

A Study of Pleural Fluid Cholesterol in Differentiating Transudative and Exudative Pleural Effusion

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Abstract: Pleural effusion is one of the common condition encountered in day to day practise. Pleural effusions represent a very common diagnostic task to the physician. A correct diagnosis of the underlying disease is essential to rational management. Today there are a number of laboratory tests available to differentiate exudates and transudates which are considered cost effective to the patients. So this study was designed for the measurement of pleural fluid cholesterol to differentiate transudative and exudative pleural effusions (sensitivity-97.8%, specificity-100%) with the advantage that a contemporary blood sample is not required, thereby lowering cost of diagnostic procedure. To study the diagnostic value of Pleural fluid Cholesterol in differentiating transudative and exudative pleural effusions. This cross sectional descriptive study was conducted in the Department of Medicine, Shri B M Patil medical college hospital and research centre, Vijayapura on patients of pleural effusion. A study design consists of 60 patients. Age >18 years and patients with with definitive clinical diagnosis and evidenced by radiological diagnosis of pleural effusion were taken as inclusion criteria. The results showed majority of the patients were males (63.33%) and females (36.67%). According to lights criteria 46 patients were exudates and 14 patients were transudates and according to Pleural fluid Cholesterol criteria 45 patients were exudates and 15 patients were transudates with sensitivity of 97.8% and specificity of 100% and accuracy of 98.3%. The pleural fluid cholesterol criteria were found to be the most efficient criteria. Since this parameter involves the measurement of only pleural fluid values of cholesterol, it has following advantages-Economically it reduces number of biochemical tests and Simpler as there is no need to take simultaneous blood sample at the time of thoracocentesis.

Keywords: Pleural Effusion, Transudates, Exudates, Cholesterol.

INTRODUCTION

Pleural effusions represent a very common diagnostic task to the physician. A correct diagnosis of the underlying disease is essential to the rational management [1].

Normally the pleural space contains only a few millimetres of fluid. Accumulation of excessive amount of fluid is a frequent manifestation of many diseases of both thoracic and extra thoracic. Indeed pleural effusion must be regarded as a trivial event but as a sign of major disorder or disease [2].

The first diagnostic step is the identification of pleural effusions as either a transudate or exudates. This is useful because it indicates the pathophysiological mechanisms involved. Exudates are secondary to alteration of capillary permeability or lymphatic drainage. Transudates are due to either alterations of hydrostatic and / or osmotic pressure in pleural capillaries or to a fluid passing from the peritoneal cavity via diaphragmatic defects.

If an exudate is present further diagnostic procedures and tests are imperative for definitive diagnosis and specific therapy. On the other hand if the fluid is clearly a transudate one need not worry about manoeuvres directed at the pleura and need to treat only the congestive cardiac failure, nephrosis, cirrhosis or hypoproteinemia [3].

Over the years many criteria have been developed by various workers for separation of exudates and transudates.

OBJECTIVE OF THE STUDY

To study the diagnostic value of Pleural fluid Cholesterol in differentiating transudative and exudative pleural effusions.

REVIEW OF LITERATURE

HISTORICAL ASPECTS OF PLEURAL DISEASE

The word ‘pleura’ means ‘rib’ in Greek. Galen used the term pleura for both the ribcage and the lining membrane of the chest wall. Later Mandino used the word pleura for the lining membrane exclusively and this has been used ever since.

Pleurisy means inflammation of the Pleura. Hippocrates was the first to use this termin 5th century. The first to establish the site of pleurisy exclusively in the Pleura was Hermann Boerhaave(1668-1730). It was Laennec in 1820 who first to describe the association between phthisis and Pleural effusion. In 1761 AD, Auenbrugger introduced chest percussion which proved to be very useful in clinical detection of Pleural

effusion. GuidoBacelli’s description of aponic pectorilquy of Pleural effusion was another landmark. Grocco (1856-1916) described the Para vertebral dullness known as Grocco’s triangle of pleural effusion. Armand trosseau (18th century) was the person to aspirate fluid from the Pleural cavity. Later on, Delafouy, his pupil improved the procedure by employing a trocar. But it was Henry Bowditch (1802-92) who perfected the procedure paracentesis thoracis. In 1925 Jacobaeus first viewed tubercles studded over the pleura through thoracoscopy. In 1954 Sutcliff introduced open pleural biopsy as a diagnostic aid. In 1954 Defrancis used liver biopsy needle for closed biopsy. In 1958 Abram developed pleural biopsy needle which is in general use till today.

Table-1: Shows the historical aspects of the various criteria/ parameters

Sl. No.	Worker & year	Criteria/ parameters	Comments
1.	Paddock f. k [4] 1940	Specific Gravity	Unacceptable misclassification rates of both transudates and exudates led to recommendation of abandonment of this criteria in a later review
2.	Leuallen & carr [5] 1955	Pleural Fluid Protein Levels >3.0/100ml	Erroneous classification of both exudates and transudates of up to 10% noted in a review
3.	Carr & power [6] 1958	Pleural Fluid Protein to Serum Protein Ratio > 0.5	Somewhat better results than above but only as far as transudates were concerned. 10% of exudates still misclassified
4.	Chandras -hekar [7] J. 1958	Pleura Fluid LDH > 200 IU/L	Was found to be inferior even to Protein criteria
5.	Light R.W [8] 1972	Combination of Protein and LDH criteria. A) Pleural Fluid to -serum protein ratio >0.5 B) Pleural LDH > 200 IU/L C) Pleural Fluid serum LDH >0.6 (LIGHTS CRITERIA)	Used routinely till today. However a large number of studies have not found satisfying results. A large percentage of transudates are misclassified in C.C.F if patient is on diuretics. Both pleural fluid and serum samples required. Hence cumbersome and costly

It is clear from the above table 1 that many of the criteria have given way to the next successive criteria. It was Lights criteria which had better success since it is based on a combination of both Protein and LDH criteria. Lights [8] criteria is used routinely today as a standard method to separate transudate and exudate.

