural fluid cholinesterase levels out of which 1 was transudative and 4 were exudative.

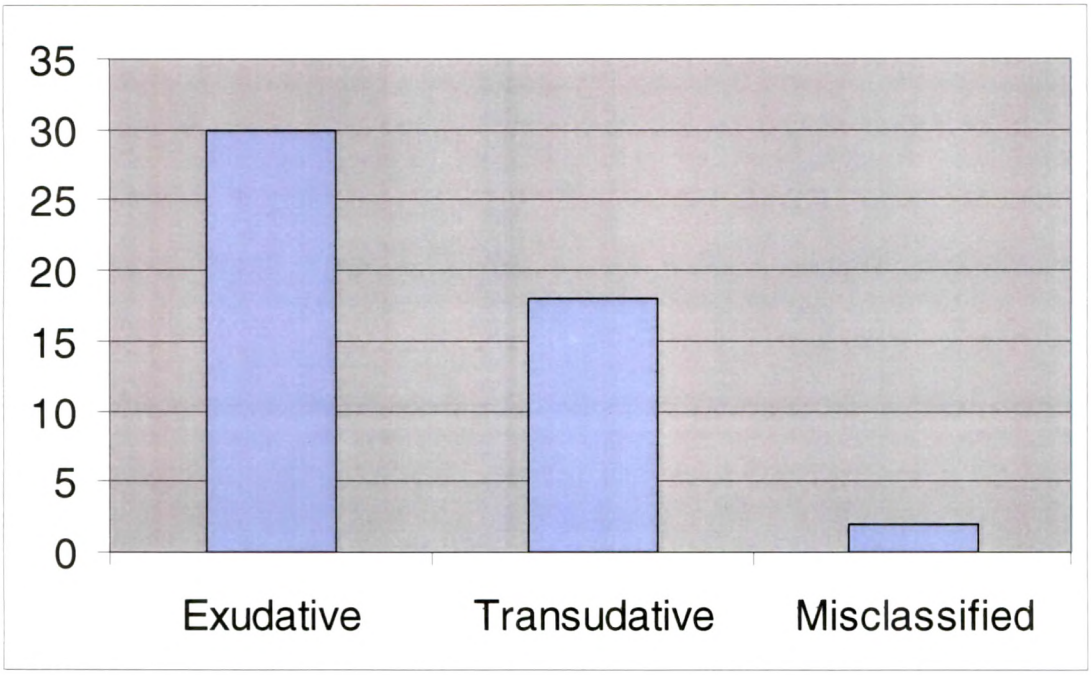
FLUID CHOLINESTERASE	EXUDATIVE	TRANSDATIVE	TOTAL
≥ 766 IU/L	27	1	28
< 766 IU/L	4	18	22
TOTAL	31	19	50

Interpreting the above data :

Sensitivity – 87.1 %
Specificity – 94.7 %
Positive Predictive Value – 96.4 %
Negative Predictive Value – 81.8 %

This parameter has a low sensitivity, which means that use of only this parameter would miss many exudative etiologies and may falsely classify them as transudative. The high specificity would imply that this parameter would efficiently rule out false negative exudates.

CLASSIFICATION ON THE BASIS OF RATIO OF PLEURAL FLUID TO SERUM CHOLINESTERASE LEVELS:



When the ratio of pleural fluid to serum cholinesterase levels was used to classify our patients (with a cut-off level of 0.24), only 2 patients (4 %) were misclassified one each of transudative and exudative etiology.

SERUM FLUID RATIO	EXUDATIVE	TRANSUDATIVE	TOTAL
≥ 0.24	30	1	31
< 0.24	1	18	19
TOTAL	31	19	50

Interpreting the above data :

Sensitivity – 96.8 %
Specificity – 94.7 %
Positive Predictive Value – 96.8 %
Negative predictive Value – 94.7 %

This parameter is the best amongst all studied here in terms of accuracy. A ratio > 2.4 would correctly identify the exudative etiology in almost 97 %. Also, a high specificity would minimize the number of false negative cases.

