

Echocardiographic Findings in Scleroderma without History of Cardiovascular Disease

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Received: 04/30/2013
Accepted: 08/07/2013

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ABSTRACT

Objectives

Scleroderma is a connective tissue disease characterized by extensive fibrosis of the skin and various organs. Heart failure and pulmonary hypertension are cardiovascular syndromes associated with this entity that determine prognosis. Doppler echocardiography plays a key role in anatomical and functional assessment of scleroderma and allows the diagnosis of early alterations in ventricular relaxation or segmental contraction, as well as assessing the presence and degree of pulmonary hypertension.

Objectives

The aim of the study was to describe relevant echocardiographic findings in patients with scleroderma without history of cardiovascular disease.

Methods

A cross-sectional, descriptive study was conducted in 46 patients with confirmed diagnosis of scleroderma, who underwent a routine echocardiographic study. Left ventricular systolic function (LVSF) was assessed through ejection fraction (EF). Left ventricular systolic function impairment was defined as EF < 50%, systolic diameter (LVSD) and diastolic diameter (LVDD), wall thickness, regional asynergies (RA), diastolic function (E and A waves and transmitral flow ratio, defined as normal, type I (impaired relaxation), type II (pseudonormal), and type III (restrictive), and septal and lateral tissue Doppler (LVTd) with S, E and A waves and the E/E' ratio. The left atrial (LA) area was assessed in cm² and LA dilation was defined as area > 20 cm². Right ventricular assessment included: qualitative systolic function (RVSF), TAPSE (tricuspid annular plane systolic excursion), diastolic diameter (RVDD) at the basal level, lateral tissue Doppler (RVTD) with measurement of S, E and A waves, and diastolic function (RVDF) by means of E and A waves and tricuspid flow. Systolic pulmonary pressure (SPP) was measured from the sum of the tricuspid reflux gradient and right atrial pressure (inferior vena cava diameter and inspiratory collapse). Presence of significant valve disease was quantified.

Results

Forty-six patients with mean age of 50±7.7 years were included in the study. Eighty-four percent of patients were female, 26% had hypertension and 24% smoking habits. Echocardiographic findings showed preserved LVSF in 98% of patients, mean EF of 62±9.95%, interventricular septum 9.7±2 mm, LVDD 43±8.5 mm, and RA in 2% of patients (n = 1). Normal LVDF was present in 48% of patients, type I in 44%, type II in 2% and type III in 4%. Mean left ventricular tissue Doppler S wave was 11±0.16 cm/s and values < 11 were found in 45% of cases, with an E/E' ratio of 5 (0% > 10). The LA area was 18±3.1 cm² and 24% of patients presented dilation. Normal RVSF was found in 96% of patients (n = 44), RVDD was 32±3.6 mm, TAPSE 24±3.1 mm, impaired RV relaxation was found in 26% of cases and RVTD S wave was 14 cm/s. Mean SPP was 40±11.7 mm Hg (range 25-110 mm Hg), with diagnosis of pulmonary hypertension in 48% of patients (n = 22). An increase in SPP ≥ 50 mm Hg (moderate-severe) was present in 15% of patients (n = 7). Pericardial effusion was found in 4 patients. There was no significant valve disease.

Conclusions

The echocardiographic findings of patients with scleroderma without history of cardiovascular disease showed a high prevalence of mild LV and RV diastolic dysfunction, LA dilation, decreased LVTd S wave (lower regional longitudinal contraction) and high incidence of pulmonary hypertension (48%).

REV ARGENT CARDIOL 2014;82:97-101. <http://dx.doi.org/10.7775/rac.v82.i2.4031>

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Key words > Echocardiography - Scleroderma – Tissue Doppler.

Abbreviations >

MEF	Ejection fraction	RVDF	Right ventricular diastolic function
LA	Left atrial	RVSF	Right ventricular systolic function
LVDF	Left ventricular diastolic function	SPP	Systolic pulmonary pressure
LVSF	Left ventricular systolic function	TAPSE	Tricuspid annulus plane systolic excursion
LVTD	Left ventricular tissue Doppler	NV	Normal value
RA	Regional asynergies		

INTRODUCTION

Systemic scleroderma is a connective tissue disease characterized by extensive fibrosis of the skin and various organs such as the lungs, the kidneys and the heart.

Cardiac manifestations occur in 15 to 35% of patients, though most cases remain in subclinical form (2).

The most common cardiovascular findings are hypertension, heart failure and pulmonary hypertension.