However Lights criteria has many deficiencies. Firstly, Lights excellent results have not been fully reproduced in several studies with respect to sensitivity and specificity. A large number of prospective studies have reported specificities of only between 70% and 86% in contrast to 98% specificity claimed by Lights

[9], Hirsh [10] 1979, Peterman [11] 1984, Costa, M [12] 1989, Roth [13] 1990, Valdes [14], [15]. The second major disadvantage of Lights criteria is the misclassification of transudative effusions as exudates in patients with congestive cardiac failure on diuretic therapy a phenomenon first noticed by Pillay [16] in 1965 and confirmed by Chaklo [17] in 1989. Thirdly, Lights criteriarequires both Pleural and blood samples and four biochemical measurements Hence, it is both expensive and cumbersome [18, 19].

For these reasons in recent years other researchers have proposed several new parameters for separation of transudates and exudates.

Table-2: Shows the newer parameters/criteria proposed as alternative to lights criteria

Sl. No.	Name of worker	Year	Criteria/ parameters	Comments
1.	Hamm H [9]	1987	Pleural cholesterol >60mg/dl Pleural Cholesterol to Serum Cholesterol ratio >0.3	First to use cholesterol, found good results
2.	Valdes L [14]	1991	Pleural Cholesterol >55 mg/dl and/or P.Cholesterol to Serum Cholesterol ratio >0.3	Confirmed Harum's routine use of this criteria since cheaper and more efficient
3.	Roth.B.J [13]	1990	Serum-effusion albumin gradient (1.2g/dl)	Specificity not affected by concomitant diuretic therapy
4.	Meisel. S [20].	1990	Pleural bilirubin to serum bilirubin ratio >0.6	Good results not obtained in subsequent studies
5.	Tahaoglu. K [21]	1994	Alkaline phosphatase levels of Pleural fluid	Further studies needed to confirm claim of authors of high efficacy
6.	Costa. M [12]	1995	Pleural. Cholesterol>45mg/dl + Pleural LDH>200 IU/L.	No simultaneous serum sample needed. Pleural fluid data alone sufficient. Hence very cost effective.
7.	Eduardo- Garcia p [22]	1996	Pleural fluid to serum Cholinesterase ratio	Claimed to be the most accurate of all. Further studies needed since it is the newest in literature

From table 2, it is evident that the recent literature has seen a plenty of reports on various alternative criteria to Lights criteria. Controversy exists as to which method is more accurate [23].

General mechanisms of pleural effusion [38]

Increased Pleural Fluid Formation

- Increased interstitial fluid in the lung: e.g. left ventricular failure, pneumonia, pulmonary embolus.
- Increased intravascular pressure in the pleura: e.g. Right or left ventricular failure, SVC obstruction syndrome.
- Increased pleural fluid protein level:
- Protein leak through capillaries
- Protein exudation due to local pleural inflammation
- Defective lymphatic absorption
- Decreased pleural pressure : e.g. Lung atelectasis
- Increased fluid in the peritoneal cavity: e.g. Ascites or peritoneal dialysis.
- Disruption of the thoracic duct: Trauma, tumour, lymphomas, congenital absence of thoracic duct.

Decreased Pleural Fluid Absorption

- Obstruction of draining lymphatics: Tumour-lymphomas, tuberculosis, lymphangiomatosis, yellow nail syndrome, filariasis.
- Elevation of systemic vascular pressure:Right ventricular failure and SVC syndrome.

DIFFERENTIAL DIAGNOSIS OF PLEURAL EFFUSION

Transudative pleural effusion

- Congestive heart failure
- Cirrhosis
- Nephrotic syndrome

- Superior venacaval obstruction
- Fontan procedure
- Urinothorax
- Peritoneal dialysis
- Glomerulonephritis
- Myxoedema.
- Pulmonary emboli
- Sarcoidosis.

Exudative pleural effusion

Neoplastic disease

- Metastatic disease eg: Ca Lung, CaBreastand lymphoma.
- Mesothelioma

Infectious diseases

- Bacterial infections
- Tuberculosis
- Fungal infections
- Parasitic infections
- Viral infections

Pulmonary embolization

Gastrointestinal diseases

- Pancreatic diseases
- Subphrenic abscess
- Intrahepatic abscess
- Intrasplenic abscess
- Oesophageal perforation
- After abdominal surgery
- Diaphragmatic hernia
- Endoscopic variceal sclerosis
- After liver transplant

Collagen vascular diseases

- Rheumatoid pleuritis
- Systemic lupus erythematosus
- Drug induced lupus
- Immunoblastic lymphadenopathy
- Sjogrenssyndrome
- Familial Mediterranean fever
- ChurgStrauss syndrome
- Wegenersgranulomatosis

Drug induced pleural disease

- Nitrofurantoin
- Dantrolene
- Methysergide
- Bromocryptine
- Amiodarone
- Procarbazine
- Methotrexate

Miscellaneous diseases and conditions

- Asbestos exposure
- Meig syndrome
- Post myocardial infarction syndrome
- Yellow nail syndrome
- Sarcoidosis
- Pericardial disease
- After coronary artery bypass surgery
- After lung transplant
- Fetal pleural effusions
- Uremia
- Trapped lung

Haemothorax

Chylothorax

CHOLESTEROL IN PLEURAL FLUID

It has long been known that cholesterol is constantly present in all pleural fluids. Until recently the cholesterol content of pleural fluid has been used, together with the concentrations of other lipid fractions to distinguish between Chylothorax and pseudochylothorax. Chylothorax occurs when the thoracic duct is disrupted causing chyle to enter the pleural space. A Pseudochylothorax occurs due to accumulation of large amounts of cholesterol in long standing effusions.

