Int. J Med. Pharm. Res. (P-ISSN: 2958-3675 | E-ISSN: 2958-3683)
Available on: https://ijmpr.in/

International Journal
of Medical and
Pharmaceutical Research

ORIGINAL ARTICLE **OPEN ACCESS**

DIAGNOSTIC ACCURACY OF A DROP HYDROGEN PEROXIDE TO DIFFERENTIATE BETWEEN EXUDATIVE AND TRANSUDATIVE PLEURAL EFFUSION

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Received: 25-04-2024
Accepted: 02-07-2024
Available online: 09-07-2024

ABSTRACT

Background: Patients presenting with clinical and radiological features suggestive of pleural effusion will have to be managed by diagnostic and therapeutic aspirations . Underlying pleural effusion is either exudative or transudative which is determined by light's criteria. Our study is meant to see the effectiveness of simple and rapid bed side diagnostic test that is H2O2 test in the place of light's criteria.

AIMS: Bed side Hydrogen peroxide test to differentiate exudative and transdudative pleural effusion.

Objectives: 1) To differentiate between exudate and trasudate pleural effusion through this simple bed side H2O2 test.

2) To compare the hydrogen peroxide test of pleural fluid to that of standard analysis as per light's criteria.

Materials &Methods: This is a prospective observational study carried out in a tertiary care hospital from December 2023-April 2024.A total of 96 patients presenting with clinical and radiological features of pleural effusion who met the eligibility criteria are included in the study were subjected to routine diagnostic workup ,chest imaging, pleural fluid analysis and rapid H2O2 test of pleural fluid.

Result: There were 96 patients who had pleural effusion,of them 32 patients had nil or minimal reaction indicating transudative pleural effusion while 64 patients had bubbling reaction indicating of exudative pleural effusion based on drop hydrogen peroxide test. Pleural fluid analysis based on light's criteria showed 21 patients as transudative pleural effusion while 75 patients had exudative pleural effusion based on Light's criteria .Sensitivity of A drop Hydrogen peroxide test was 81.3%, Specificity was 85.74%, Positive Predictive Value(PPV) was 95.3%.Negative Predictive Value (NPV) was 56.25% . The diagnostic accuracy of A Drop hydrogen peroxide test in our study is 82.29% to differentiate the nature of pleural fluid into exudative and transudative.

Conclusion: This bedside test allows for more rapid determination of the nature of pleural effusions as an exudate or transudate and can be used as a screening test while waiting for results through light's criteria.Further reaserch have to be done to know the validity of this bed side test.

Key Words: light's criteria, h2o2 test, exudate, transudate

INTRODUCTION:-

Pleural effusions contribute to a significant proportion of cases coming to pulmonary medicine Out patient clinic or casualty. Pleural effusion constitutes an important differential diagnosis of any abnormnal chest radiograph. Homogenous opacities on chest radiograph with or without parenchymal infiltrates,mass lesions represent pleural fluid[1].

The differentiation of pleural effusions as being either transudate or exudate is the first step in the diagnostic workup of the pleural fluid. Such categorization assists diagnostic and therapeutic decisions[1].

Pleural fluid protein level is used to separate transudate from exudate, with exudative pleural effusions characterized by a protein level above 3 g/dl. Use of this only protein criterion as a diagnostic biomarker for the purpose led to the misclassification of approximately 10% of the pleural effusions. , it is demonstrated that with the use of simultaneously obtained serum and pleural fluid protein and LDH value, 99% of pleural effusions could be correctly classified as either transudate or exudates. This is the basis of currently most popular diagnostic criteria (Light's criteria) for such differentiation[2].

According to sciencedirect article on Comparative analysis of Light's criteria and other biochemical parameters for distinguishing transudates from exudates-Light's criteria are just as useful as the association of pleural cholesterol and LDH to detect exudates. In the present study, no parameter, including pleural cholesterol, was superior to Light's criteria[3].

Congestive heart failure, Nephrotic Syndrome and Hepatic Cirrhosis are among the common causes of transudative pleural effusion while Tuberculosis, Parapneumonic effusion, Primary and metastatic lung cancer, Vasculitis and Pancreatitis are often listed under exudative pleural effusion which are often local cause[4].

