

## Bed Side Diagnosis of Pleural Fluid Using Reagent Strips

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### ABSTRACT

**Introduction:** On average, the total volume of pleural fluid in a 70-kg non-smoking human is 18mL. **Objectives:** To determine the frequency of correctly diagnosed type of pleural effusion by reagent strips in comparison to Light's criteria. **Study Design:** Cross sectional Analytical study. **Setting:** Department of Pulmonology DHQ Hospital Faisalabad. **Duration of Study:** Study was carried out over a period of six months from 01-06-2015 to 31-11-2015. **Materials and Methods:** Total one hundred patients with pleural effusion were included in this study. The pleural fluid was tested by use of a reagent strip. Different cut off values for reagent strip were:(specific gravity; dark green 1.005, light green 1.015, brown 1.02, orange 1.03) and (protein; 1+ 30, 2+ 100, 3+ 500 mg/dl). The type of pleural effusion

(exudative or transudative) obtained from reagent strips as per according to operational definition were compared with results according to Light's criteria which was taken as Gold Standard. **Results:** Regarding age distribution, majority of the patients i.e. 38 (38.0%) were between 40-59 years of age while minimum 9 (9.0%) were < 20 years. Mean age of the patients was observed 41.3±6.9. Distribution of cases by gender shows 63 (63.0%) patients were male while remaining 37 (37.0%) were females. Out of 100 patients, 84 (84.0%) were correctly diagnosed type on reagent strips. **Conclusion:** Pleural effusion is a commonly encountered problem in medical practice in our country. The initial step in evaluating case of pleural effusion is to establish the type of pleural effusion. **Key words:** Pleural effusion, Reagent strips, Light's criteria

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### INTRODUCTION

Pleural effusion is defined as abnormal fluid collection in the pleural space. The pleural space is normally filled with ~5 to 10 mL of serous fluid, which is secreted mainly from the parietal pleura at a rate of 0.01 mL/kg/h and absorbed through the lymphatics in the parietal pleura.<sup>1</sup>

Approximately 1.5 million patients are diagnosed with pleural effusion each year in the United States.<sup>2</sup> Pleural effusion is classically divided into transudate and exudate based on Light's criteria. In transudate, fluid accumulates in the pleural space due to increased hydrostatic pressure

or decreased oncotic pressure across the intact capillary beds of pleural membranes. However, in exudate, the capillary beds themselves are diseased and its increased permeability results in fluid leak into the pleural space.<sup>2</sup> In adults, congestive heart failure and liver cirrhosis are the most common causes of transudative pleural effusions. On the other hand, pneumonia, malignant pleural disease, pulmonary embolism, and gastrointestinal disease account for ~90% of exudative pleural effusions.<sup>3</sup> In the pediatric population, congenital heart disease, pneumonia, and malignancy are the most common causes of pleural effusion<sup>1</sup>. Use of reagent strips has been proposed for the rapid diagnosis of meningitis, ascites, and urinary tract infections.<sup>4</sup> It has also been validated for determination of the pH of pleural effusions<sup>5</sup>. Reagent strips have been used in the diagnosis of the spontaneous bacterial

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empyema having sensitivity 92% and specificity 80%<sup>6</sup> which is exudative type of pleural effusion. However, reagent strips have not been tested for their accuracy in the determination of the levels of specific gravity and proteins in pleural effusion, parameters that are of paramount importance for distinguishing transudative from exudative effusion. Reagent strips analysis in exudative pleural effusion will be compared with LIGHTS criteria which is taken as gold standard having sensitivity 100% and specificity 80%<sup>7</sup>.

The rationale of the study is to determine the accuracy of reagent strips in the diagnosis of type of pleural effusion as compare to laboratory biochemical analysis of pleural fluid which is the gold standard for the diagnosis of type of pleural effusion. If found to be true it is much cheaper, rapid and can be done easily at bedside.

#### Lights Criteria

The Light's criteria are used to differentiate Exudative from Transudative pleural effusions. This is based on the fact that elevation of pleural fluid proteins and lactate dehydrogenase and specific gravity is seen in pleural inflammations. The lights criteria include the following<sup>7</sup>.