The most prevalent associated cardiovascular manifestations are pericarditis, pericardial effusion, myocardial fibrosis, heart failure, myocarditis, microvascular disease, conduction disorders, arrhythmias and, less frequently (in rare cases), valve disorders. (3)

The development of cardiac injury is an indicator of poor prognosis and is used in rheumatology to define therapeutic conducts (4).

Doppler echocardiography allows anatomical and functional assessment of cardiac structures, and is of great utility in scleroderma to estimate chamber diameters and function, endocavitary flow, presence and degree of pulmonary hypertension and the diagnosis of incipient alterations in ventricular segment contraction or relaxation. The aim of this study was to describe relevant echocardiographic findings in a group of patients diagnosed with systemic scleroderma without history of cardiovascular disease.

METHODS

This was a descriptive, cross-sectional study of 46 consecutive patients with confirmed diagnosis of systemic scleroderma, referred from a specialized outpatient clinic to the echocardiography laboratory of Sanatorio San José for a routine exam, on October 15 and 16, 2010.

All patients underwent two-dimensional echocardiography and color Doppler, as recommended by the American Society of Echocardiography. (4)

Left ventricular systolic function (LVSF) was assessed through ejection fraction (EF) measured using Simpson's biplane method. Left ventricular systolic function impairment was defined by EF < 50 %, systolic diameter, diastolic diameter (NV < 55 mm) and wall thickness (NV < 12 mm), measured in M mode from the left parasternal view. Presence of regional asynergies (RA) was evaluated in parasternal views and in the 3 apical views (4, 2 and 3 chambers).

Left atrial (LA) function was analyzed through the anteroposterior diameter (NV < 40 mm) and area (NV < 21 cm²). Right ventricular (RV) function was evaluated measuring diastolic diameter at the basal level (NV < 42 mm), qualitative systolic function, and tricuspid annular plane systolic excursion (TAPSE) (NV > 20 mm).

Diastolic function was assessed by pulsed Doppler measuring transmitral flow E and A waves and their ratio which

was defined as normal, type I (prolonged relaxation), type II (pseudonormal) and type III (restrictive). Transtricuspid flow E and A wave velocities were measured and their ratio was calculated.

Systolic pulmonary pressure (SPP) was calculated from the sum of the tricuspid reflux gradient and right atrial pressure (estimated by the inferior vena cava diameter (IVCD) and the degree of inspiratory collapse) Pulmonary hypertension was classified as mild, moderate or severe, according to systolic pressure between 35 and 45 mmHg, 45 and 60 mmHg and > 60 mmHg, respectively.

Septal and lateral tissue Doppler were used to measure S, E and A wave velocities and the E/E' ratio was calculated (averaging septal and lateral E'). Right ventricular free wall S, E and A wave velocities were also measured.

In addition, pulsed and continuous color Doppler was used to search for valve disorders and quantify their severity.

The echocardiographic study was performed using an Esaote MyLab™ 30 Gold ultrasound machine with 2.5 MHz transducer, in supine gurney and with the patient lying in lateral decubitus position.

Statistical analysis

Continuous variables with normal distribution were analyzed using Student's t test and dichotomous variables were assessed using the chi-square test. An alpha error < 0.05 was defined.

RESULTS

Forty-six patients with mean age of 50±7.7 years were included in the study. Thirty-eight patients were women (84%), prevalence of hypertension was 26% and that of smoking 24% (Table 1).

Echocardiographic findings are shown in Table 2.

Left ventricular systolic function impairment occurred in one patient (2%). Mean ejection fraction was 62±9.95%, interventricular septum thickness 9.7±2 mm, LV diastolic diameter 43±8.5 mm, and regional asynergies were found in 2% of patients (n = 1).

Left ventricular diastolic function measured by mitral flow pulsed Doppler was normal in 22 patients (48%), with type I dysfunction in 20 (44%), type II in one (2%) and type III in 2 (4%) patients.

Mean S wave measured by left ventricular tissue Doppler was 11±0.16 cm/s and values < 11 cm/s were found in 21 patients (45%). Mean E/E' ratio was 5±1.1, and in no patient was higher than 10.

Left atrial area was 18±3.1 cm² and 11 patients (24%) presented dilation.