CHOLESTEROL PLEURAL EFFUSION [84, 85, 86, 87, 83]

(Syn-pseudochylous effusion, cholesterol thorax, chyloform effusion)

History

Cholesterol pleural effusion is a rare condition. Until 1961 only 99 cases had been reported in literature .The first description was by Nauyn in 1865 and then by Guneau de Moussy in 1874. Churton published the first detailed description in 1882 in his case he found that there was degeneration of cells leading to formation of

cholesterol. Malgatti reviewed 44 cases from literature up to 1929, in his series the commonest associated condition was tuberculosis. Stein in 1932 reported a male of 45 years with 25 years history of pleural effusion. Pleural fluid cholesterol was 2353 mg%, autopsy revealed gross pleural thickening with calcification enabling the pleural sac to be removed like a cast. Durham and Diamond, Moll and Fowweather 1940, Erwin 1941 have all described cholesterol thorax. In most of their cases the pleural effusion was long standing (mean 7 years).

Aetiology

The most common causes are tubercular pleuritis and rheumatoid pleuritis.

Pathogenesis [85, 86, 88]

The precise mechanism of chyloform effusions is not known. Most of the cholesterol is associated with HDL in contrast to the cholesterol in acute exudates where it is mostly bound to LDL [89]. It has been hypothesized that cholesterol that enters the pleural space with acute inflammation becomes trapped and undergoes change in lipoprotein binding characteristics. The diseased pleura results in abnormally slow transfer of cholesterol out of the pleural space resulting in accumulation.

The origin of the cholesterol and other lipids is not definitely known but one possibility is from degenerating red and white blood cells in the pleural fluid. Most patients with cholesterol effusions have no altered cholesterol metabolism because the serum cholesterol levels are normal. Some chyloform effusions contain cholesterol crystals.

Diagnosis

Is based on pleural fluid appearance, microscopic detection of cholesterol crystals and by elevated pleural fluid cholesterol levels. Lipoprotein analysis may have to be performed if doubt exists whether the fluid is chylous or pseudochylous because only chylous fluid contains chylomicrons. Triglyceride levels may be elevated even in cholesterol effusions and hence are not useful in differentiation from chylous effusion.

Treatment

Is both by specific therapy (eg Anti Tubercular Therapy) and by therapeutic thoracentesis Decortication may result in markedly improved functional status in many cases.

MATERIALS AND METHODS

Source of data

- Data is collected from patients who are attending Medicine OPD and admitted in BLDEU'S Shri B. M. Patil medical college hospital and research centre, VIJAYAPURA.
- Period of study is from November 2016 to July 2018.

Method of collection of data

Inclusion Criteria

- Age >18years
- Patients with definite clinical diagnosis and Pleural effusion evidenced by radiological imaging.

Exclusion criteria

- Age <18years
- Patients without definitive clinical diagnosis
- Patients previously diagnosed and already on treatment.

Type of study

Cross sectional descriptive study

Sample size

Using expected incidence of exudates cases among pleural effusion as 69.4%, expected sensitivity as 88%, expected specificity as 100% and desired precision as +/-10%,

The minimum sample is 60. This sample size will give the precision of 10% for both sensitivity and specificity.

Formula used

$$N = z^2 (1-p)/d^2$$

Z-value of z statistic at 5% level of significance

d-margin of error

p-expected incidence rate

STATISTICAL ANALYSIS

Data will be analysed using mean+/-SD Chi square test for association, comparison of means using test, ANOVA for comparison between and within groups and diagrammatic presentation.

RESULTS AND OBSERVATION

The present study was undertaken in 60 cases of Pleural Effusion over a period of 2 and half years from November 2016 to July 2018, the results of which are given below.

Table-1: Age and sex distribution

AGE (years)	Male		Female		p value
	N	%	N	%	
18-20	1	2.6	0	0.0	0.641
21-30	5	13.2	4	18.2	
31-40	8	21.1	7	31.8	
41-50	12	31.6	3	13.6	
51-60	8	21.1	5	22.7	
>60	4	10.5	3	13.6	
Total	38	100.0	22	100.0	

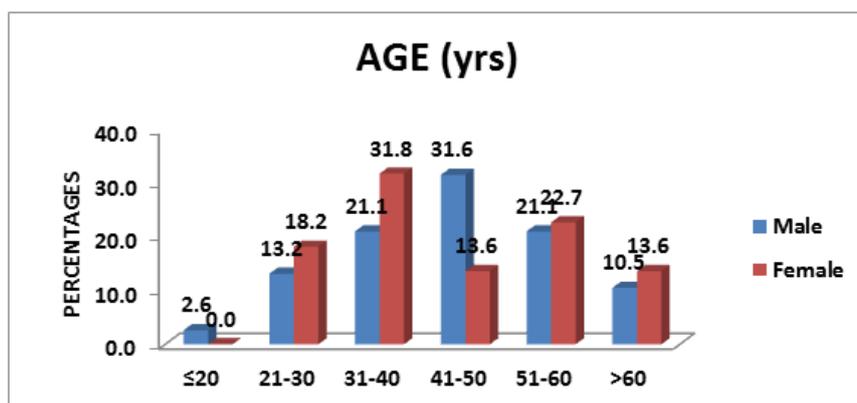


Fig-1a: Age and sex distribution

The age of the patient in this study ranged from 18years to 75 years. 1 patient was 18 years,9 patients were under 21-30years,15 patients were under 31-40 years,15 patients were under 41-50years,13

patients were under 51-60 years,7 patients were above 60 years. Out of 60 patients there were 38 males and 22 females.

