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Thallium-201 gated single-photon emission tomography for assessing left ventricular volumes and function in patients with aortic valve stenosis: Comparison with echocardiography as the reference standard

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ABSTRACT

Background: Aortic valve stenosis (AS) is characterized by chronic left ventricular pressure overload, leading to left ventricular hypertrophy (LVH). We assessed correlations in left ventricular volumes and function between echocardiography and quantitative gated SPECT (QGS) in patients with AS.

Methods and results: The study population consisted of 28 patients with AS defined as a peak velocity of >3.0 m/s and 28 age- and sex-matched control subjects. Patients with AS had a peak pressure gradient of 73.4 ± 24.5 mm Hg and a larger LVM index compared to control subjects (115.5 ± 29.2 g/m^2 vs 78.3 ± 12.1 g/m^2, $p < 0.01$). There were good correlations in end-diastolic volume and end-systolic volume between echocardiography and QGS in patients with AS as well as control subjects. Bland–Altman plot for end-systolic volume showed a significant negative slope of −0.51 in patients with AS. There was a good correlation in ejection fraction between the 2 methods in patients with AS as well as control subjects. However, Bland–Altman plots showed significant negative slopes of −0.40 in patients with AS and −0.74 in control subjects.

Conclusions: Our data suggested that QGS was a useful method for assessing left ventricular volumes and function even in patients with AS. Cardiologists should recognize its specific characteristics.

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1. Introduction

Aortic valve stenosis (AS) is currently the most common valvular heart disease characterized by chronic left ventricular pressure overload, leading to left ventricular hypertrophy (LVH) [1–3]. Previous studies have shown that left ventricular ejection fraction (EF) is strongly associated with outcome in patients with AS [4–6], and it is clinically important to assess left ventricular volumes and function. Echocardiography and quantitative gated single photon emission computed tomography (SPECT) [QGS] are commonly used for assessing left ventricular volumes and function, and several studies have shown good correlations between the 2 methods [7–9]. However, their correlations in patients with AS remain to be investigated.

In the current study, we compared left ventricular geometric pattern between patients with AS and control subjects. We also assessed correlations in left ventricular volumes and function between echocardiography and QGS.

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2. Methods

2.1. Patients

The study population consisted of 28 patients with AS defined as a peak velocity of >3.0 m/s and 28 age- and sex-matched control subjects.

Table 1
Patient characteristics.

	Patients with AS (n = 28)	Control subjects (n = 28)	p value
Age (years)	78.0 ± 8.0	77.6 ± 6.5	ns
Male gender	14 (50%)	14 (50%)	ns
Body mass index (kg/m^2)	23.4 ± 4.0	23.5 ± 3.3	ns
Peak pressure gradient (mm Hg)	73.4 ± 24.5	–	–
Interventricular septal thickness (mm)	10.5 ± 2.0	8.3 ± 0.8	<0.01
Posterior wall thickness (mm)	10.4 ± 1.5	8.3 ± 0.9	<0.01
Left ventricular internal dimension (mm)	47.2 ± 4.9	45.8 ± 3.5	ns
Relative wall thickness	0.44 ± 0.08	0.36 ± 0.05	<0.01
Left ventricular mass index (g/m^2)	115.5 ± 29.2	78.3 ± 12.1	<0.01
Left ventricular hypertrophy	16 (57%)	0 (0%)	<0.01
Sum of rest score	1.0 ± 1.7	0.6 ± 1.2	ns

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Table 2
Left ventricular volumes and function.

	Patients with AS (n = 28)	Control subjects (n = 28)	p value
Echocardiographic measurements			
Left ventricular end-diastolic volume (ml)	86.9 ± 27.5	71.2 ± 13.5	<0.01
Left ventricular end-systolic volume (ml)	33.9 ± 22.0	25.7 ± 5.6	0.07
Left ventricular ejection fraction (%)	63.1 ± 9.3	64.0 ± 4.0	ns
QGS measurements			
Left ventricular end-diastolic volume (ml)	69.8 ± 31.9*	48.6 ± 11.0*	<0.01
Left ventricular end-systolic volume (ml)	28.5 ± 26.5*	17.5 ± 5.9*	<0.05
Left ventricular ejection fraction (%)	64.1 ± 13.5	64.2 ± 7.0	ns

* $p < 0.01$ vs echocardiography.

Control subjects were selected according to the absence of both valvular heart disease and left ventricular hypertrophy (LVH). Patients with evidence of heart failure, renal failure (serum creatinine > 2 mg/dl), atrial fibrillation or ventricular pacing were excluded in this study.

