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ECHOCARDIOGRAPHIC DIFFERENTIATION OF PRE-CAPILLARY *VERSUS* POST-CAPILLARY PULMONARY HYPERTENSION

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Background: Echocardiography is currently used as a method of assigning a level of probability for pulmonary hypertension (PH), but not for differentiation between pre-capillary and post-capillary PH. We aimed to find echocardiographic parameters able to discriminate between pre-capillary and post-capillary PH.
Methods: We analyzed 50 patients referred to our ward from a PH center. Echocardiography was performed according to current guidelines recommendations.
Results: There were 2 echocardiographic variables found to distinguish between pre-capillary and post-capillary PH. Patients with post-capillary PH had a more dilated LA and higher values of E/E' (Table 2) and the correlation had a high statistical significance ($p < 0.001$) (Table 3).
The cut-off values found were: E/E' = 11.6 (with a sensitivity of 0.87 and a specificity of 0.8) and LA volume = 58 mL (with a sensitivity of 0.88 and a specificity of 0.83).
Conclusion: Echocardiography, by means of evaluation of the LV diastolic function and LA volume, can provide diagnostic information which can differentiate between pre-capillary and post-capillary PH.

Key words: pulmonary hypertension, echocardiography, diastolic function.

INTRODUCTION

Pulmonary hypertension (PH) is defined by an increase in mean pulmonary arterial pressure (mPAP) $\geq$ 25 mmHg at rest, as measured by right heart catheterisation (RHC)[1]. Various combinations of pulmonary artery pressure (PAP), pulmonary artery wedge pressure (PAWP), cardiac output (CO), diastolic pressure gradient (DPG) and pulmonary vascular resistance (PVR), assessed in stable clinical conditions, lead to different hemodynamic definitions of PH, which have been classified accordingly by the European Society of Cardiology in the Guidelines for the Management of Pulmonary Hypertension (2015) (Table 1)[1].

Transthoracic echocardiography is used to evaluate the effects of PH on the heart and estimate PAP from continuous wave Doppler measurements. Echocardiography should always be performed when PH is suspected and may be used to infer a possible diagnosis of PH[1]. Conclusions derived from an echocardiographic examination should aim to assign a level of probability of PH[1]. However, there are currently no echocardiographic parameters that can distinguish between pre-capillary and post-capillary PH.

Table 1

Hemodynamic definitions of pulmonary arterial hypertension[1]

Definition	Characteristics	Clinical group
PH	mPAP ≥ 25 mmHg	All
Pre-capillary PH	mPAP ≥ 25 mmHg PAWP ≤ 15 mmHg	1.Pulmonary arterial hypertension 3. PH due to lung diseases 4. Chronic thromboembolic PH 5. PH with unclear and/or multifactorial mechanism
Post-capillary PH	mPAP ≥ 25 mmHg PAWP ≤ 15 mmHg	2. PH due to left heart disease 5. PH with unclear and/or multifactorial mechanisms
Isolated post-capillary PH (Ipc-PH)	DPG <7 mmHg and/or PVR ≤ 3 UW	
Combined post-capillary and pre-capillary PH (Cpc-PH)	DPG ≥7 mmHg and/or PVR > 3 UW	

DPG: diastolic pressure gradient (diastolic PAP – mean PAWP); mPAP: mean pulmonary arterial pressure; PAWP: pulmonary arterial wedge pressure; PH:pulmonary hypertension; PVR: pulmonary vascular resistance; WU: Wood units.

OBJECTIVE

We sought to find echocardiographic parameters that would differentiate pre-capillary and post-capillary PH.

MATERIAL AND METHOD

We included 50 patients in our study: 23 patients with pre-capillary PH confirmed by right heart catheterization and 27 patients with left heart disease (left ventricular systolic dysfunction, mitral and aortic valvulopathies), leading to post-capillary PH. Patients with associated pulmonary disease or pulmonary embolism were excluded from the post-capillary group. Patients with pre-capillary PH were referred to our cardiology ward from the "Marius Nasta" Institute of Pneumology, and were all included in the National Program for Pulmonary Arterial Hypertension Management. All subjects underwent complete transthoracic echocardiography using a Vivid 7 system[2]. We then compared values measured in the pre-capillary PH group with values in the post-capillary PH group to find those which discriminated between the 2 entities.

