COMPARISON BETWEEN LUNG ULTRASONOGRAPHY, BIOIMPEDANCE DATA AND ECHOCARDIOGRAPHY PARAMETERS IN HEMODIALYSED END STAGE RENAL DISEASE PATIENTS

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AIM & OBJECTIVES

To compare assessment of fluid status in hemodialysed (HD) end stage renal disease patients using 2 methods: lung ultrasonography (LU) and bioimpedance (BIA), and to evaluate their relation to echocardiography parameters.

Objectives:

1. To evaluate a rate of lung congestion by ultrasonography before and after hemodialysis;
2. To evaluate correlation of hypervolemia index detected by LU and BIA;
3. To evaluate relation between echocardiography data and hypervolemia detected by LU and BIA

METHODS

Cross-sectional study included adult chronic HD patients dialysed in Hospital of Lithuanian University of Health Sciences in October 2015. We used three different methods of evaluation: LU before and after HD, BIA after HD, and echocardiography. LU was done by one trained doctor using BLUE-protocol: comet-tail signs (B lines) were calculated from 8 positions. Exclusion criteria: acute and chronic lung disease, lung cancer. According to sum of B lines patients were divided into 2 groups: norm – under 3 B lines, lung congestion - 3 and more B lines. BIA analysis was performed after HD session and extracellular water (ECW) ratio with total body water (TBW) was evaluated: ratio under 0.39 normovolemia group, 0.39 and more – hypervolemia group. From echocardiography data patients were grouped according to left ventricular mass index (LVMI) into hypertrophy (LVH) (>95 gm/m^2 for woman and >115 gm/m^2 for men) and normal geometry. Statistical analysis was performed using SPSS package. Student's t-test, Paired sample – t-test, Fisher's Exact test were used to campare the groups. Statistical significance assumed at $p<0.05$.

RESULTS

From 57 patients 40 patients participated in our study: 15 (38%) women and 25 (62%) men, mean age 60±13.5 years. Mean ECW/TBW ratio was 0.39±0.01. Echocardiography data: mean LVMI 117.1 ± 30.04 g/m^2. LVH was found in 57% of patients.

Mean sum of B lines before HD – 3.6±4 was significantly reduced after HD 1.8±3.2 ($p<0.001$). Lung congestion was found in 45% of patients before HD and in 12.5% of patients after HD (figure 1). We did not find correlation between sum of B lines before and after HD and ECW/TBW ratio. Lung congestion before HD group had higher LVMI (129.62 ± 28.99 g/m^2 vs 107.51 ± 27.78 g/m^2 p=0.02) than normovolemic group (table 1). Lung congestion after HD group had higher LVMI (151.83 ± 27.53 g/m^2 vs 114.01 ± 28.62 g/m^2 p=0.03), higher SBP before and after HD (before 169.6 ± 14.55 mmHg vs 146.6 ± 23.19 mmHg p=0.02; after 169.6 ± 14.89 mmHg vs 137.7 ± 24.17 mmHg p=0.03) than normovolemic group (table & figure 2). No B line correlation was found with age, ultrafiltration, dialysis vintage and other echocardiography data.

Evaluating relation between echocardiography and BIA data, hypervolemic patients had higher LVMI (144.4 ± 27.1 g/m^2) than normovolemic (108.7± 26.4 g/m^2), p=0.02 (figure 3). In patients with LVH 75% were normovolemic and 25% were hypervolemic, but all patients with no LVH were only normovolemic (p=0.01). No other echocardiography data were different between hypervolemic and normovolemic groups. In hypervolemic patients we found higher SBP before HD than normovolemic (163±14 mmHg vs 145±25 mmHg, p=0.003).