TABLE 4: NUMBER AND PERCENTAGE OF MICLASSIFIED TRANSUDATES WITH EACH PARAMETER

PARAMETER	CCF	CRF	HYPOPROTEINEMIA	TOTAL(%)
P protein	3	0	3	6 (12%)
P LDH	3	0	2	5 (10%)
P ChE	1	0	0	1 (2%)
P:S ChE	1	0	0	1 (2%)

Out of the 3 CCF misdiagnosed as exudative causes of pleural effusion, 2 were left-sided. Although there was no evidence of consolidation, there is a possibility of underlying secondary infection of the fluid.

TABLE 5: NUMBER AND PERCENTAGE OF MISCLASSIFIED EXUDATES WITH EACH PARAMETER

PARAMETER	TB	SYNPNEUMONIC	MALIGNANCY	TOTAL(%)
P protein	1	0	0	1 (2%)
P LDH	2	0	0	2 (4%)
P ChE	4	0	0	4 (8%)
P:S ChE	1	0	0	1 (1%)

KEY:

P – Pleural Fluid

LDH – Lactate Dehydrogenase

ChE – Cholinesterase

S – Serum

There were cases of tuberculous pleural effusion which were misclassified as transudative, the number varying with different parameters.

In the single case of the tuberculous effusion with low protein, the serum total protein was 5.4 g/dl. The possible explanation here is the since pleural effusion is a filtrate of serum, the low protein content of serum would not raise the pleural fluid protein above 3 g/dl to label it as exudative.

The application of another parameter to these patients like pleural fluid Adenosine Deaminase (ADA) level would have helped to correctly classify the etiology.

TABLE 6: SUMMARY OF ACCURACY OF DIFFERENT PARAMETERS USED IN THIS STUDY TO EVALUATE PLEURAL FLUID

PARAMETER	SENSITIVITY	SPECIFICITY	PPV	NPV
P protein	96.8 %	66.7 %	83.8 %	92.3 %
P LDH	93.5 %	73.7 %	85.3 %	87.5 %
P ChE	87.1 %	94.7 %	96.4 %	81.8 %
P:S ChE	96.8 %	94.7 %	96.8 %	94.7 %

Considering all four measures of accuracy of a test, it is quite evident from the values above that the ratio of pleural fluid to serum cholinesterase is the best parameter to classify the etiology of a pleural effusion into transudative or exudative.

COMPARISON WITH SIMILAR STUDIES

Two studies have been done in the past which studied the accuracy of pleural fluid to serum cholinesterase ratio to differentiate transudative from exudative etiologies.

1. Study of 153 patients by Eduardo Garcia-Parchon *et al*[2] published in CHEST 1996; 110:97-101
2. Indian study of 110 patients by Manju Sharma *et al*[3] published in JAPI May,2004; 52:387-390

Following is the comparison of results from these studies with our study:

NUMBER OF CASES OF PLEURAL EFFUSION MISCLASSIFIED (IN PERCENTAGE) USING VARIOUS PARAMETERS:

PARAMETER	OUR STUDY		EDUARDO *et al*[2]		SHARMA M *et al*[3]	
	T %	E %	T %	E %	T %	E %
P protein	12	2	25.7	2.5	20	16.36
P LDH	10	4	-	-	16.6	13.63
P ChE	2	8	22.8	4.2	10	4.54
P:S ChE	2	1	5.7	0	3.3	1.81

In the above table, in all 3 studies, the percentage of misclassified effusions are least with the last parameter viz. the ratio of pleural fluid to serum cholinesterase.

ACCURACY OF DIFFERENT PARAMETERS (IN PERCENTAGE):

PARAMETER	SENSI		SPECI		PPV		NPV	
	OS	MS	OS	MS	OS	MS	OS	MS
P Protein	96.8	85	66.7	80	83.8	91.9	92.3	66.7
P LDH	93.5	90	73.7	76.7	85.3	91.1	87.5	74.2
P ChE	87.1	97.5	94.7	90	96.4	96.3	81.8	93.1
P:S ChE	96.8	98.7	94.7	96.7	96.8	98.8	94.7	96.7

Thus, the superiority of the estimation of ratio of cholinesterase in our study has a similar inference in the other 2 similar studies.

Key:

SENSI – Sensitivity

SPECI – Specificity

PPV – Positive Predictive Value

NPV – Negative Predictive Value

OS – Our study

MS – Manju Sharma *et al*[3] study