Right ventricular systolic function was normal in 96% of patients (n = 44), mean diastolic diameter was 32±3.6 mm, and TAPSE 24±3.1 mm. Twenty-six

Table 1. Baseline characteristics of the population

Variables	
Age, years	50
Female gender, %	84
Hypertension, %	26
Smoking, %	11
Pulmonary fibrosis, %	5
Dyspnea, %	11

Table 2. Echocardiographic findings

Variables	
Preserved LVSF, %	98
LVDF %	
Normal	48
Type I	46
Type II	2
Type III	4
LVTD S wave, cm/s	11
LA area, cm ²	18
LA dilation, %	24
Preserved RVSF, %	96
Altered RVDF, n (%)	21 (45)
TAPSE, mm	24.5
RVTD S wave, cm/s	14
SPP, mm Hg	40
Pericardial effusion, n (%)	4 (8)

LA: Left atrial. LVDF: Left ventricular diastolic function. LVSF: Left ventricular systolic function. LVTD: Left ventricular tissue Doppler. RVDF: Right ventricular diastolic function. RVSF: Right ventricular systolic function. RVTD: Right ventricular tissue Doppler. SPP: Systolic pulmonary pressure. TAPSE: Tricuspid annular plane systolic excursion.

percent of patients (n = 12) presented relaxation disorders and tissue Doppler peak S wave velocity was 14 ± 2.1 cm/s.

Systolic pulmonary pressure evaluation was feasible in 94% of patients and mean SPP was 40 ± 11.7 mm Hg (range 25-110 mm Hg). Pulmonary hypertension criteria was present in 22 patients (48%), with moderate-severe hypertension (SPP > 50 mm Hg) in 15% of patients (n = 7).

Pericardial effusion was observed in 4 patients, with severe criteria in one patient.

No significant valve disease was found.

DISCUSSION

Scleroderma is a collagen disease characterized by excessive fibrosis and vascular dysfunction. Its pathogenesis involves immune activation, vascular damage and excessive extracellular matrix synthesis characterized by significant collagen deposition. (5)

The term scleroderma, Greek for “sclerus” is used to describe a thickened and hardened skin. This may be the clinical finding of a disease that only affects the skin and underlying tissues or it can be associated with systemic involvement when it affects several organs such as the lungs, the kidneys and the cardiovascular system.

The most characteristic clinical manifestation of vascular damage in systemic scleroderma is Raynaud’s phenomenon, and others, such as pulmonary hypertension, contribute to the pathogenesis of cardiac manifestations of the disease.

The primary cardiac involvement in systemic scleroderma, excluding that secondary to pulmonary or systemic hypertension, is due to the underlying vascular pathology which may generate microvascular dysfunction and small vessel recurrent vasospasm resulting in myocardial fibrosis with distribution of typical patches in histological findings (6).

When clinical manifestations of cardiac involvement become evident patient prognosis is poor, with a mortality risk 2.8 times greater than in patients not presenting them. Therefore, identification in preclinical stages is important for patient prognosis and therapeutic decision making.

In this context, Doppler echocardiography and specially tissue Doppler have demonstrated their efficacy in previous studies.

Pulsed tissue Doppler imaging, described towards the end of the 1980s by Izaas et al., allows measuring myocardial wall motion velocities at different times of the cardiac cycle.

Systolic tissue velocities (S’) are reduced in the walls presenting segmental wall motion abnormalities as well as in the walls presenting subtle changes in contractility that segment wall motion, evaluated subjectively by two-dimensional images, fail to demonstrate. In our population systolic function parameters assessed in both ventricles were normal in most patients while measurements of systolic left ventricular tissue velocities and diastolic function parameters in both ventricles showed significant alterations in a high percentage of studied patients.

These altered tissue Doppler parameters could be predictors of poor outcome in this group of patients who would benefit from more aggressive treatment schemes, although this must be demonstrated in long-term monitored studies.

Our findings are consistent with those reported in the literature, as in the work of Menue et al., (8) who described left ventricular systolic velocity (S’) as a sensitive parameter of subclinical systolic dysfunction in this group of patients. Moreover, the present study describes an increased left atrial diameter compared to healthy controls and frequent alterations in left ventricular diastolic relaxation, as well as increased pulmonary pressure.

In a population of patients with systemic scleroderma and unknown heart disease, Kahan et al. (9) found a

very low percentage of patients with left ventricular systolic dysfunction and 40 % incidence of abnormal diastolic relaxation assessed by the transmitral flow pattern.

Pulmonary arterial pressure and pericardial effusion findings are similar to those previously reported in the literature.

Development of pulmonary hypertension is a marker of poor outcome, with a significant decrease in survival. In this sense, the purpose and added value of Doppler echocardiography is represented by its earlier detection of functional class I-II patients and the potential benefit of a timely onset of different drug regimens.