Table 1. **Comparison between patients group with lung congestion and normal lung before HD**

Factors	Before HD		
	Lung congestation (B lines ≥3) (n=18)	Normal lung (B lines <3) (n=22)	p
Age	61.09 ± 15.6	59.1 ± 11.7	0.7
Dialysis vintage (years)	2.04 ± 2.5	3.2 ± 3.5	0.2
Ultrafiltration (l)	2.5 ± 1.2	2.6 ± 1.2	0.7
SBP before HD (mmHg)	154.3 ± 23.4	145.6 ± 23.3	0.2
SBP after HD (mmHg)	144.4 ± 24.7	137.7 ± 24.3	0.4
DBP before HD (mmHg)	79.7 ± 13.3	81.3 ± 12.5	0.7
DBP after HD (mmHg)	79.8 ± 13.03	78.9 ± 12.4	0.8
ECW/TBW ratio	0.39± 0.01	0.38± 0.01	0.2
LVMI (g/m²)	**129.62 ± 28.99**	**107.51 ± 27.78**	**0.02**
ST (mm)	12.9 ± 1.8	11.95 ± 1.9	0.1
LV ESV (mm/m²)	27.6 ± 4.2	27.1 ± 10.9	0.8
LVEF (%)	49.9 ± 12.4	52.4 ± 6.1	0.4
E\A ratio	0.95 ± 0.42	0.99 ± 0.47	0.8
LAD (mm)	41.2 ± 7.5	40.2 ± 5.9	0.6

Table 2. **Comparison between patients group with lung congestion and normal lung after HD**

Factors	After HD		
	Lung congestation (B lines ≥3) (n=5)	Normal lung (B lines <3) (n=35)	p
Age	64.9 ± 14.7	59.3 ± 13.3	0.4
Dialysis vintage (years)	0.4 ± 0.3	3 ± 3.2	0.08
Ultrafiltration (l)	3.1 ± 0.9	2.5 ± 1.2	0.3
SBP before HD (mmHg)	**169.6 ± 14.55**	**146.6 ± 23.19**	**0.02**
SBP after HD (mmHg)	**169.6 ± 14.89**	**137.7 ± 24.17**	**0.03**
DBP before HD (mmHg)	79.4 ± 13.6	80.1 ± 12.8	0.8
DBP after HD (mmHg)	78.8 ± 13.3	79.4 ± 12.6	0.9
ECW/TBW ratio	0.39± 0.01	0.38± 0.01	0.08
LVMI (g/m²)	**151.83 ± 27.53**	**114.01 ± 28.62**	**0.03**
ST (mm)	14.1± 1.6	12.2 ± 1.9	0.1
LV ESV (mm/m²)	29.0 ± 2.6	27.2 ± 8.9	0.7
LVEF (%)	53.3 ± 2.9	51.1 ± 9.6	0.7
E\A ratio	1.2 ± 0.5	0.95 ± 0.5	0.4
LAD (mm)	46 ± 1.4	40.4 ± 6.6	0.2

SBP – systolic blood pressure, DBP – diastolic blood pressure, LVMI - left ventricular mass index , ST – septal thickness, LV ESV – left ventricular end systolic volume, LVEF – left ventricular ejection fraction, LAD – left atrium diameter.

