Imaging the Right Heart-Pulmonary Circulation Unit

The Role of MRI and Computed Tomography

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KEYWORDS

• Cardiovascular MRI • Computed tomography • Pulmonary circulation • Pulmonary hypertension • Right ventricle

KEY POINTS

- The right heart pulmonary circulation unit has been increasingly recognized as a crucial element in defining the clinical and prognostic status of patients with pulmonary hypertension.
- MRI has clear advantages over echocardiography for accurate definition of right heart function and structure and to derive functional information regarding the pulmonary vasculature.
- Computed tomography is superior for the assessment of parenchymal and vascular pathologies of the lung with indications in the diagnostic work-up of pulmonary hypertension, but with more limited capability to evaluate right ventricular function and in deriving pulmonary hemodynamics.
- In recent years, few new techniques based on the use of MRI and computed tomography have been proposed with potential for further improvement in the evaluation of right heart pulmonary circulation unit.

INTRODUCTION

Noninvasive imaging has a well-recognized role in the diagnosis and management of patients with pulmonary hypertension (PH).[1] In particular, echocardiography established itself as a simple, accessible, and repeatable tool for cardiac and hemodynamic evaluation in PH. However, currently recommended echocardiography-based strategies do not prevent the need to apply right heart catheterization (RHC) as the standard of reference for initial diagnosis and following reassessment in patients with pulmonary arterial hypertension (group 1 PH based on the clinical classification as recently re-established by the European Society of Cardiology; **Fig. 1**).[2] Lately, the interest for additional noninvasive imaging modalities, such as MRI and computed tomography (CT), with the capacity to evaluate pulmonary hemodynamics and right

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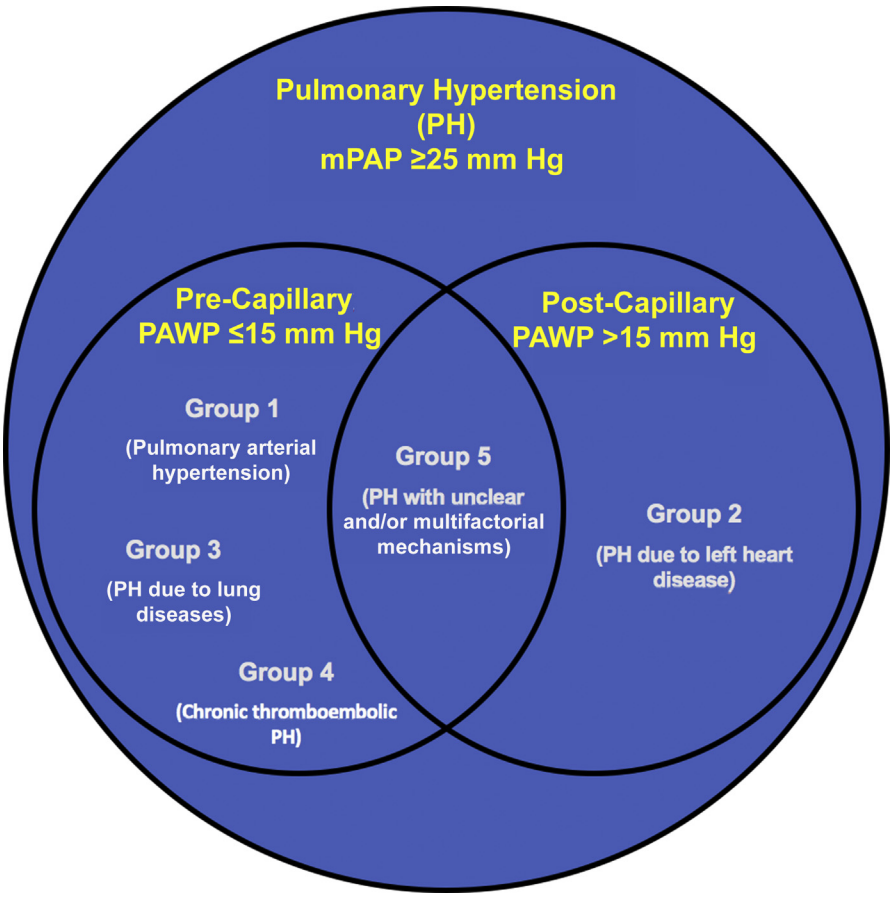

Fig. 1. Hemodynamic definitions of pulmonary hypertension and clinical classification. mPAP, mean pulmonary arterial pressure; PAWP, pulmonary arterial wedge pressure.

ventricular (RV) functional status, has been encouraged by an increasing recognition of the importance of the right heart pulmonary circulation (RH-PC) unit in defining the clinical and prognostic status of patients with PH.[3] It is now well known that RV progression from a normal to a compensated and, then, decompensated state parallels the pathologic changes involving the pulmonary vasculature, from high-capacitance vessels to vasoconstricted arteries and arterioles (with a typical obliterative vascular remodeling).[4] At the same time, to obtain prolonged survival, a need has clearly emerged for therapies that not only improve PH pathology, but that also exert a favorable impact on RV function.[5] Over the years, several investigators have proposed multiple markers of impaired RH-PC unit, mainly including clinical and invasive variables, with potential for effective outcome prediction.[4] However, because of invasiveness of RHC or methodologic difficulties with echocardiography, these strategies are frequently impractical and new approaches are certainly needed that include a better understanding of the pathophysiology of the RH-PC unit. In this defined context, cardiovascular MRI and CT have evolved into advanced imaging techniques able to provide complex evaluations of RV morphology, function, and tissue composition, together with the capacity to accurately investigate pulmonary circulation and perfusion.[6]

Current and new applications of cardiovascular MRI and CT for the characterization of the RH-PC unit represent the main topic of this review. The potential efficacy of implementing strategies for patients with PH that include advanced imaging modalities and the factors that are preventing a more extensive dissemination of their use in clinical practice are also discussed.

CARDIOVASCULAR MRI

Cardiovascular MRI can certainly be considered a fully mature imaging modality with several strong indications, as confirmed by its inclusion in multiple clinical guidelines.[7,8] It is considered the gold standard for noninvasive assessment of RV