THE ROLE OF LUNG ULTRASOUNDS, BIOIMPEDANCE ANALYSES AND NATRIURETIC PEPTIDES IN THE ASSESSMENT OF EXTRAVASCULAR LUNG WATER IN HEMODIALYSIS PATIENTS

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INTRODUCTION AND OBJECTIVES

The assessment of pulmonary congestion in maintenance hemodialysis (MHD) patients is challenging.
Lung ultrasound (LUS) allows a non invasive evaluation of extravascular lung water (EVLW) trough the analysis of B-lines in heart failure (HF) patients. Natriuretic peptides are also measured to evaluate HF. Total body (TB) and segmental thoracic impedance analysis (BIA) can estimate TB and lung water compartments. More recently LUS has been proposed to assess EVLW in MHD patients.

The aims of this study were: 1) to evaluate the correlation between B-lines and TB and segmental thoracic hydration estimated by means of BIA; 2) to compare LUS and BIA data with natriuretic peptides dynamic changes, echocardiographic findings and inferior vena cava (IVC) diameters; 3) to evaluate the usefulness of a comprehensive antero-lateral and posterior LUS scanning.

METHODS

Thirty-one MHD patients (24 males) were examined. LUS *(Fig. 1)*, natriuretic peptides, physical examination, TB and thoracic BIA were performed immediately before and after a dialytic session. Echocardiography and IVC analysis were performed in the interdialytic period.

***Fig 1**. Lung ultrasound scanning schemes*

***Fig 2**. Pre HD B-lines.*

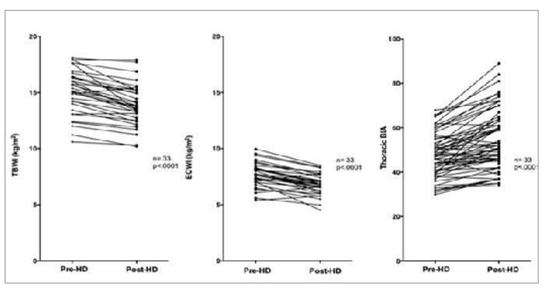

***Fig 3**. Dynamic variation after HD in total body water index, in extracellular water index and in thoracic impedance.*

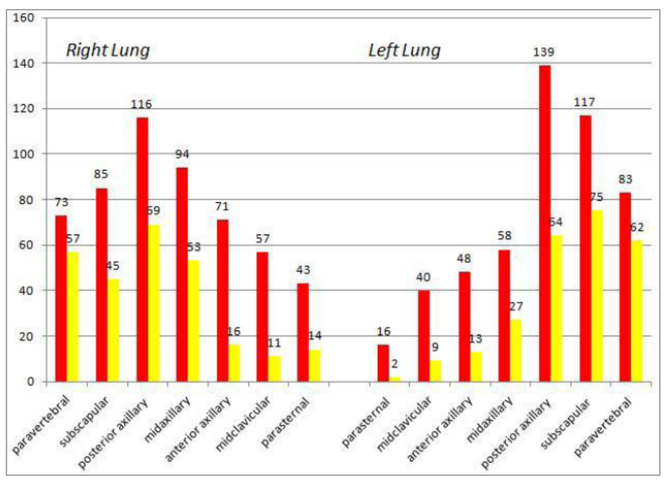

***Fig 4.** Frequency distribution of B-lines along the different thoracic lines pre (red bars) and post (yellow bar) HD*

RESULTS

- Pre-HD B-lines *(Fig.2)* ranged between 0 to 147 and decreased by 51% ($p<0.0001$) post HD.
- The decrease in B-lines was accompanied by the decrease in total body water index (TBWI) and in extracellular water index (ECWI), and by the increase in thoracic impedance and resistance, indicative for a decrease in lung water content *(Fig. 3)*.
- A significant correlation was found between the total number of B-lines and the ECWI ($r=0.45$, $p<0.001$).
- A higher number of B-lines was found in lateral and posterior lung segments *(Fig. 4)*, but the correlation between B-lines and ECWI was similar when the total number of B-lines was calculated on the whole chest or only on the lateral regions.
- Multivariate analysis showed that only segmental thoracic BIA was an independent predictor of pulmonary congestion (>30 B-lines) post HD.
- BNP and NT-proBNP, which were markedly increased due to severe renal dysfunction, were still correlated with left ventricular ejection fraction (LVEF) and with thoracic BIA.
- The residual number of B-lines after HD was correlated with LVEF and with BNP.
- No correlation was found between inferior vena cava diameters, left atrium dimensions, diastolic dysfunction, physical examination and B-lines.

CONCLUSIONS

B-lines correlate better with segmental thoracic than total body impedance and with extra-cellular water index.
When assessing B-lines, a focused examination of the lateral chest regions appears to be as accurate as more a comprehensive whole chest assessment.
LUS together with BIA and BNP at the end of dialysis may have a complementary role in the assessment of pulmonary congestion in MHD patients.

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