Journal of Cardiology 65 (2015) 369–376

Contents lists available at ScienceDirect

Journal of Cardiology

journal homepage: www.elsevier.com/locate/jjcc

Original article

An easy and reproducible parameter for the assessment of the pressure gradient in patients with aortic stenosis disease: A magnetic resonance study

Valentina Valenti (MD)[a,b,*], Sebastiano Sciarretta (MD)[c], Matt Levin (BS)[a], Leon Shubayev (BS)[a], Sophia Edelstein (BS)[a], Mohammad I. Zia (MD)[a,d], Speranza Rubattu (MD)[c,e], Massimo Volpe (MD, FAHA)[c,e], Seth Uretsky (MD)[f], Steven D. Wolff (MD)[a]

[a] Carnegie Hill Radiology, New York, NY, USA
[b] Department of Radiology, University "La Sapienza," Sant'Andrea Hospital, Rome, Italy
[c] IRCCS Neuromed, Pozzilli, IS, Italy
[d] Schulich Heart Centre, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada
[e] Division of Cardiology, Department of Molecular and Clinical Medicine, Sant'Andrea Hospital, University "La Sapienza", Rome, Italy
[f] Department of Cardiovascular Medicine, Morristown Medical Center, Morristown, NJ, USA

ARTICLE INFO

Article history:
Received 2 December 2013
Received in revised form 30 June 2014
Accepted 14 July 2014
Available online 22 August 2014

Keywords:
Aortic stenosis
Cardiac magnetic resonance
Pressure gradient
Gorlin's formula
Hakki's formula

ABSTRACT

Aim: Cardiovascular magnetic resonance (CMR) has been increasingly used as an alternative method to evaluate the severity of aortic stenosis. The aim of our study was to evaluate whether the indirect measurement of the aortic gradient (Calc-PG), derived from Gorlin's formula, is a reproducible parameter for gradient assessment. Then, we evaluated if this parameter is correlated with left ventricular hypertrophy, considered as a marker of severity of aortic stenosis, better than phase-contrast sequences-derived pressure gradient (PC-PG) and aortic valve area.
Methods: Forty-one patients with isolated aortic stenosis underwent CMR. Calc-PG was obtained from the formula (cardiac output/aortic valve area)^2, and it was compared to PC-PG.
Results: We found that the Calc-PG has higher correlation with left ventricle mass than PC-PG (r^2 0.44, $p < 0.001$ vs. r^2 0.26, $p < 0.01$), also after multivariate analysis adjusting for age, gender and hypertension ($p < 0.001$). Furthermore, Calc-PG was more reproducible than PC-PG. The receiver operating characteristic comparison curve analysis showed that Calc-PG has a significantly higher ability to describe the presence of left ventricular hypertrophy than PC-PG (area under the curve 0.85, 95% CI 0.70–0.94, $p < 0.0001$ vs. 0.74, 95% CI 0.58–0.87, $p = 0.03$).
Conclusions: We propose that transaortic gradient indirectly calculated by using the simplified Gorlin's equation could be an alternative method to assess the severity of aortic stenosis.
© 2014 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

Introduction

Aortic stenosis is the most common valvular heart disease [1]. The 2006 American College of Cardiology/American Heart Association guidelines for the management of valvular heart diseases recommend assessing the severity of aortic stenosis by using both anatomical and hemodynamic parameters, namely the aortic valve area and the transaortic gradient, respectively [2]. However, recent evidence suggests that the evaluation of the transaortic gradient might be more accurate to distinguish subjects with moderate or severe aortic stenosis [3–5].

Cardiovascular magnetic resonance (CMR) has been increasingly used as an alternative method to echocardiography to evaluate the severity of aortic stenosis [6–8]. Echocardiography generally provides reliable measurement of pressure gradient. However, a proper visualization of aortic valve and an accurate estimation of pressure gradient by echocardiographic examination can be difficult in some patients with poor acoustic windows, such as obese subjects, subjects affected by chronic obstructive pulmonary disease, or in patients who underwent major cardiac surgery. In addition, an accurate estimation of pressure gradient by

* Corresponding author at: Advanced Cardiovascular Imaging, 170 East 77th Street, New York, NY 10075, USA. Tel.: +1 212 369 9200; fax: +1 212 369 5048.
E-mail addresses: valevale2012@hotmail.com, v.valenti80@yahoo.it (V. Valenti).

http://dx.doi.org/10.1016/j.jjcc.2014.07.015
0914-5087/© 2014 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

echocardiography requires a significant technical expertise of the sonographer [9,10]. With CMR, evaluation of the aortic valve area with steady-state-free-precession sequence has been demonstrated to be highly reliable and reproducible [8,11,12]. On the other hand, the assessment of aortic flows and aortic pressure gradient by using the phase-contrast sequences-derived pressure gradient (PC-PG) is subject to several potential sources of error that may compromise the correct classification of the severity of aortic stenosis and, subsequently, the clinical management of these patients [13].

Here we tested the ability of an additional non-invasive parameter, beyond PC-PG and aortic valve area, for estimating pressure gradient in aortic stenosis by using CMR. It consists of the indirect calculation of the gradient from the cardiac output and aortic valve area, by using the inverse simplified Gorlin's formula [14,15]. A potential advantage of this method is that it can be used to determine the transvalvular pressure gradient without the acquisition or analysis of phase contrast images.

Left ventricular (LV) hypertrophy represents the main marker of preclinical organ damage in patients with aortic stenosis. Previous studies indicated that LV hypertrophy represents a valid surrogate marker of the severity of the disease, and remarkably, it is an accurate and strong predictor for the occurrence of major adverse events in subjects affected by aortic stenosis [16,17].