- Pleural fluid protein > 3g/dl
- Pleural fluid protein/Serum protein ratio of more than 0.5
- Pleural fluid LDH/Serum LDH ratio of more than 0.6.
- Pleural fluid LDH more than 200 units/l

An exudative effusion is one which meets at least one of the above four criteria. The accuracy of the Lights criteria to identify exudates was 94.7%<sup>8</sup>.

The objective of the study was:

- To determine the frequency of correctly diagnosed type of pleural effusion by reagent strips in comparison to Light's criteria.

#### MATERIAL AND METHODS

This is Cross sectional Analytical study done at Department of Pulmonology, DHQ Hospital Faisalabad. Study was carried out over a period of six months from 1-06-2015 to 31-11-2015. 100 patients both male and female were included in the study using non probability purposive sampling.

All patients, male and female having age between 16 to 80 years with Pleural effusion diagnosed on the basis of History, Clinical examination, chest x-ray and chest ultrasound will be included in this study. Patients presenting to the Department of Pulmonology DHQ Hospital Faisalabad from outdoor and emergency with pleural effusion fulfilling the inclusion and exclusion criteria were taken as cases. Informed consent was taken for pleural fluid aspiration and using their data in research. Demographic information (name, age, gender, etc) was recorded. Pleural fluid was aspirated by insertion of an 8-mm needle and was sent to the clinical laboratory for biochemical tests (levels of specific gravity and proteins) and blood for serum proteins. The pleural fluid was then tested, by use of a reagent strip (Combur 10 by Roche Diagnostics Germany). Different cut off values for reagent strip are:(specific gravity; dark green 1.005, light green 1.015, brown 1.02, orange 1.03) and (protein; 1+ 30, 2+ 100, 3+ 500 mg/dl).

Exudative pleural effusion; As per any one of LIGHTS criteria exudative effusion were taken as Fluid proteins > 3g/dl, Fluid/Serum (F/S) protein ratio >0.5, specific gravity of  $\geq 1.016$  and for reagent strip values of protein (3+) or specific gravity (light green 1.015, brown 1.02, orange 1.03) were taken as exudative. Transudative pleural effusion; as per any one of LIGHTS criteria transudative effusion were taken as Fluid proteins < 3g/dl, F/S protein ratio < 0.5, specific gravity of <1.016 and values of reagent strip for proteins (2+ or less) or specific gravity (dark green 1.005) were taken as transudative. Levels of pleural fluid laboratory analysis reports were taken as gold standard for comparison between respective variables of reagent strip. Exudative and Transudative Pleural Effusion obtained from fluid Laboratory analysis (gold standard) fulfilling the LIGHTS criteria was taken as positive and negative respectively.

Grossly hemorrhagic pleural effusion by diagnostic tap. Patients already taking antibiotics by taking history were excluded from the study.

Reports of reagent strips and Light's criteria was assessed to determine the correctly diagnosed type defined as the cases in which reagent strips and Light's criteria diagnosed the same type of pleural

effusion. All this information was collected through a Performa attached.

The data was analyzed using SPSS version 11. Quantitative variables like age was presented as mean and standard deviation. Qualitative variables like Gender and correctly diagnosed type was presented as frequency and percentage.

## RESULTS

One hundred patients were included in this study during the study period of six months from 1-06-2015 to 30-11-2015 in the Department of Pulmonology.

Majority of the patients i.e. 38 (38.0%) were between 40-59 years of age while 9 (9.0%) were < 20 years. Mean age of the patients was observed  $41.3 \pm 6.9$  (Table-1).

Distribution of cases by gender shows 63 (63.0%) were male while remaining 37 (37.0%) were females (Table-2).

Table-3 reveals, transudative pleural effusion in 21 (21.0%) cases and exudative pleural effusion in 79 (79.0%) cases both by reagent strips and light's criteria.

Out of 100 patients, 84 (84.0%) were correctly diagnose on reagent strips (Table-4).