TABLE 1(light's criteria)

$\frac{\text{pleural fluid protein}}{\text{serum protein}} > 0.5$
$\frac{\text{pleural fluid LDH}}{\text{serum LDH}} > 0.6$
$\text{pleural fluid LDH} > \frac{2}{3}\text{normal upper limit for serum}$

METHODS :-

Prospective Observational study done in patients attending to Pulmonary Medicine Dept, G.G.H, Siddhartha Medical College, Vijayawada during the period from September 2023 to april 2024 for 8 months . 96 Patients who met the inclusion and exclusion criteria are included in the study.

Patients meeting the eligibility criteria and willing for study are included in further evaluations. Demographic data of patients noted in case sheets.After thorough physical examination patients are subjected to

1) Routine blood investigations-CBP/LFT/RFT/RBS/Viral markers.

2) Chest imaging-Chest X RAY/CT CHEST(if necessary)/USG CHEST (if necessary)

3) Pleural fluid analysis – After confirming clinically and radiologically diagnostic tap done under aseptic conditions in $5^{th}/6^{th}$ Intercostal space and fluid taken for analysis.Therapeutic aspiration done in symptomatic patients.

-Pleural fluid sent for Proteins and sugars/LDH/Total and differential counts.

-BED SIDE HYDROGEN PEROXIDE TEST-Two milliliters of tapped pleural fluid of patients who underwent aseptic thoracocentesis was collected in a test tube to which two to three drops of 10% hydrogen peroxide was added. After a few seconds of gentle shaking of the tube, the presence of visible air bubbles in the tube was observed. Presence of profuse bubbles was taken as exudative fluid and its absence as transudative type .

Some patients with incomplete diagnosis further subjected to other interventions as per hospital protocol.

INCLUSION CRITERIA

Patients above 18 yrs of age presenting with clinical and radiological features of pleural effusion..

EXCLUSION CRITERIA

Hemothorax-Blood in the pleural space

Empyema-Pus in the pleural space

Chylothorax-Chyle in the pleural space

Hydro pneumothorax –Fluid along with air in the pleural space

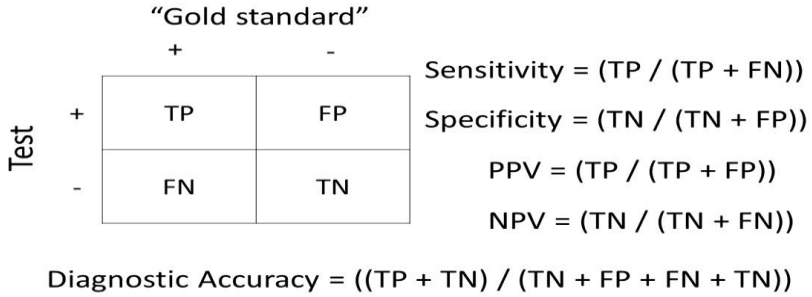
Pyopneumothorax-Pus and air in the pleural space

Severly ill patients with organ failures

STATISTICAL ANALYSIS

Data was transferred from data collection sheet to Excel sheet andSensitivity ,specificity, positive , negative predictive value and diagnostic accuracy of drop hydrogen peroxide test were done to assess the validity of the test.

TABLE 2



Ethics approval done in Siddhartha medical college and Govt.General hospital.

RESULTS

In the study conducted during the period from December 2023 to april 2024, 96 patients selected with pleural effusion.

TABLE3

AGEDISTRIBUTION(years)	MALE	FEMALE
20-30	15	8
30-40	10	7
40-50	8	12
50-60	12	9
60-70	5	10

1)Age group- (20-70 yr)-average age group-45 yrs
2)Gender -50 males and 46 females as per table 3

TABLE 4

Symptom	Presentation
SOB	75%
Cough	80%
Fever	35%
Chestpain	30%
Lossof appetite	20%
Weight loss	15%
Hemoptysis	5%

3)Clinical presentation- Patients major complaints are shortness of breath(75%) , Cough(80%),Fever(35%),Chest pain(30%).less common symptoms such as Loss of appetite(20%),Weight loss(15%),Hemoptysis(5%) as per table 4

4)Pleural fluid analysis and classification as exudative or transudative effusion which is determined by light's criteria.
75 (78.12%) of them had exudative pleural effusion and 21(21.87%) had transudative pleural effusion by Light's criteria.Out of exudates Pleural fluid protein value range 3-4g/dl in 50 patients,4-5 g/dl in 20 patients,>5 g/dl in 5 patients.

