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SHORT COMMUNICATION

A simple laboratory measurement for discrimination of transudative and exudative pleural effusion: Pleural viscosity

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Summary
Background: The initial step in establishing the cause of an effusion is to determine whether the fluid is a transudate or exudate. Plasma viscosity is influenced by the concentration of plasma proteins and lipoproteins with the major contribution resulting from fibrinogen. In this study we aimed to evaluate the role of pleural fluid viscosity in discrimination of transudate and exudates.
Materials and Methods: We studied prospectively 63 consecutive patients with pleural effusion in whom diagnostic or therapeutic thoracentesis had been performed. The criteria of Light were applied to differentiate transudates from exudates: 33 patients (23 male, 13 female, mean age $= 68 \pm 4$ years) had exudates and 30 patients (17 male, 13 female, mean age $= 68 \pm 5$) had transudates (due to congestive heart failure). Measurements of pleural fluid and plasma viscosity were performed using a viscometer.
Results: There was no statistically significant difference between patients with transudate and exudates in respect to plasma viscosity. However, pleural viscosities of the patients with exudates were significantly higher than those of patients with transudate (1.37 ± 0.16 mPa vs 0.93 ± 0.03 m Pa s $p < 0.001$, respectively). Pleural viscosity has a high sensitivity, specificity (94%, 93%, respectively), positive and negative predictive value (97%, 97%, respectively) for the discrimination of transudative or exudatetive pleural fluid.
Conclusion: We have demonstrated for the first time that pleural viscosity of the exudative effusion is higher than that of transudative effusion with high sensitivity,

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specificity, positive and negative predictive value. Regarding the simplicity of this measurement, it may play a valuable role in the accurate and fast discrimination of pleural fluid.

Introduction

The development of inflammation in the pleura results in an increased vascular permeability leading to pleural fluid accumulation. This pleural fluid is enriched in proteins, inflammatory cells, and mediators.[1,2] Classification of pleural effusions into transudates and exudates is based on pleural fluid absolute lactic dehydrogenase value, fluid to serum ratio of and fluid to serum ratio of total protein used in a parallel combination strategy. Since additional diagnostic or therapeutic interventions will be tailored based on the transudative or exudative nature of the pleural fluid, it is a crucial diagnostic step to categorize the effusion as an exudates or transudate.[3] Multiple investigations have examined the discriminative properties of different pleural fluid tests for identifying exudative effusions.[4,5] Established clinical practice has favored diagnostic strategies that combine pleural fluid lactate dehydrogenase, the ratio of pleural fluid to serum lactate dehydrogenase, and the ratio of pleural fluid to serum protein combined in ''or'' rules (Light's criteria)[4] wherein an exudative effusion is identified if any one of the criteria is fulfilled.

Plasma viscosity is influenced by the concentration of plasma proteins and lipoproteins with the major contribution resulting from fibrinogen.[6] The physico-chemical or rheological approach states that the contribution of individual plasma proteins and lipoproteins to plasma viscosity depends on their concentration, molecular weight, rigidity and asymmetrical shape.[7,8] It has been previously reported that plasma viscosity has a valuable importance and can be used as an acute phase reactant.[9] In this study we aimed to evaluate the role of pleural fluid viscosity in discrimination of transudate and exudates.

Materials and methods

We studied prospectively 63 consecutive patients with pleural effusion in whom diagnostic or therapeutic thoracentesis had been performed. The criteria of Light et al.[4] were applied to differentiate transudates from exudates: 33 patients (23 male, 13 female, mean age $= 68 \pm 4$ years) had exudates and 30 patients (17 male, 13 female, mean age $= 68 \pm 5$) had transudates (due to congestive heart failure). Exudative pleural effusions meet at least one of Light criteria (namely, pleural fluid/serum protein ratio, pleural fluid/serum LDH ratio, pleural fluid LDH concentration). If none of these criteria is met, the patient has transudative pleural effusion. Eighteen exudates were considered malignant (three patients with small extensive stage cell lung cancer, 15 patients with stage IV non-small lung cancer), since malignant cells were detected on cytologic examination of the pleural fluid or biopsy specimens. A pleural effusion was considered parapneumonic ($n = 12$) when there was an acute febrile illness, with purulent sputum and pulmonary infiltrates, in the absence of malignancy or other diseases causing exudate and neutrophilia in pleural fluid. Tuberculous pleural effusion was diagnosed in two patients by positive culture findings for *Mycobacterium tuberculosis* or a pleural biopsy specimen showing typical epithelioid cell granulomas. After the first successful thoracentesis of pleural fluid, a specimen was subjected to routine biochemical analysis including tests for total protein, glucose, and lactate dehydrogenase. A second sample was added to a tube containing ethylenediaminotetraic–potassium anticoagulant for differential cell counting. Bacterial cultures and cytologic examinations were performed on all pleural effusions. Measurements of pleural fluid and plasma viscosity were performed using Brookfield DV-II viscometer. One milliliter of plasma was separated by centrifugation at 3000 rpm for 10 min and used for plasma viscosity measurement. Viscosity was measured in a Brook-field DV-I1 viscometer (Brookfield, Stoughton, MA) at shear rates of 100, 20, and 5 s21 at 37 °C. Hospital ethic committee approved the study protocol and all patients gave informed consent.

Statistical analysis

Continuous variables are presented as mean $\pm$ s.d., and categorical variables are presented as percentage. Unpaired *t*-test was used to compare continuous variables between two groups. McNemar test was used to compare categorical variables in