Theses

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Diagnosing pulmonary hypertension due to left heart disease using diastolic echo markers: The National Echo Database of Australia (NEDA) PH-LHD predictive formula

Kevin Chung

Differentiating Pre-Capillary and Post-Capillary Pulmonary Hypertension by Doppler Echocardiography in a Large Real-world Database

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Abstract

Background: Pulmonary hypertension (PH) is common, dangerous and has multiple causes. Vasodilator therapy has significantly improved the prognosis of patients with pulmonary arterial hypertension (PAH), but the diagnosis can be challenging, requiring right heart catheterisation (RHC). Differentiating pre-capillary PH (prePH) and post-capillary PH (postPH) and measuring pulmonary vascular resistance (PVR) are key steps for diagnosing PAH. A novel echocardiographic parameter, the pulmonary to left atrial ratio (ePLAR), which is derived from the tricuspid regurgitation velocity (TRV) divided by the ratio between the early diastolic filling velocity and the early mitral annulus velocity (E/e'), i.e., ePLAR=TRV/E/e', has been described as a surrogate for RHC. This retrospective cohort study tests the ability of ePLAR to differentiate prePH and postPH, in a large real world database.

Methods: The data from all RHC performed within a 5-year period (January 2010 to February 2015) were extracted from the hospital database. The closest corresponding echocardiograms (echos) were searched in the national echo database Australia (NEDA) using the identifiers from RHC data. The performance of ePLAR in differentiating two PH physiologies was compared against the gold standard RHC using various statistical methods.

Results: 887 pairs of echos and RHCs were merged and analysed in our study. The median time difference between RHC and echocardiography was 7 (IQR 1-62) days. The ePLAR was calculable in 184 cases (21%). Median (IQR) ePLAR values were significantly different between prePH and postPH groups: 0.35 (0.13-0.50) m/s vs 0.17 (0.12-0.23) m/s (P=0.003), despite both groups having similar mean pulmonary artery pressures. The optimal ePLAR cut-off of 0.28m/s had a positive predictive value of 94% for postPH, with sensitivity of 83% and specificity of 67%.

Conclusions: ePLAR helps to discriminate postPH from prePH and may be useful in evaluating these patients.

List of Publications/Presentations

Publications

1) Naing P, Kuppusamy H, Scalia G, Hillis GS, Playford D. Non-Invasive Assessment of Pulmonary Vascular Resistance in Pulmonary Hypertension: Current Knowledge and Future Direction. Heart Lung Circ. 2017;26(4):323-30

2) Naing P, Playford D, Scalia G, Hillis GS, Strange G. Differentiating Pre-Capillary and Post-Capillary Pulmonary Hypertension by Doppler Echocardiography in a Large Real-world Database. (Original Research Article). Under review.

Presentations

1) Naing P, Scalia G, Hillis GS, Playford D. Performance of a novel echocardiographic marker against right heart catheterisation in identifying pulmonary hypertension due to left heart disease. mini oral presentation at the Cardiac Society of Australia and New Zealand ASM 2017.

2) Chung K, Strange G, Codde J, Naing P, Bulsara M, Celermajer D, Scalia G, Playford D. NEDA PH-LHD predictive model: Validation of diastolic markers of pulmonary hypertension with Right Heart Catheterisation. Oral presentation at the Cardiac Society of Australia and New Zealand ASM 2017.

3) Naing P, Scalia G, Hillis GS, Strange G, Codde J, Playford D. Differentiating Pre-Capillary and Post-Capillary Pulmonary Hypertension by Doppler Echocardiography in a Large Real-World Database. Poster presentation at American Society of Echocardiography (ASE) ASM 2018, 22-26 June 2018 Nashville, TN, USA

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Declaration and Disclosure of Contributions by Co-authors

I declare that

- This thesis is my own work and contains no material which has been accepted for the award of any other degree or diploma in any university or institution.

- The contribution by co-authors have been indicated and acknowledged.

- The permission has been granted by all the contributing co-authors of publications included in this thesis.

Author contributions

Paper 1: Non-invasive Assessment of Pulmonary Vascular Resistance in Pulmonary Hypertension: Current Knowledge and Future Direction
Dr Pyi Naing: 40%
Prof David Playford: 30%
Dr Harveen Kuppusamy: 10%
Prof Graham Hillis: 10%
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Paper 2: Differentiating Pre-Capillary and Post-Capillary Pulmonary Hypertension by Doppler Echocardiography in a Large Real-world Database
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Yours sincerely,

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List of Abbreviations

PVR	Pulmonary Vascular Resistance
WU	Wood Units
TPG	Transpulmonary Gradient
DPG	Diastolic Pulmonary Gradient
CO	Cardiac Output
RHC	Right Heart Catheterisation
Echo	Echocardiography
mPAP	Mean pulmonary artery pressure
PCWP	Pulmonary Capillary Wedge Pressure
ePLAR	echocardiographic Pulmonary to Left Atrial Ratio
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
TRV	Tricuspid Regurgitation Velocity
PASP	Pulmonary Artery Systolic Pressure
RVSP	Right Ventricular Systolic Pressure
PH or PHT	Pulmonary Hypertension
PAH	Pulmonary Arterial Hypertension
PH-LHD	Pulmonary Hypertension due to Left Heart Disease
CTEPH	Chronic Thromboembolic Pulmonary Hypertension
prePH	Pre-capillary Pulmonary Hypertension
postPH	Post-capillary Pulmonary Hypertension
TVI_{RVOT}	Time velocity integral of blood flow through right ventricular outflow tract
NEDA	National Echo Database Australia