RESULTS

Mean age of the study group was 63.2 ± 15.35 years, with an age range of 26–90 years, and 48% women.

Mean right ventricular (RV) to right atrial (RA) pressure gradient across the whole group was 64.23 mmHg (minimum 16 mmHg, maximum 169 mmHg) with a standard deviation of 29.2 mmHg. There were no significant differences between pre-capillary PH patients and post-capillary PH patients related to the mean RV to RA pressure gradient.

Mean left atrial (LA) volume across the entire study group was 80.5 mL (minimum 15 mL, maximum 208 mL). Mean E/E' in the entire group was 16.1 (minimum 3.5, maximum 42). Patients with post-capillary PH had a more dilated LA and higher values of E/E' (Table 2) and the correlation had a high statistical significance ($p < 0.001$) (Table 3).

The cut-off values found were: E/E' = 11.6 (with a sensitivity of 0.87 and a specificity of 0.8) and LA volume = 58 mL (with a sensitivity of 0.88 and a specificity of 0.83).

Table 2

Results for LA volume and E/E' for pre-capillary and post-capillary patients, respectively

Parameter	Group	N	Mean	Std. Deviation
LA volume	Pre-capillary	23	43.22	16.398
	Post-capillary	27	112.26	45.648
E/E'	Pre-capillary	15	8.4933	3.09365
	Post-capillary	24	20.8542	8.85585

N: number, Std.: standard

Table 3

P value of correlations between LA volume and E/E' respectively and type of PH

Parameter	P value
LA volume	0.001
E/E'	0.001

DISCUSSION

It is common knowledge that echocardiography can detect elevated left ventricular (LV) filling pressures and thus differentiate pulmonary arterial hypertension (PAH) from pulmonary venous hypertension[3]. Previous studies have shown that PAH patients have a mitral inflow suggestive of impaired relaxation[4] and E/E'<10. These findings suggest a compressed and underfilled LV with normal LV filling pressures[5]. Pulmonary venous hypertension patients present E/E' > 15 consistent with elevated LV filling pressures[6].

Current guidelines for the management of PH patients[1] acknowledge the utility of echocardiographic examination in order to assign a level of probability for PH. Moreover, echocardiography can be helpful in detecting the cause of suspected or confirmed PH[1], but no specific parameters are currently accepted to differentiate pre-capillary PH from post-capillary PH.

A recent study by D'Alto M. *et al.*[7] proposed five echocardiographic parameters to predict pre-capillary PH: E/E' ratio ≤ 10, a right heart chamber larger than the left, left ventricular eccentricity index > 1.2, a dilated inferior vena cava without inspiratory collapse, and the right ventricle forming the heart apex[7].

Our study confirmed that E/E' is lower in PAH patients than in pulmonary venous hypertension patients ($p = 0.001$). Furthermore, we proposed a cut-off value of E/E' = 11.6 which had excellent specificity and sensitivity in differentiating between the two entities.

We also investigated the value of LA volume as a consequence of the impaired LV diastolic function in predicting post-capillary PH. We found that patients with post-capillary PH displayed larger mean volumes of the LA compared to pre-capillary PH patients: 112 mL in comparison with 43 mL. We proposed a cut-off LA volume of 58 mL, higher values predicting post-capillary PH with a sensitivity of 0.88 and a specificity of 0.83.

CONCLUSIONS

Echocardiography is a safe, widely-available and cost-effective investigation which can be used to discriminate between pre-capillary and post-capillary pulmonary hypertension patients. Evaluation of the LV diastolic function and LA volume can provide diagnostic information regarding the two entities.

Conflict of Interest: *none declared.*

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