The aim of our study was to evaluate whether the above-mentioned parameter (hereafter Calc-PG) based on the formula, $(\text{cardiac output/aortic valve area})^2$, is an easy and reproducible index for the evaluation of pressure gradient. In addition, we tested whether this parameter is correlated with LV hypertrophy, considered as a marker of cardiac remodeling caused by aortic stenosis and as a marker of the severity of the disease, better than PC-PG and aortic valve area.

Methods

This study is a retrospective analysis of patients referred for a clinical CMR evaluation in our center. Inclusion criteria included at least moderate aortic stenosis, as indicated by aortic valve area, and preserved ejection fraction (LV ejection fraction >50% and right ventricular ejection fraction >40%). Exclusion criteria included regional ventricular wall motion abnormalities, other significant associated valve disease, myocardial ischemia or scar, intra-cardiac shunt, and patients with an irregular cardiac rhythm. We collected a total of 99 patients with aortic stenosis, who underwent CMR study. From these we excluded 58 patients due to the presence of atrial fibrillation, concomitant presence of other valve diseases, myocardial fibrosis detected by contrast delay analysis, segmental anomalous wall motion, or global LV dysfunction. The remaining 41 patients represent our study population. We used the same protocol as in our previous published papers for the evaluation of transvalvular flow by CMR [18,19].

Patients were imaged with a 1.5-T MRI scanner using a 8 elements, phased-array cardiac coil (GE Signa, EXCITE, GE Medical Systems, Milwaukee, WI, USA). Imaging was electrocardiogram-gated, and performed during breath holds. After scout images acquisition, short- and long-axis cine images were acquired using a steady-state free precession pulse sequence (FIESTA) with the following parameters: repetition time (TR) was 3.5 ms; echo time (TE) was 1.5 ms; the flip angle was 60°; views per segment (VPS) were 12; field of view (FOV) was 350 mm × 350 mm; matrix size was 192 × 160; nominal temporal resolution was 42 ms; breath hold time range was 12–20 s; slice thickness was 8.0 mm, and nominal spatial resolution (voxel size) was 8 mm × 1.8 mm × 2.2 mm. With regard to velocity-encoded phase contrast imaging, a cine localizer was obtained parallel to the direction of flow in order to ensure that measurements of velocity were perpendicular to the plane of flow (Fig. 1A). From this localizer, PC images were acquired in an imaging plane perpendicular to the jet, from the LV outflow tract through the tips of the aortic valve cusps. Typically, 6–9 contiguous slices were acquired, each 4 mm thick, extending 16–24 mm proximal to the aortic cusp tips and 4–12 mm distal (Fig. 1B). Valve 0 mm corresponds to the reference plane at the level of tips of the open aortic cusps, whereas valve −24 mm and valve +12 mm are located 24 mm and 12 mm proximal to and distal to this reference, respectively. We used the following nominal scan parameters: TR was 6.5 ms; TE was 3.8 ms; the flip angle was 20°; VPS was 6; FOV was 480 mm × 360 mm; matrix size was 512 × 224; nominal temporal resolution was 78 ms; breath hold time range was 18–30 s; maximum encoded velocity (VENCmax) was 550 cm/s. Slice thickness was 4.0 mm; and nominal spatial resolution (voxel size) was 4 mm × 0.94 mm × 2.1 mm. After that the clinical scan was completed and additional phase contrast images of a stationary bottle of water (phantom) were acquired for baseline flow correction [20]. CMR data were analyzed utilizing Report Card 4.0 software (GE Medical Systems, Waukesha, WI, USA). Left ventricle volumes were determined by manual endocardial border tracing in short axis, from the base to apex in end-diastolic and end-systolic phases. LV mass was measured

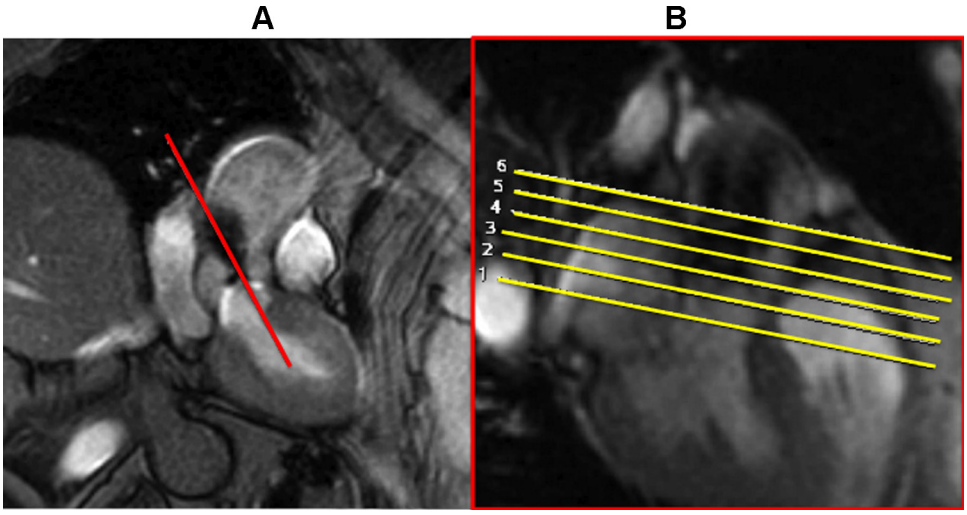

Fig. 1. The aortic localizer view (A) showing a turbulent aortic stenosis jet and imaging slice planes perpendicular to the jet (B).

Download English Version:

https://daneshyari.com/en/article/2962971

Download Persian Version:

https://daneshyari.com/article/2962971

Daneshyari.com