Original Article

Aortic Distensibility in β-Thalassemia Major

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Background: Any unfavorable effect of β-Thalassemia major on aortic distensibility will contribute to the adverse effects of β-Thalassemia major on the cardiovascular system. To evaluated aortic distensibility in patients with β-Thalassemia major.
Patients and Methods: The study comprised eighty (46 males) consecutive β-Thalassemia major patients and 80 control subjects matched for age and gender were selected.
Results: Aortic distensibility was approximately two-fold lower in patients compared with control subjects [aortic distensibility: 1.4 ± 0.8 vs 3.6 ± 1.2, $cm^2\ dyn^{-1}\ 10^{-6}$, $P = 0.01$).
Conclusion: β-Thalassemia major causes significant decrease in aortic distensibility.

Keywords: Aorta, Distensibility, Thalassemia

Introduction

Alterations of arterial structures, with disruption of elastic tissue and calcification, have been demonstrated in patients with β-Thalassemia major.[1,2]. Previous studies showed that carotid and brachial artery stiffness are increased in patients with β-Thalassemia major.[3] It is well appreciated today that aorta not only serves as a conduit but also plays an important role in modulating left ventricular function, coronary blood flow, and arterial function throughout the cardiovascular system.[4,5,6] It seems that any unfavorable effect of β-Thalassemia major on aortic distensibility will contribute to the adverse effects of β-Thalassemia major on the cardiovascular system. The aim of this study was to evaluate aortic distensibility in patients with β-Thalassemia major.

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Patients and Methods

In this case-control study, a total of 80 consecutive patients with β-Thalassemia major, followed by the Hematology Clinic and Transfusional Medicine at our University, were enrolled in the study. All patients were receiving iron chelation therapy with deferoxamine. Healthy subjects, matched for age and gender, were selected as a control group. All subjects gave informed consent.

Transthoracic echocardiography was performed using a 2 to 4 MHz phased-array scanner. Standard parasternal short axis view at just below the tips of mitral valve leaflets was used to derive the M-mode measurements of LV systolic and end-diastolic dimensions and thickness of interventricular septum and posterior LV wall at diastole.[7,8] Average values of these indexes obtained from 5 consecutive cardiac cycles were used for analysis. Thoracic aortic diameters (mm/m^2) were measured 3 cm above the aortic valve by two-dimensional guided M-mode transthoracic echocardiography

of the aortic root at left parasternal long-axis view. Aortic systolic diameter (AoS) was measured at the time of full opening of the aortic valve, and diastolic diameter (AoD) at the peak of the QRS complex at the simultaneous electrocardiogram recording. The following indices of aortic function were calculated:

$$\text{Aortic Distensibility} = 2 \times (AoS - AoD) / (AoD \times PP)$$

Pulse pressure (PP) was obtained simultaneously by cuff sphygmomanometer of the left brachial artery as systolic blood pressure minus diastolic blood pressure.

Statistical Analysis

Data are presented as mean ± SD. Data on aortic distensibility were analyzed offline, blinded to whether the subject had β-Thalassemia. Differences in demographic data, echocardiographic parameters and indices between patients and controls were compared using paired Student's *t* test. Statistical significance was defined as $P < 0.05$.

Results

Eighty patients (46 males) aged 20.4±6.4 years were studied. The patient and control groups were similar with regard to age and sex (Table 1). The demographic data, clinical parameters, and hematologic profile of patients and controls are summarized in Table 1.

Aortic systolic and diastolic diameters were significantly greater in β-Thalassemia patients compared with control subjects. Aortic distensibility was approximately twofold lower in patients compared with control subjects [aortic distensibility: 1.4 ± 0.8 vs 3.6 ± 1.2, $cm^2\ dyn^{-1}\ 10^{-6}$, P = 0.01).

Discussion

Arterial stiffness was evaluated in patients with β-Thalassemia major in previous studies. Cheung et al. showed increased carotid and brachio-radial artery stiffness in patients with β-Thalassemia major,[10] without measuring aortic function indices.

Our study demonstrates increased aortic stiffness in patients with β-Thalassemia major. Importantly, these phenomena occur in the absence of cardiac dysfunction that is known to alter arterial tone.[9] Previous studies have demonstrated systemic arterial endothelial dysfunction in patients with β-Thalassemia major.[10] Regarding the important role of

Table 1. Comparison of clinical, hematologic and echocardiographic profile between patients and controls

	Patients	Controls	P value
Age (years)	20.4 ± 6.4	21.5 ± 6.6	NS
Weight (Kg)	39.7 ± 7.2	62.1 ± 9.5	<0.001
Height (cm)	150.6 ± 16.1	167.5 ± 11.6	<0.001
Body mass index (Kg/m^2)	19.2 ± 2.1	21.8 ± 3.7	0.01
Hear rate (min^{-1})	70.4 ± 11.1	70.5 ± 9.9	NS
Systolic BP (mmHg)	115 ± 11	120 ± 10.6	NS
Diastolic BP (mmHg)	65 ± 12	70 ± 14	NS
Hemoglobin (g/dL)	12.7 ± 0.5	14.8 ± 0.9	<0.001

BP=blood pressure

endothelium-derived nitric oxide as an inhibitor of smooth muscle contraction,[10] endothelial dysfunction may contribute to increasing in aortic stiffness in patients with β-Thalassemia major. Diffuse arterial elastorrhexis, as characterized by fragmentation and defects of the internal elastic lamina, has been observed in the surgically removed spleens and liver biopsy specimens of patients with β-Thalassemia major.[11]

Additionally, radiological studies have demonstrated calcifications in posterior tibial artery of patients with β-Thalassemia major.[12] Furthermore, alteration of glycosaminoglycan composition with increased fibrosis has been documented histologically in the aorta, iliac, and pulmonary arteries in postmortem examination of patients with β-Thalassemia major.[13] Undoubtedly, these structural changes may explain the increase in aortic stiffness in patients with β-Thalassemia major.

The present study demonstrates that β-Thalassemia major clearly induce significant decrease in the aortic distensibility.

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