Table-2: Distribution of exudates and transudate according to lights criteria

BASED ON LIGHTS CRITERIA	N	%
EXUDATE	46	76.7
TRANSUDATE	14	23.3
Total	60	100

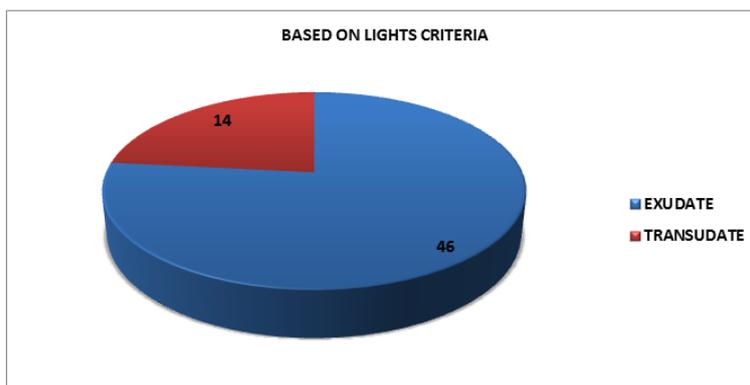


Fig-2a: Distribution of exudates and transudate according to lights criteria

Based on Lights criteria, out of 60 patients 46 were exudates (76.7%) and 14 were transudates (23.3%) (Fig-2a).

Based on pleural cholesterol level criteria, out of 60 patients 45(75%) were exudates and 15(25%) were transudates (Fig-3a).

Table-3: Distribution of exudates and transudate according to pleural fluidcholesterol criteria

BASED ON CHOLESTEROL CRITERIA	N	%
EXUDATE	45	75
TRANSUDATE	15	25
Total	60	100

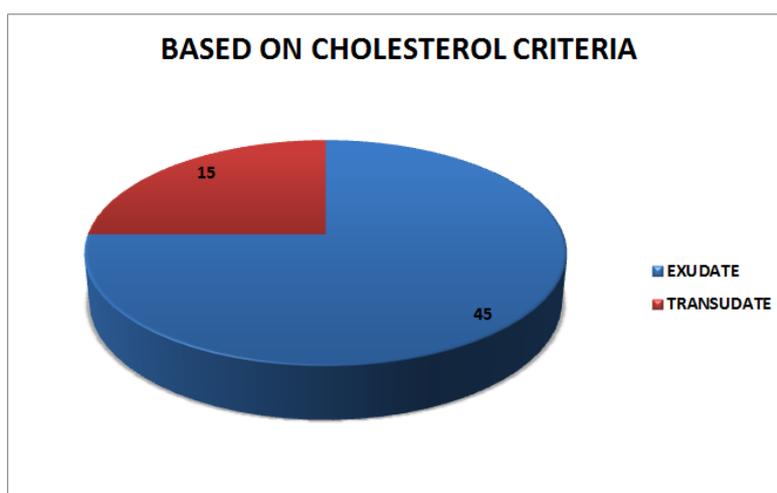


Fig-3a: Distribution of exudates and transudate according to pleural fluidcholesterol criteria

Table-4: Distribution of symptoms in pleural effusion at presentation

PRESENTING SYMPTOMS	NUMBER (N=60)	PERCENTAGE
1. COUGH	50	83.3
2. FEVER	22	36.7
3. CHEST PAIN	34	56.7
4. DYSPNOEA	47	78.3
5. SWELLING OF LIMBS	10	16.7
6. DISTENSION OF ABDOMEN	10	16.7
7. FACIAL PUFFINESS	6	10
8. LOSS OF APPETITE	60	100
9. LOSS OF WEIGHT	40	66.7

Cough was present in 50 patients (83.3%) , fever in 22 patients (36.7%), chest pain in 34 patients (56.7%), dyspnoea in 47(78.3%) , swelling of limbs and

abdominal distension each in 10 patients (16.7%) , facial puffiness in 6 patients , loss of appetite in 60 patients (100%) , loss of weight in 40 patients (66.7%).

