Assessment of Pulmonary Hypertension in Lung Transplantation Candidates: Correlation of Doppler Echocardiography With Right Heart Catheterization

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ABSTRACT

Background.   Right heart catheterization (RHC) remains the gold standard to diagnosis of pulmonary hypertension among lung transplantation candidates. Doppler echocardiography (DE) may be as accurate as RHC, without risks of an invasive test. The aim of the study was to assess the feasibility of DE for the measurement of pulmonary artery pressure in lung transplantation candidates and the correlation between pulmonary artery pressures estimated by DE versus measured by RHC.

Methods.   A total of 103 lung transplantation candidates undergoing DE who were scheduled to undergo RHC within 72 hours were analyzed. The performance characteristics of DE were compared with RHC, and correlation analysis was performed to determine the correlation of pulmonary pressures obtained by DE versus measured by RHC.

Results.   The prevalence of pulmonary hypertension was 57% in lung transplantation candidates. Of the 103 candidates, evaluation of pulmonary artery systolic pressure (PASP) by DE was possible in 92 (89%). Median PASP by RHC was 45 (12–145) mm Hg and by DE 45 (20–144) mm Hg. There was a positive correlation between PASP estimated by DE and measured by RHC ($r = 0.585$, $P < .0001$). Sensitivity, specificity, and positive and negative predictive values of PASP estimation for diagnosis of pulmonary hypertension were 85%, 67%, 87%, and 61%, respectively.

Conclusions.   There is a strong positive correlation between PASP estimated by DE compared with measured by RHC with an acceptable sensitivity and specificity in detecting pulmonary hypertension. Echocardiography can be recommended for measuring pulmonary pressures in lung transplantation candidates.

L UNG transplantation (LT) is a successful therapeutic modality for end-stage pulmonary diseases. Whereas decisions regarding single versus bilateral lung transplantation procedures and the need for cardiopulmonary bypass or extracorporeal lung support are often made on the basis of pulmonary artery systolic pressure (PASP), estimating PASP is crucial in LT candidates [1]. Furthermore, the eligibility for transplantation of patients with end-stage lung disease is dependent on PASP. The current guidelines for the assessment of LT candidates recommend an echocardiogram in all LT candidates in their preoperative evaluation [2]. Right heart catheterization (RHC) and Doppler echocardiography (DE) are routine tests to measure PASP of LT candidates in many transplantation centers.

Although pulmonary artery pressures (PAP) and other cardiac hemodynamic parameters can be accurately

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assessed by RHC, a simple, reliable, and non-invasive method to estimate PAP in end-stage lung disease patients is preferable. The main disadvantage of RHC is that it is an invasive procedure and is associated with some morbidity (1.1%) and mortality (0.055%) [3]. Although DE is non-invasive, inexpensive, widely available, and valuable as a screening tool for estimating PAP and monitoring disease progression, there are some concerns about the accuracy of this technic. Fisher et al [4,5] demonstrated that DE may frequently be inaccurate in estimating PAP and cardiac measurements in patients with pulmonary hypertension (PH) and emphysema.

The purpose of this study was to evaluate the accuracy of DE in estimating pulmonary and cardiac pressures in end-stage lung disease patients referred for transplantation. We hypothesized that DE is as accurate as RHC at our experienced cardiology and transplantation center in Turkey.

METHODS
Study Population

We included patients with the diagnosis of end-stage lung disease who were referred as lung transplantation candidates to the lung transplantation unit of Kartal Kosuyolu Training Hospital between January 2012 and September 2015. The study was approved by the local ethics committee, and all participants gave written informed consent. Consecutive patients referred for RHC were asked to participate in the study. Lung transplantation candidates underwent DE within 72 hours of completing the RHC. A flow chart of the study design is summarized in Fig 1.

Data Collection

Demographic data, body mass index, disease duration, and 6-minute walking test (6MWT) results were collected from patients' records. The 6MWT was performed according to American Thoracic Society guideline criteria by a physiotherapist with the specific experience while the subjects had their usual oxygen flow [6].