TABLE 5- Light's Criteria (Reference test)

Hydrogen peroxide (i ndex test)	Positive	Negative	Total
Positive	61(TP)	3(FP)	64
Negative	14(FN)	18(TN)	32
Total	75	21	96

5)Rapid diagnostic test by a drop of Hydrogen peroxide
64 (66.66%) of them had exudative pleural effusion and 32 (33.33%) had transudative pleural effusion by A drop hydrogen peroxide test as per table 5.
61 were diagnosed as exudative by both A Drop Hydrogen Peroxide Test as well as by Light's criteria that is they were the true positives.
18 were true negatives that is transudate by both the tests.
3 samples were false positive that is exudate by H2O2 test but transudate by Light's criteria .
14 samples were false negative that is exudate by Light's criteria but transudate by H2O2 tests.
Above outcomes derives following inferences
Sensitivity of A drop Hydrogen peroxide test was 81.3%,
Specificity was 85.74%,
Positive Predictive Value(PPV) was 95.3%,
Negative Predictive Value (NPV) was 56.25% ,
The diagnostic accuracy of A Drop of hydrogen peroxide test in our study is 82.29% to differentiate the nature of pleural fluid into exudative and transudative.

According to European Respiratory journal 2020 article-There were 75 patients who had pleural effusion, 63 (84%) of them had exudative pleural effusion and 12 (16%) had transudative pleural effusion by Light's criteria and 54 (72%) of them had exudative pleural effusion and 21 (28%) had transudative pleural effusion by hydrogen peroxide test. 53 were the true Positives, and 11 were true negatives. 1 sample was false positive, and 10 samples were a false negative. The sensitivity of Hydrogen peroxide test was 84.13%, Specificity was 91.67%, PPV was 98.15%, and NPV was 52.38%, and Diagnostic Accuracy was 85.33%.[5]

Fig 1

DISCUSSION

Investigating pleural effusion which is evident on chest radiographs should follow a stepwise approach to diagnosis. Proper history taking and physical examination are critical in diagnosing a case of pleural effusion, followed by a chest radiography,USG chest.

Proper history taking and physical examination are critical in diagnosing a case of pleural effusion, followed by a chest radiography. Chest radiography (Posteroanterior and lateral view) usually confirms the presence of a pleural effusion. Lights criteria developed by Light has found to have maximum sensitivity and specificity of 100% and 83% respectively and is considered gold standard for analyzing the nature of pleural fluid and differentiating it into exudates and transudates. Increased catalase activity is the unique characteristic of exudative fluid.

Additionally, if direct diagnosis of pleural effusion cannot be found via analysis of the fluid appearance and biochemical parameters, further radiological investigations like CT or invasive procedures like pleural biopsy can be done.

A simple bedside test using hydrogen peroxide to verify the presence of catalase can be done, due to the ability of catalase to speed the decomposition of hydrogen peroxide to water and oxygen And the fluid can be classified as transudative or exudative. If profuse bubbling occurs within one minute of the addition of hydrogen peroxide to fluid, it signifies exudative fluid. The bubbling occurs as a result of the decomposition reaction. If hydrogen peroxide is added to transudative fluid, bubbling does not occur.

Sarkar et al. in his study with the sample size of 52, observed that all the exudative pleural fluids which were considered for the study showed profuse bubble formation after addition of hydrogen peroxide . Whereas transudative pleural fluids which are considered for the study showed no bubble formation after addition of hydrogen peroxide but addition of catalase or blood in transudate showed profuse bubble formation after addition of H2 O2 . The bubble formation in blood mixed or catalase mixed transudate was also inhibited by supplementation of sodium cyanide or sodium azide prior addition of H2 O2 . The bubble formation in the exudate was definitely due to its increased catalase activity which was significantly less in transudate. They concluded blood uncontaminated pleural fluid sample this newly developed protocol's sensitivity and specificity will be equivalent to Light's criteria probably with more advantage as by this procedure transport of the sample to the clinical laboratory is not required due to its inherent simplicity.[6]

Limitations

The concentration and amount of h2o2 used for this test is variable in different studies.

Conclusion

This bedside test allows for more rapid determination of the nature of pleural effusions and can be rapidly characterized as an exudate or transudate.

Firstly, this will shorten the diagnostic time and allow for treatment options to be considered with less delay by eliminating the need for lab work that may require several hours.

Secondly, the low price of the test will make it more acceptable in the limited lab resource facility.

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