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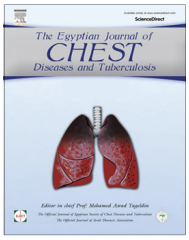

ORIGINAL ARTICLE

Diagnostic significance of pleural fluid pH and pCO_2

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KEYWORDS

Pleural effusion;
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Abstract The diagnosis of pleural effusion is still difficult. The presence of pleural effusion can be confirmed by radiological studies including simple chest radiography, ultrasonography, or computed tomography. Identifying the causes of pleural effusions by pleural fluid analysis is essential.

Aim of this work: The aim of this work is to assess the role of pleural fluid pH and pCO_2 in differentiating the etiologies of pleural effusion and to study the correlation between pleural fluid pH and pCO_2 and cellular content of the effusion.

Results: We conducted this study on 50 patients with pleural effusions of different causes. The patients were classified into 5 groups according to the cause. For all the patients, measurement of pleural pH, pCO_2, pO_2, HCO_3, protein, LDH, glucose and WBC was done. We observed lowest pH in complicated parapneumonic effusion (empyema) 6.80 ± 0.15 and highest pH was observed in transudative effusion 7.47 ± 0.07. Tuberculous effusion has pH lower than pH of malignant effusion 7.17 ± 0.017 and 7.39 ± 0.08, respectively. Post pleurodesis malignant effusion has pH lower than pH of malignant effusion 7.28 ± 0.17 and 7.39 ± 0.08, respectively. There is a strong inverse correlation between pH and pCO_2, WBC, LDH and protein ($r = -0.813$ and $p < 0.001$), ($r = -0.796$ and p, 0.001), ($r = -0.829$ and p, 0.001) and ($r = -.837$ and p, 0.001), respectively. While there is a weak correlation between pH and glucose of pleural fluid ($r = 0.249$ and $p = 0.066$). The highest increase of PNL numbers was in empyema (20169 ± 8094.8 cells/cc). The highest increase of lymphocytes was in malignant effusions (4285.00 ± 2948.20 cells/cc) and tuberculous effusion (3977.7 ± 3169 cells/cc).

Introduction

The diagnosis of pleural effusion is very difficult, even though the patients often complain of typical symptoms indicating pleural diseases. Pleural effusion is characterized by the pleural cavity filled with transudative or exudative pleural fluids, and it develops by various etiologies. The presence of pleural effusion can be confirmed by radiological studies including simple chest radiography, ultrasonography, or computed tomography. Identifying the causes of pleural effusions by pleural fluid analysis is essential for proper treatments [1].

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According to Light's Criteria [2] Exudative Effusions will have at least one of the following:

Pleural fluid protein/Serum protein > 0.5.
Pleural fluid LDH/Serum LDH > 0.6.
Pleural fluid LDH > 2/3 Serum LDH Upper Limit of Normal.

It is noted that While Light's Criteria are reported to be highly sensitive for exudative effusions, their specificity is only 83%.

These criteria require simultaneous measurement of pleural fluid and serum protein and LDH. However, a meta analysis of 1448 patients done by Heffner et al. [3] suggested that the following pleural fluid measurements alone might have sensitivity and specificity comparable to Light's criteria for distinguishing transudates from exudates:

- Pleural fluid LDH is more than 0.45 of the upper limit normal serum values.
- Pleural fluid cholesterol is more than 45 mg/dl.
- Pleural fluid protein is more than 2.9 g/dl.

As regards transudative effusion, three basic mechanisms lead to its formation:

1-. Systemic venous hypertension.
2-. Pulmonary venous hypertension, and
3-. Reduced plasma oncotic pressure.

Because the pleural surfaces are not affected, the protein concentration and lactic dehydrogenase levels in the pleural fluid are low.

Also, white and red blood cell count are low and pleural fluid glucose and amylase levels are close to those in the plasma Porcel and Vives [4].

Aim of the work

The aim of this work is to assess the role of pleural fluid pH and pCO_2 in differentiating the etiologies of pleural effusion and to study the correlation between pleural fluid pH and pCO_2 and cellular content of the effusion.

Material and method

This study included 50 patients with pleural effusion; 28 males and 22 females with age ranged from 18 to 80 years old. They were chosen from those admitted to the chest units of Kasr El-Eini University Hospitals, National center for researches of chest diseases and allergy, and Abbasya chest hospital. For the included patients the following was done: complete medical history taking and physical examination.

Investigations done included:

1-. Chest radiograph for the presence and the amount of effusion, mediastinal position, underlying lesions.
2-. Sputum examination for AFB if indicated.
3-. Laboratory investigations including CBC, ESR, Tuberculin test, blood sugar, liver and kidney function tests.
4-. Thoracocentesis done: to evaluate the cause of the effusion and to relieve dyspnea if present.
5-. Pleural fluid analysis for:
- Biochemical analysis (LDH, Total protein, and glucose).
- pH and pCO_2.
- Total WBCs and its differentiation.
- Bacteriologic examination.
- ADA.
- Cytology examination.

Results

According to the etiological diagnosis of the pleural effusion the patients were classified into 5 groups.

Group 1: 10 Patients with transudative effusion, 5 with congestive heart failure, 3 with nephrotic syndrome and 2 with liver cirrhosis.

Group 2: 10 cases of empyema (complicating parapneumonic effusion).

Group 3: 10 Cases with tuberculous effusion.

Group 4: 10 Cases with malignant effusion (8 with malignant mesothelioma and 2 with adenocarcinoma).

Group 5: 10 Cases with post pleurodesis effusions (3 with liver cirrhosis and 7 with malignant effusion).

Discussion

In the present study 56% were males and 44% were female cases. the age range was from 18 to 80 years old with a mean of 48.5 ± 18.6 years with a statistically significant difference as regards the age; the oldest age was in malignant effusion (53.40 ± 11.96) and the youngest age was in tuberculous effusion (31.80 ± 9.82) (Table 1).

In this study, we collected pleural fluid in heparinized syringes and examined immediately by blood gas analyzer to measure pH, pCO_2, pO_2, and HCO_3. There is no need for ice as they are measured immediately, while Tarn and Lapworth [5], reported that pleural fluid samples should be handled as carefully as arterial samples for gas analysis, with fluid collected in heparinized syringes and ideally transported on ice for measurement within 6 h. However, they have shown that when collected in heparinized syringes, pleural fluid pH does not change significantly even at room temperature over several hours.

Light [6] reported that WBC count is obtained manually with heparinized samples or with EDTA because WBC is lower in plastic or glass tubes. Automated cell counter did

Table 1 Statistical analysis of age/years distribution in studied groups.

Types of pleural effusion	Range		Mean ± S.D
	MIN	Max	
Transudative	37	70	52.30 ± 10.98
Empyema	19	70	37.70 ± 17.63
Tuberculous	18	50	31.80 ± 9.82
Malignant	40	80	53.40 ± 11.96
Postpleurodesis (malignant cause)	40	59	45.43 ±
Postpleurodesis (hepatic cause)	44	55	50.33 ± 5.69