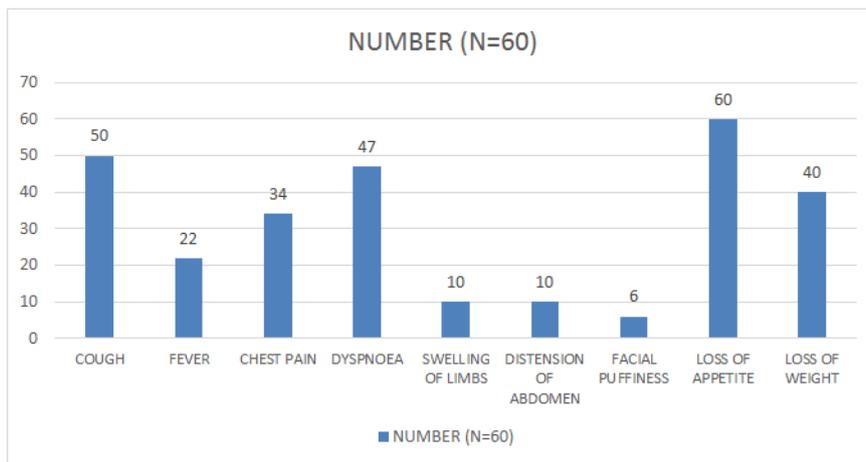


Fig-4a: Distribution of symptoms in pleural effusion at presentation

Table-5: Distribution of signs in pleural effusion at presentation

CLINICAL SIGNS	NUMBER(N=60)	PERCENTAGE
1. STONY DULLNESS	60	100
2. ABSENT BREATH SOUND	50	83.3
3. DECREASED VF/VR	52	86.7
4. MEDIASTINAL SHIFT	50	83.3
5. PLEURAL RUB	4	6.6
6. CREPITATIONS	5	8.3

Stony dullness in 60 patients (100%), Decreased/ absent breath sounds in 50 patients (83.3%), Mediastinal shift in 33 patients (83.3%), Decreased vf/vr in 52 patients (86.7%), Pleural rub in 4 patients (6.6%), Crepitations in 5 patients (8.3%).

Out of 60 patients, 36 had right sided effusion, 19 had left sided effusion, 5 patients had bilateral pleural effusion (Table-6).

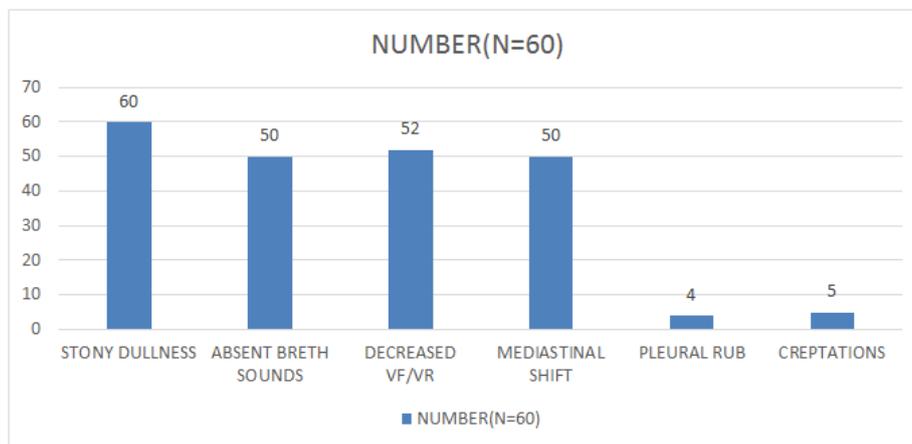


Fig-5a: Distribution of signs in pleural effusion at presentation

Table-6: Pleural effusion right and left side distribution

SIDE OF EFFUSION	NUMBER(N=60)	PERCENTAGE
RIGHT	36	60.0
LEFT	19	31.7
BILATERAL	5	8.3

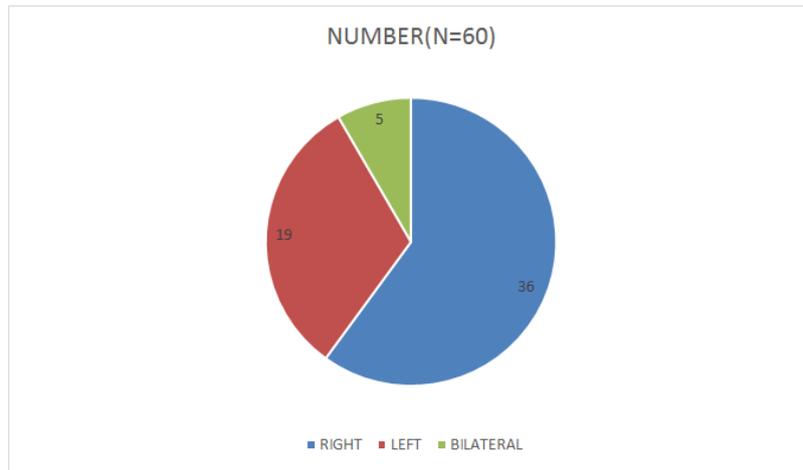


Fig-6a: Pleural effusion right and left side distribution

Table-7: Result of sputum AFB

SPUTUM AFB	TOTAL		P VALUE
	N	%	
NEGATIVE	28	46.7	0.232
POSITIVE	32	53.3	
TOTAL	60	100.0	

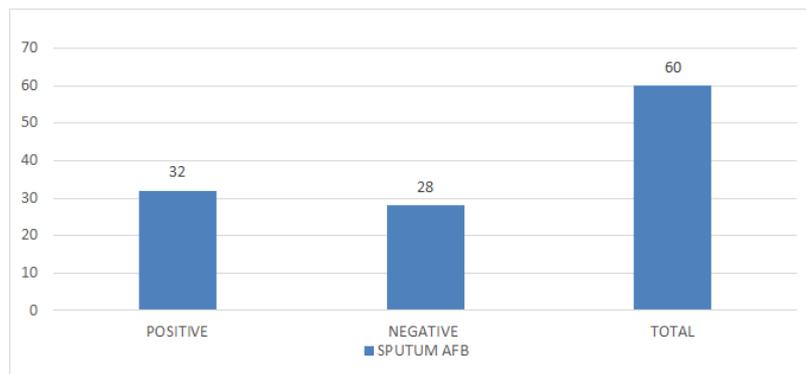


Fig-7a: Result of sputum AFB

In the study group of 60 patients, sputum AFB was positive in 32 (53.3%) patients and 28 (46.7%) patients had sputum AFB was negative (Fig-7a).