2.2. Echocardiography

Comprehensive echocardiographic assessment was conducted by 2 experienced sonographers using commercially available ultrasound systems with 3.5 MHz probes. Interventricular septal thickness (IVS), posterior wall thickness (PWT) and left ventricular internal dimension (LVID) were measured at end-diastole according to established standards of the American Society of Echocardiography (ASE). Left ventricular end-diastolic volume (EDV), end-systolic volume (ESV) and EF were obtained using a modified biplane Simpson's method from the apical 2- and 4-chamber views [10]. These echocardiographic measurements were considered as the reference standard method. Left ventricular mass (LVM) was calculated according to the ASE-recommended formula [11]: $LVM\ (g) = 0.8 \times \{1.04[(IVS + LVID + PWT)^3 - (LVID)^3]\} + 0.6$. LVM was divided to body surface area to obtain the LVM index. LVH was diagnosed as LVM index > 115 g/m^2 in men and 95 g/m^2 in women.

2.3. Thallium-201 gated SPECT

All patients fasted overnight, and underwent stress–rest thallium-201 (Tl-201) gated SPECT. Adenosine was infused over 6 min (120 μg/kg/min), and Tl-201 (111 MBq) was injected 3 min after the initiation of adenosine infusion. The stress Tl-201 SPECT acquisition was started 5 min after the stress test. Four hours later, rest Tl-201 SPECT images were also obtained. Gated SPECT images were acquired with a dual-head gamma camera system (Siemens E-CAM, Siemens

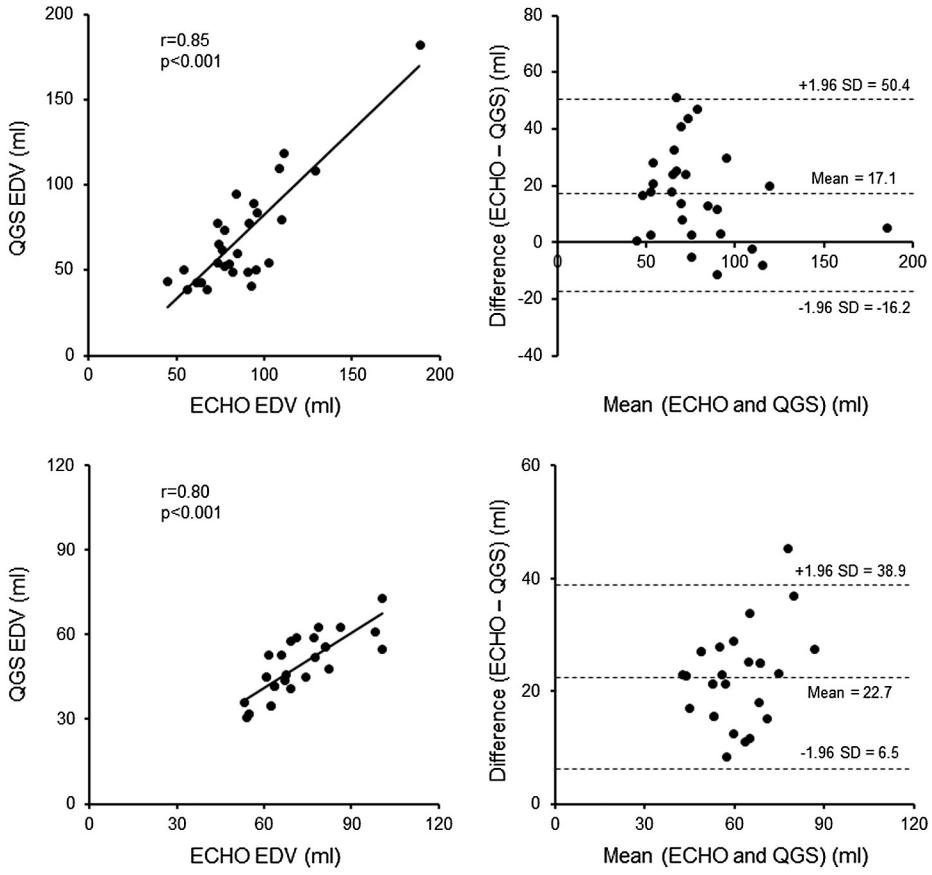

Fig. 1. Correlation in left ventricular end-diastolic volume between echocardiography and quantitative gated SPECT in patients with aortic valve stenosis (upper panels) and control subjects (lower panels).

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