CONCLUSIONS

Among the echocardiographic findings in scleroderma patients without history of cardiovascular disease, the study showed high prevalence of mild LV and RV diastolic dysfunction, LA dilation, decreased S wave in LV tissue Doppler and high percentage of pulmonary hypertension.

RESUMEN

Hallazgos ecocardiográficos en la esclerodermia sin antecedentes cardiovasculares

Introducción

La esclerodermia es una enfermedad del tejido conectivo que se caracteriza por extensa fibrosis cutánea y de diversos órganos. La insuficiencia cardíaca y la hipertensión pulmonar son síndromes cardiovasculares asociados con esta entidad que determinan pronóstico. La ecocardiografía Doppler cumple un papel fundamental en el examen anatómico y funcional de las estructuras cardíacas en la esclerodermia y permite el diagnóstico de alteraciones incipientes, en la relajación o la mecánica segmentaria ventricular, entre otras, además de la evaluación de la presencia y el grado de hipertensión pulmonar.

Objetivo

Describir los hallazgos ecocardiográficos relevantes en pacientes con diagnóstico de esclerodermia sin antecedentes cardiovasculares.

Material y métodos

Estudio de corte transversal y descriptivo de 46 pacientes con diagnóstico establecido de esclerodermia, que asistieron al laboratorio de ecocardiografía por control de rutina.

Se realizó el análisis del ventrículo izquierdo (VI) que comprendió función sistólica (FSVI) a través de la fracción de eyección (FEy) y se definió deterioro de la FSVI ante una FEy < 50%, determinación de diámetro sistólico (DS) y diastólico (DD), espesores parietales, asinergias regionales (AR), función diastólica (ondas E y A, relación del flujo transmitral), que se definió como normal, tipo I (alteración de relajación), tipo II (seudonormal) y tipo III (restrictivo), y Doppler tisular septal y lateral con ondas S, E y A, relación E/E'. En la aurícula izquierda (AI) se cuantificó el área en cm²; se consideró dilatación ante valores > 20 cm². En el ventrículo derecho se evaluó función sistólica (FSVD) cualitativa,

TAPSE (excursión del anillo tricuspídeo), diámetro diastólico (DDVD) a nivel basal, Doppler tisular lateral (DTVD) con determinación de ondas S, E y A, función diastólica (FDVD) por ondas E y A y relación del flujo tricuspídeo. Se calcularon la presión pulmonar sistólica (PPS) a través de la suma del gradiente del reflujo tricuspídeo y la presión de la aurícula derecha (diámetro de la vena cava inferior y colapso inspiratorio). Se evaluó la presencia de valvulopatías significativas.

Resultados

La edad media de los pacientes fue de 50 ± 7,7 años, el 84% de sexo femenino, el 26% tenía hipertensión arterial y el 24%, tabaquismo. Entre los hallazgos ecocardiográficos se observaron: FSVI conservada en el 98%, FEy promedio del 62 ± 9,95%, septum interventricular de 9,7 ± 2 mm, DDVI de 43 ± 8,5 mm, AR en el 2% (n = 1); la FDVI fue normal en el 48%, tipo I en el 44%, tipo II en el 2% y tipo III en el 4%. El DTVI presentó una onda S promedio de 11 ± 0,16 cm/seg y valores < 11 en el 45%, con una relación E/E' de 5 (0% > 10). El área promedio de la AI fue de 18 ± 3,1 cm² y se observó dilatación en el 24%. VD: FSVD normal en el 96% (n = 44), DDVD de 32 ± 3,6 mm, TAPSE 24 ± 3,1 mm, trastorno de relajación del VD en el 26%, onda S DTVD 14 ± 2,1 cm/seg; la PPS promedio fue de 40 mm ± 11,7 Hg con un rango de 25-110 mm Hg y con diagnóstico de hipertensión pulmonar en el 48% (n = 22). El incremento de los valores de PPS ≥ 50 mm Hg (moderada-grave) alcanzó el 15% (n = 7). Se halló derrame pericárdico en 4 pacientes. No se observaron valvulopatías significativas.

Conclusiones

Entre los hallazgos ecocardiográficos de los pacientes con esclerodermia sin antecedentes cardiovasculares se observó una prevalencia elevada de disfunción diastólica leve del VI y del VD, dilatación de la AI, disminución de la onda S en el DTVI (menor contracción longitudinal regional) y un porcentaje elevado de hipertensión pulmonar (48%).

Palabras clave > Ecocardiografía - Esclerodermia Doppler tisular

Conflicts of interest

None declared.

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