Colour of pleural effusion – 36 patients had amber colour, 18 patients had clear, 4 patients had haemorrhagic and straw colour in 2 patients (Fig-8a).

Table-8: Appearance of pleural effusion

COLOUR	Total		p value
	N	%	
AMBER	36	60.0	0.864
CLEAR	18	30.0	
HAEMORRHAGIC	4	6.7	
STRAW	2	3.3	
Total	60	100.0	

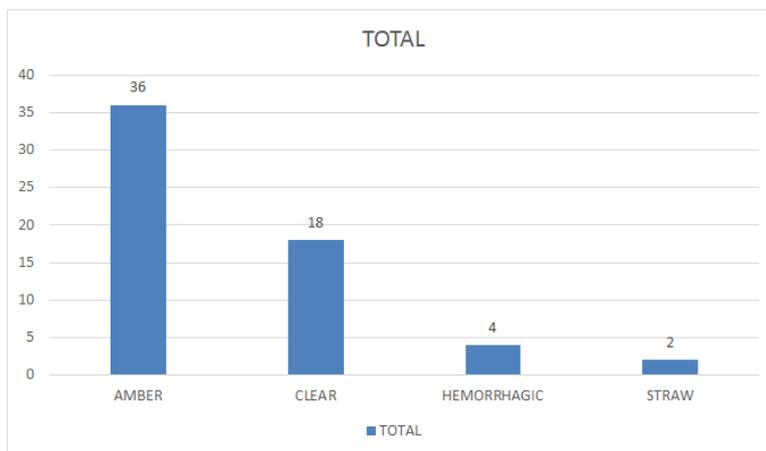


Fig-8a: Appearance of pleural effusion

Table-9: Cytology of pleural effusion

CYTOLOGY	Total		p value
	N	%	
LYMPHOCYTES + MESOTHELIAL CELLS	3	5.0	0.476
PREDOMINANTLY LYMPHOCYTES	42	70.0	
PREDOMINANTLY NEUTROPHILS	15	25.0	
Total	60	100.0	

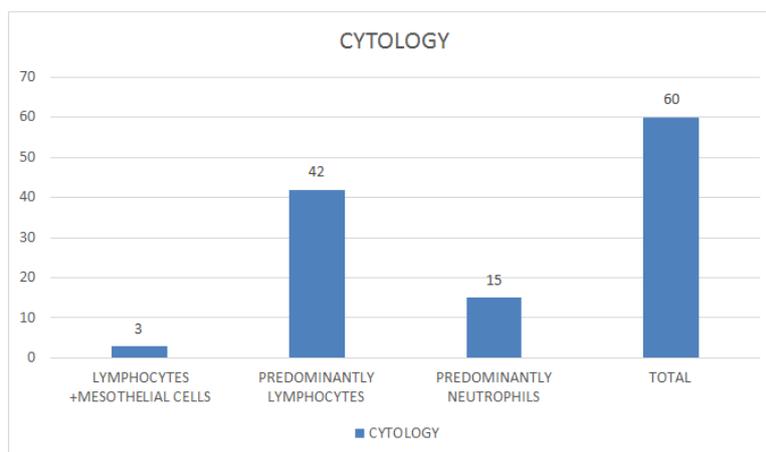


Fig-9a: Cytology of pleural effusion

Out of 60 patients, 3 patients had lymphocytes plus mesothelial cells, 42 patients had predominantly lymphocytes and 15 patients had predominantly neutrophils.

Table-10: Distribution of pleural protein

PLEURAL PROTEIN (gram/dl)	Number (n=60)
1-2	6
2-4	16
4-6	34
>6	4
Total	60

The above table shows the values of pleural protein. 6 patients had pleural protein values ranging from 1-2 gram/dl, 16 patients of pleural protein ranging

from 2-4 gram/dl, 34 patients ranging from 4-6 gram/dl and 4 patients had protein levels above 6 gram/dl.

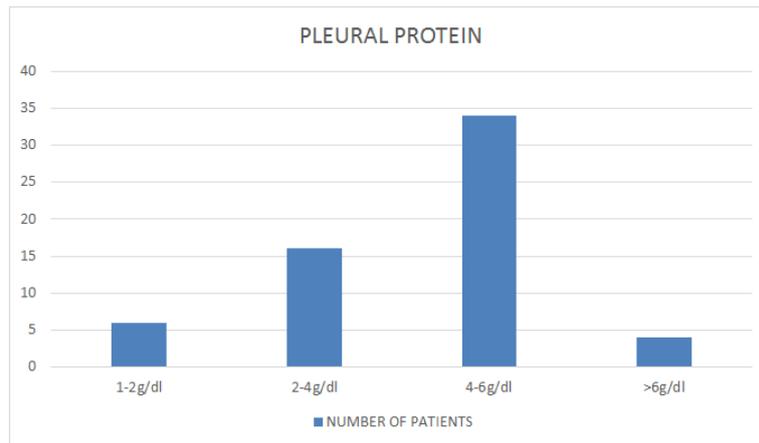


Fig-10a: Distribution of pleural protein

Table-11: Distribution of pleural cholesterol

PLEURAL CHOLESTEROL	NUMBER (N=60)
<45 mg/dl	15
>45 mg/dl	45
Total	60

15 patients had pleural cholesterol levels less than 45 mg/dl and 45 patients had cholesterol level above 45 mg/dl.

