Cardiovascular coupling and elastic properties of pulmonary artery in different phenotypes of patients with pulmonary hypertension

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Topic(s):
Pulmonary Hypertension

Citation:
Background: The cardiovascular (CV) coupling and elastic properties of pulmonary artery (PA) were assessed only in a few studies, and their role in determination of severity in IPAH/CTEPH patients need further investigation.

Purpose: To assess CV coupling and elastic properties of PA in different phenotypes of IPAH and inoperable CTEPH pts at baseline and in dynamics after riociguat treatment using 2D and 3D Echo.

Methods: The study included 88 IPAH and 38 inoperable CTEPH pts. Pts were divided into groups: according to the age at time of diagnosis verification (age<50 (n=69)/ age>50 years (n=57)); WHO functional class (FC) (FC I-II (n=43)/ FC III-IV (n=83)); mean pulmonary arterial pressure (mPAP) (mPAP<51 (n=47)/ mPAP>51 mmHg (n=79)). For the first time we assessed right-ventricular (RV)-PA coupling, left ventricular (LV)-Aorta (Ao) coupling, PA elastic properties (strain, global capacitance and stiffness, β stiffness index, Peterson’s elastic modulus) at the time of diagnosis verification and in dynamics after 6 months of riociguat treatment in IPAH/CTEPH pts with different demographic, functional and hemodynamics status using 2D and 3D Echo. CV coupling was calculated as the ratio of PA or Ao effective elastance (Ea) and RV or LV end-systolic elastance (Es).

Results: IPAH/CTEPH pts older than 50 years at the time of diagnosis verification had significantly more reduced PA strain (7,7[3,3;11]%), increased β stiffness index (9[6,5;23,6]) and Peterson’s elastic modulus (797[370;1391]105Pa) compared to the younger pts (3,5[3;6,7]%, 23,7[14,6;31,6], 1666[833;2000]105Pa, respectively). Pts with FC III-IV (WHO) had significantly increased Es LV (4,5[3,7;5]mmHg/ml, decreased PA strain (4[3;7]%), increased β stiffness index (21[11;30]) and Peterson’s elastic modulus (1410[791;2000]105Pa) compared to the pts with FC I-II (3,6[3;4] mmHg/ml, 7,4[6,4;13]%, 12,7[7,5;16,5], 714[370;909]105Pa, respectively). In pts with mPAP>51 mmHg the PA global stiffness (1,1[0,9;1,5]mmHg/ml and Es LV (4,5[3,8;6]mmHg/ml) were significantly increased compared to the pts with mPAP<51mmHg (0,8[0,6;1,1]mmHg/ml and 3,9[3;4,5]mmHg/ml, respectively). The significant correlation between RV-PA coupling and RV ejection fraction (EF) (3D Echo) (r=-0,73;p<0,05), RV-PA coupling and NT-proBNP (r=0,61;p<0,05), moderate correlation between PA strain and RV EF (r=0,47;p<0,05) were found. After 6 months of riociguat treatment in 24 IPAH/CTEPH pts with II-III FC the significant reduction of RV-PA coupling due to Ea PA decrease, also as elevation of LV-Ao coupling due to Es LV decrease were revealed in addition to reverse remodeling of RV, and improvement in PA elastic properties, functional and hemodynamic status.

Conclusion: The evaluation of CV coupling and PA elastic properties at the time of diagnosis verification and in dynamics can be used in clinical practice to assess the disease severity and the efficacy of the treatment in IPAH and inoperable CTEPH pts.
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Conclusion: The evaluation of CV coupling and PA elastic properties at the time of diagnosis verification and in dynamics can be used in clinical practice to assess the disease severity and the efficacy of the treatment in IPAH and inoperable CTEPH pts.

Dynamics of cardiovascular coupling and elastic properties of pulmonary artery after 6 months of riociguat treatment

Cardiovascular coupling = Ea / Es, e.g. Ea – effective arterial elastance; Es – LV or RV end systolic elastance;
* - difference at baseline and after 3-6 months of treatment (p<0.05);