**Table 1: Distribution of cases by age (n=100)**

Age (Year)	Number	Percentage
< 20	09	09
20-39	31	31
40-59	38	38
60-80	22	22
Total	100	100.0
Mean±SD	41.3±6.9	

**Table 2: Distribution of cases by gender (n=100)**

Gender	Number	Percentage
Male	63	63.0
Female	37	37.0
Total	100	100.0

**Table 3: Type of pleural effusion (n=100)**

Type	REAGENT STRIPS		LIGHT'S CRITERIA	
	No.	%	No.	%
Transudative	21	21.0	21	21.0
Exudative	79	79.0	79	79.0
Total	100	100.0	100.0	100.0

**Table 4: Correctly diagnosed type by reagent strips (n = 100)**

Correctly diagnosed type	Number	Percentage
Yes	84	84.0
No	16	16.0
Total	100	100.0

## DISCUSSION

A transudative pleural effusion occurs when pleural fluid accumulates because of an imbalance between the hydrostatic and oncotic pressures. The leading causes of transudative pleural effusions are congestive heart failure, cirrhosis, and pulmonary embolism. In contrast, an exudative pleural effusion occurs when the local factors influencing the accumulation of pleural fluid are altered. The leading causes of exudative effusions are pneumonia, cancer, and pulmonary embolism.<sup>9</sup>

The first step in the evaluation is to determine whether an effusion is transudative or exudative. If it is exudative, more diagnostic tests are required in order to determine the cause of the local disease, whereas if it is transudative, the physician must establish or rule out a diagnosis of congestive heart failure, cirrhosis, or pulmonary embolism.<sup>9</sup>

The cause of the effusion remains unclear in the cases of a substantial percentage of patients with exudative effusions after the history, physical examination, and analysis of pleural fluid.<sup>10</sup> If the effusion persists despite conservative treatment, thoracoscopy should be considered, since it has a high yield for cancer or tuberculosis. If thoracoscopy is unavailable, alternative invasive

approaches are needle biopsy and open biopsy of the pleura. No diagnosis is ever established for approximately 15 percent of patients despite invasive procedures such as thoracoscopy or open pleural biopsy.<sup>11</sup>

For the past several decades, transudates have been differentiated from exudates according to Light's criteria, by measurement of the levels of protein and lactate dehydrogenase in the pleural fluid and in the serum. Since these criteria were originally published, several alternative measurements have been proposed for making this distinction.<sup>12</sup>

Light's criteria are the most sensitive for identifying exudates but have lower specificity than other criteria, that is, on the basis of Light's criteria, some patients who actually have transudative pleural effusions will be thought to have exudative pleural effusions. If the clinical appearance suggests a transudative effusion but the pleural fluid is an exudate according to Light's criteria, the difference between the albumin levels in the serum and the pleural fluid should be measured. Almost all patients with a serum albumin level that is more than 1.2 g per deciliter higher than the pleural-fluid albumin level have a transudative effusion.<sup>12</sup>

However, this albumin gradient alone should not be used to distinguish transudates from exudates because it will misidentify approximately 13 percent of exudates as transudates.<sup>12</sup>

For an effusion that is likely to be transudative, initial measurement should be limited to the pleural fluid protein and lactate dehydrogenase levels.<sup>13</sup>

In patients with such effusions, additional tests provide no additional information and sometimes produce misleading results.<sup>13</sup> Additional tests are needed, however, on exudative pleural fluids. Depending on the clinical presentation, these may include total and differential cell counts, smears and cultures for organisms, measurement of glucose and lactate dehydrogenase levels, cytologic analysis, and testing for a pleural-fluid marker of tuberculosis. An elevated pleural-fluid amylase level is seen in patients with pancreatic disease and esophageal rupture.<sup>14</sup>

Number of male patients was higher than female in present study with 63.0% males and 37.0%

females. In comparison, the sex distributions in some of the previous studies are; Subhakar<sup>15</sup> 77.5% males and 22.5% females; Burgess et al.

In present study correctly diagnosed type by reagent strips were 84% which is comparable with a study by Castellote et al.

## CONCLUSION

Pleural effusion is a commonly encountered problem in medical practice in our country. The initial step in evaluating case of pleural effusion is to establish the type of pleural effusion.

Reagent strip method is very simple, cheap and quick bedside technique to determine the type of pleural effusion. However the results need to be verified through further studies.

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