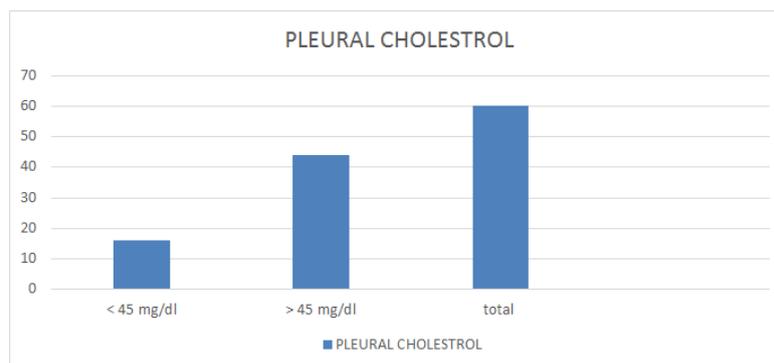


Fig-11a: Distribution of pleural cholesterol

Table-12: Biochemical analysis of pleural effusion

PARAMETERS	EXUDATES		TRANSUDATE		P VALUE
	MEAN	SD	MEAN	SD	
LIGHTS CRITERIA (TRANSUDATE=14 EXUDATE=46)					
SERUM PROTEIN	5.7	1.0	6.1	1.1	0.215
PLEURAL PROTEIN(G/DL)	4.7	1.0	2.4	0.9	<0.001*
PLEURAL SUGAR	68.2	40.1	126.7	75.9	<0.001*
PLEURAL FLUID PROTEIN:SERUM PROTEIN	0.8	0.2	0.3	0.1	<0.001*
PLEURAL CHOLESTEROL CRITERIA(TRANSUDATE=15 EXUDATE=45)					
PLEURAL CHOLESTEROL	78.2	23.7	21.9	9.2	<0.001*

Note:* significant at 5% level of significance (p<0.05). The p value of serum protein is 0.215, pleural protein is <0.001, pleural sugar is <0.001, pleural cholesterol is <0.001, pleural fluid protein: serum protein is <0.001. P value of <0.001 is statistically significant.

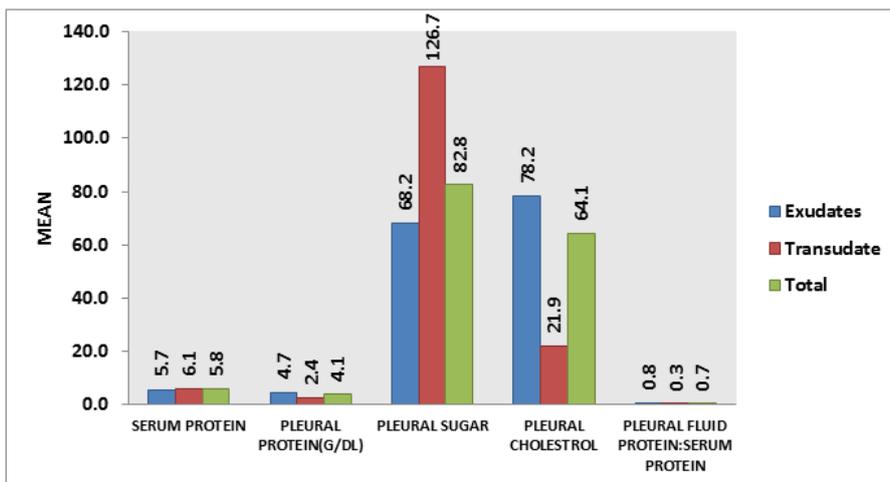


Fig12a: Biochemical analysis of pleural effusion

Table-13: USG Abdomen examination in pleural effusion

USG	Total		p value
	N	%	
CIRRHOSIS WITH PORTAL HYPERTENSION	7	11.7	0.182
MILD HEPATOMEGALY	1	1.7	
MINIMAL ASCITES	1	1.7	
NORMAL	39	65.0	
NOT DONE	12	20.0	
Total	60	100.0	

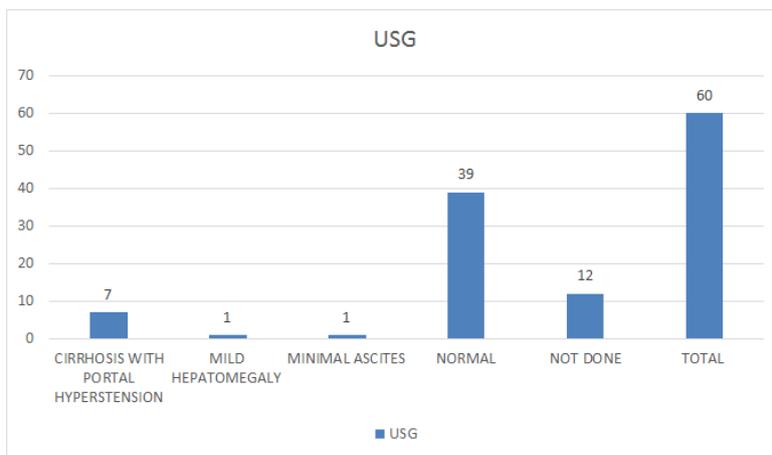


Fig-13a: USG Abdomen examination in pleural effusion

In the study group of 60 patients, cirrhosis was present in 7 patients, hepatomegaly in 1 patient, ascites in 1 patient, and normal in 39 patients.

Based on lights criteria 46 patients were exudate and 14 patients were transudative pleural

effusion, based on cholesterol criteria 45 patients were exudative and 15 were transudative pleural effusion.