Figure 1. **Rate of lung congestion of HD patients before and after HD**

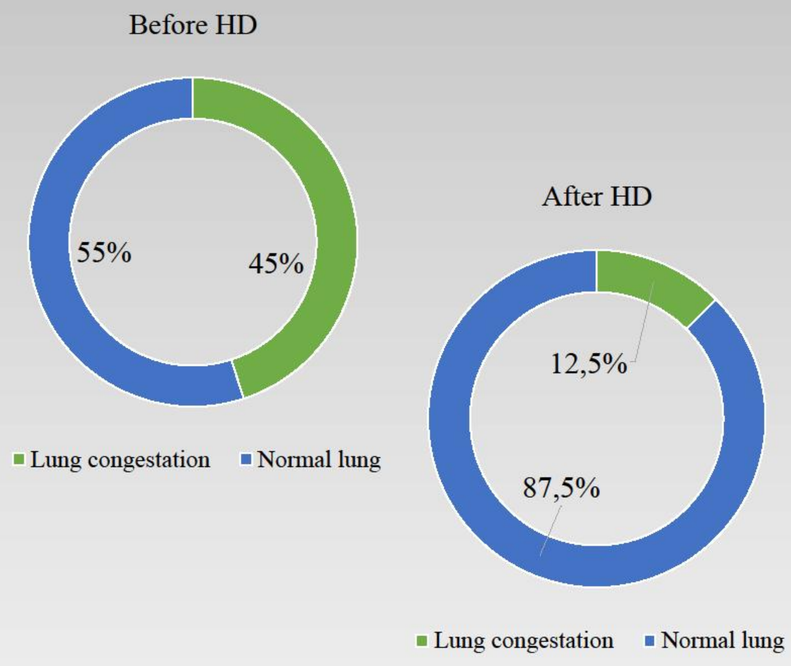


Figure 2. **Correlation between lung volemia before and after HD and left ventricular mass index**

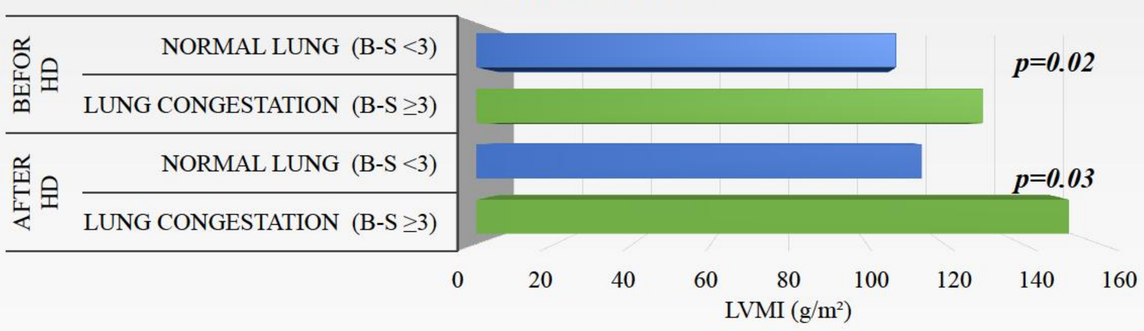
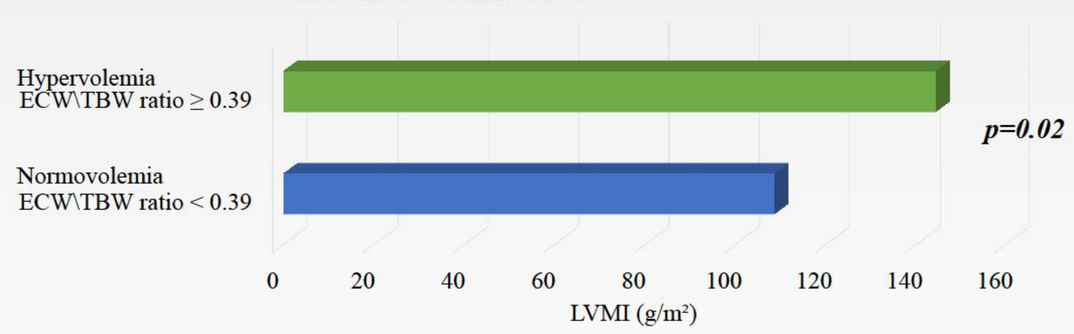


Figure 3. **Correlation between left ventricular mass index and BIA measured volemia status**



CONCLUSIONS

1. Ultrasonography showed lung congestion in almost half chronic HD patients, which decreased after HD in 72.2% patients.
2. Ultrasound parameters of lung congestion (B lines) did not correlated with BIA findings (ECW/TBW ratio).
3. LVMI correlated with hypervolemia detected by LU and BIA, difference was more prominent with BIA.

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