RHC was performed with the use of a balloon-tipped, flow-directed pulmonary artery catheter. The catheter was introduced via the right femoral vein or right internal jugular vein, using the Seldinger technique under local anesthesia. The following measurements were obtained in duplicate: right atrial pressures, pulmonary artery systolic and diastolic pressures, pulmonary artery occlusion pressure, and cardiac output.

DE was implemented with the use of conventional clinical echocardiographic equipment (Philips iE33 xMATRIX ultrasound system, Andover, Mass, United States). Transthoracic Doppler and 2-dimensional images were gained from parasternal long- and short-axis, apical 4-chamber, and subcostal 4-chamber views. Echocardiograms were reviewed to assess the pericardium, valvular anatomy and function, left- and right-sided chamber size, and cardiac function. Right ventricular size and function were assessed qualitatively. Tricuspid regurgitant flow was identified with the use of color flow Doppler techniques, and the maximum jet velocity was measured by means of continuous-wave Doppler without the use of intravenous contrast. Right ventricular systolic pressure was
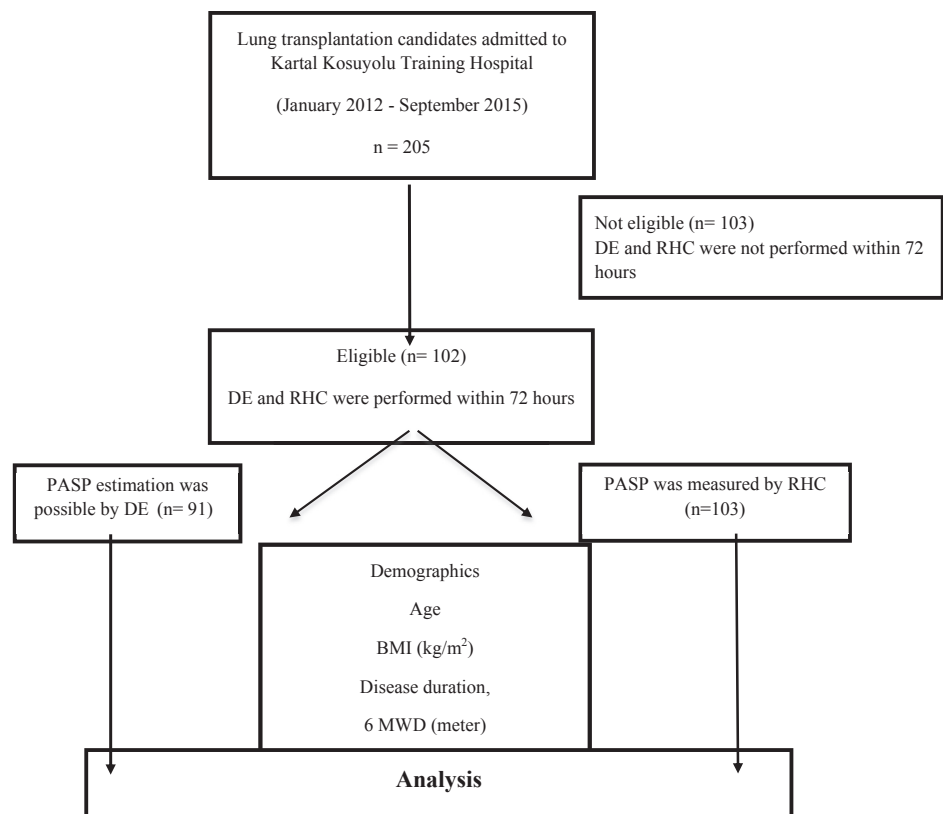

Fig 1. Consort diagram showing patient enrollment, follow-up, and analysis. PASP, pulmonary artery systolic pressure; RHC, right heart catheterization; DE, Doppler echocardiography; BMI, body mass index; 6MWD, 6-minute walking distance.