Comparison of lung ultrasound and other volumetric methods in peritoneal dialysis patients

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All peritoneal dialysis patients in the clinic have been invited to the study. Exclusion criteria were patients younger than 18 years old, unwilling to participate to the study, immobile patients unable to perform tests in the same day, history of PD less than 3 months, the presence of active infection, history of lung cancer and/or lung operations.

All enrolled patients answered the questions about hypervolemia symptoms, had physical and laboratory examination, chest radiography, echocardiography, bioelectrical impedance analysis and lung ultrasound on the same day.

This study was approved by local ethics committee. All participants provided informed consent form.

DEMOGRAPHIC CHARACTERISTICS

Data regarding demographic characteristics, ESRD etiology, past and present medical history was taken from patients' medical files.

HYPERVOLEMIA SYMPTOMS and PHYSICAL EXAMINATION

Patients were asked for orthopnea, dyspnea at rest, effort dyspnea, paroxysmal nocturnal dyspnea. They had a physical examination including height, weight, blood pressure measurement, the definition of New York Heart Association (NYHA) class, the presence of third heart sound (S3), crackles, pretibial edema. Edema was classified as present or absent.

LABORATORY

VEGF-C levels were measured in the serum samples. R&D Systems kit (Minneapolis, MN) (Catalog Number DVEC00) was used for the assays according to the user instructions. NT-proBNP was measured on the Elecsys 2010 analyzer (Elecsys proBNP Immunoassay; Roche Diagnostics).

CHEST RADIOGRAPHY

All radiographs were taken when the patient was standing erect position during deep inhalation. They were reported by an expert radiologist blinded to clinical data. Films taken at a supine position or during expirium were excluded. Chest radiographs were classified into 3 stages to reflect a degree of hypervolemia [12]. Stage 1 was redistribution defined as an increased artery-to-bronchus ratio in the upper and middle lobes. Stage 2 was interstitial edema evident by Kerley B lines and peribronchial cuffing. Stage 3 was alveolar edema phase perihilar consolidation and air bronchograms, pleural fluid, the increased width of the vascular pedicle, enlarged cardiac silhouette.

ECHOCARDIOGRAPHY

Transthoracic echocardiography was performed by the same cardiologist blinded to all other parameters. It was done while the abdomen was empty. LV end diastolic diameter (mm), interventricular septum thickness (mm), posterior wall thickness (mm), ejection fraction (%), left ventricle end diastolic volume (ml), left atrial volume (ml), left ventricle mass index (LVMI) (g/m^2), left ventricle filling velocity(cm/sec), E/E' ratio, pulmonary artery systolic pressure (mm Hg) were the parameters taken by echocardiography [13].

BIOELECTRICAL IMPEDANCE ANALYSIS

The Body Composition Monitor (BCM) (type 0BJA1394, Fresenius Medical Care AG & Co. KGaA, D-61343 Bad Homburg) was used for assessment of hydration status in patients. Peritoneal cavities were free of intraperitoneal fluid during measurement [14]. Patients were accepted as normovolemic if their result were between -1.1lt and 1.1 lt [15].

LUNG ULTRASOUND

It was performed by 28 area method which contains ultrasound examination from second to fifth intercostals spaces at the parasternal region, midclavicular line, anterior and midaxillary lines [16]. Lung ultrasound had been done by the same radiologist who was an expertise in ultrasonography

blinded to all other parameters. It was performed by 1,6 MHz convex probe when a patient lying at the supine position.

STATISTICAL ANALYSIS

All values were given as a median and interquartile range. Due to the limited number of patients, all data were accepted as abnormally distributed. Comparison of continuous variables was performed by the Mann Whitney U test and comparison of categorical variables was done by Chi-Square test. Correlation analysis was done by Pearson correlation test. P value was accepted as significant if less than 0.05. SPSS 21 was used for statistical analysis.