The p value is < 0.001 which is statistically significant.

Table-14: Comparison of exudative and transudative pleural effusion according to pleural fluid cholesterol criteria and lights criteria

	ACCORDING TO PLEURAL FLUID CHOLESTEROL CRITERIA (N=60)		ACCORDING TO LIGHTS CRITERIA(N=60)		P VALUE
	N	%	N	%	
EXUDATE	45	75.0	46	76.66	<0.001*
TRANSUDATE	15	25.0	14	23.33	
TOTAL	60	100.0	60	100.0	

Note: * significant at 5% level of significance (p<0.05)

Table-15: Sensitivity analysis of pleural cholesterol criteria

TP (true positive)	45
FN (false negative)	1
FP (false positive)	0
TN (true negative)	14
Sensitivity	97.8%
Specificity	100.0%
PPV(positive predictive value)	100.0%
NPV(negative predictive value)	93.3%
Accuracy	98.3%

DISCUSSION

A total of 60 patients were taken up for this study. Out of 60, 46 were exudates and 14 were transudates. Among 46 exudates, 40 were tubercular effusions, 5 patients were synpneumonic effusion and 1 patient with malignant effusion.

Among 14 transudative, 7 patients were congestive cardiac failure, 7 patients were cirrhosis.

AGE AND SEX

The age of the patient in this study ranged from 18 years to 75 years. 1 patient was 18 years, 9 patients were between 21-30 years, 15 patients were between 31-40 years, 15 patients were between 41-50 years, 13 patients were between 51-60 years and 7 patients were above 60 years. Out of 60 patients, males were 38 and females were 22.

Biochemical analysis of pleural effusion

Table-16: Biochemical analysis of pleural effusion

PARAMETERS	EXUDATES		TRANSUDATE		P VALUE
	MEAN	SD	MEAN	SD	
LIGHTS CRITERIA (TRANSUDATE=14 EXUDATE=46)					
SERUM PROTEIN	5.7	1.0	6.1	1.1	0.215
PLEURAL PROTEIN(G/DL)	4.7	1.0	2.4	0.9	<0.001*
PLEURAL SUGAR	68.2	40.1	126.7	75.9	<0.001*
PLEURAL FLUID PROTEIN:SERUM PROTEIN	0.8	0.2	0.3	0.1	<0.001*
PLEURAL CHOLESTEROL CRITERIA(TRANSUDATE=15 EXUDATE=45)					
PLEURAL CHOLESTEROL	78.2	23.7	21.9	9.2	<0.001*

According to Lights Criteria, the mean serum protein is 5.7±1.0 in exudates and 6.1±1.1 has p value of 0.215. The mean pleural protein is 4.7±1.0 in exudates and 2.4±0.9 has p value of 0.001. The mean pleural sugar is 68.2±40.1 in exudates and 126.7±75.9 has p value of 0.001. The mean pleural protein: serum protein is 0.8±0.2 in exudates and 0.3± 0.1 has p value

of 0.001. According to pleural cholesterol criteria, the mean pleural cholesterol is 78.2±23.7 in exudates and 21.9±9.2 and has p value of 0.001 which is statistically significant.

PLEURAL FLUID CHOLESTEROL**Table-17: Comparison of pleural fluid cholesterol values between the studies**

Sl.no	AUTHORS	SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
1	Hamm [9]	93.5	100	100	91	96
2	Valdes [14]	92.5	87.6	95	80	91.3
3	Ram [103]	96	93	96	92.6	95
4	B N Mohaptra [27]	92	100	100	99	93
5	Burgess [15]	54	92.2	87.3	50	66
6	Present study	97.8	100	100	93.3	98.3

Hamm [9] first used pleural cholesterol as a parameter. In his study of 150 patients he found excellent results (Sensitivity 93%, Specificity 100%, Accuracy 96%). Following Hamm's [9], Valdes [14] aimed to validate this parameter. In his study of 74 patients pleural cholesterol had good results as shown in the above table. Similar results were obtained from studies by Ram [103] in 100 patients and B N Mohaptra [27] in his study of 132 patients. The studies of Burgess [15] and Remero [28] of 124 patients, results were in favour of lights criteria but they had less sensitivity, specificity and accuracy. As a result the present study of 60 patients which contains Pleural Cholesterol criteria has more sensitivity, specificity and accuracy when compared to other studies done by Burgess and Remero which contains Lights criteria.

The study shows that pleural fluid cholesterol criteria (cholesterol >45 mg/dl - exudate and cholesterol <45 mg/dl – transudate) constitute a useful tool for the separation of pleural effusions.

CONCLUSION

The pleural fluid cholesterol criteria were found to be the most efficient criteria. Since this parameter involves the measurement of only pleural fluid values of cholesterol, it has following advantages

- Economically , it reduces number of biochemical tests
- Simpler, as there is no need to take simultaneous blood sample at the time of thoracentesis.

It is concluded that the determination of pleural fluid cholesterol criteria can be included in routine analysis of pleural fluid samples in place of presently used Lights Criteria.

SUMMARY

This was a cross sectional descriptive study of 60 cases of pleural effusion. The parameter pleural fluid cholesterol levels are used in comparison with Lights criteria to distinguishing transudative and exudative pleural effusion. The following results were obtained in the present study.

- True positive in 45 cases
- False negative 1 case
- False positive 0 case
- True negative 14 case

- Sensitivity 97.8%
- Specificity 100%
- Positive predictive value 100%
- Negative predictive value 93.3%
- Accuracy 98.3%

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