THE JOURNAL OF
SEXUAL MEDICINE

EVALUATION

Role of 2D Strain in the Early Identification of Cardiac Dysfunction and in the Risk Stratification of Arteriogenic Erectile Dysfunction Patients

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ABSTRACT

Background: Vasculogenic erectile dysfunction is a harbinger of vascular disease. Comprehensive cardiac workup is accepted to be beneficial in men with this condition, especially those with otherwise unrecognized cardiovascular disease. We aimed to evaluate the role of two-dimensional speckle-tracking echocardiography (2D-STE) for noninvasive evaluation in patients with documented arteriogenic erectile dysfunction.

Methods: 64 consecutive men with Doppler proven erectile dysfunction of more than 3 months of duration were recruited. Patients divided into 2 groups according to mean peak systolic velocity (PSV). Patients with PSV <20 cm/sn constituted Group 1 and patients with PSV ≥ 20 cm/sn constituted Group 2. All underwent echocardiography and were compared. According to the 2D-STE analysis for the left atrium (LA); strain during ventricular systole (LARes), during late diastole (LA-Pump), strain rate during ventricular contraction (LA-SRs), during passive ventricular filling (LA-SRe), during active atrial contraction (LASRa) values and for LV; global longitudinal strain (GLS), strain rate in systole (GSRs), strain rate in early diastole (GSRe), and strain rate in late diastole (GSRa) values were obtained.

Results: Beside diastolic parameters, LA-Res and LA-Pump were found to be significantly different between groups. GLS and GSR values were lower in Group 1. Moreover, correlation analysis revealed a significant correlation of GLS values with PSV ($r = -0.4$, $P = .001$).

Conclusion: Myocardial deformation parameters by 2D-STE are valuable for detection of subclinical cardiovascular dysfunction in men with arteriogenic erectile dysfunction. This noninvasive method may be used as an emerging prognostic marker for risk stratification.

Key Words: Speckle-tracking Echocardiography; Arteriogenic Erectile Dysfunction; Cardiovascular Disease

INTRODUCTION

Erectile dysfunction (ED) is strongly associated with cardiovascular disease. Formerly, this relationship was characterized primarily by shared vascular risk factors that bring about late end-organ disease in nearly same-sized common penile (1–2 mm) and coronary arteries (3–4 mm). The most common organic etiology of erectile dysfunction is vasculogenic origin. Endothelial dysfunction is believed to be the common pathophysiologic base both for ED and cardiovascular disease.[1] However, ED symptoms may occur nearly 2 to 5 years before the onset of cardiovascular symptoms (possibly related to the artery size), and severity of ED has been correlated with atherosclerotic burden, extent of coronary artery disease, risk of coronary artery disease, and major cardiovascular events. Lately, ED has become accepted as an independent marker of cardiovascular disease risk. Arteriogenic erectile dysfunction results from impaired penile perfusion and is a component of the generalized atherosclerotic process.[2] Hence, the presence of arteriogenic ED may provide the opportunity for cardiovascular disease risk extenuation in men with otherwise unrecognized cardiovascular disease. It is likely that individuals with apparent vasculogenic ED and no overt cardiac impairment would benefit from the most meticulous cardiovascular evaluation and advised to undergo further noninvasive evaluation.

Received November 9, 2015. Accepted May 13, 2016.

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http://dx.doi.org/10.1016/j.jsxm.2016.05.007

Two-dimensional speckle tracking echocardiography (2D-STE) is a novel technique used for the assessment of cardiac mechanics. Myocardial deformation analysis by 2D-STE is superior for prediction of outcomes. Angle independency, free of tethering and translation effects, and low measurement variability are some of its advantages. It is particularly valuable in identification of subclinical myocardial dysfunction, and early detection of myocardial changes gives us the opportunity to prevent overt cardiovascular complications.

It is suggested that, in men with organic ED believed to be vasculogenic in etiology, cardiovascular risk should be further evaluated through assessment of traditional risk factors and noninvasive methods to detect subclinical cardiovascular disease. Hence, the aim of the present study was to investigate the role of 2D-STE for noninvasive evaluation of arteriogenic ED.

MATERIAL AND METHODS

A total of 64 consecutive patients diagnosed with ED of more than 3 months of duration and had Doppler-proven penile vascular incompetence were prospectively enrolled for the study. Patients were recruited from 2 different andrology clinics. On Doppler examination peak systolic velocity (PSV) <30 cm/sn and end diastolic velocity >5 cm/sn were considered abnormal. All patients had been invited to complete the abridged 5-item version of the International Index of Erectile Function (IIEF-5) questionnaire at the diagnosis. A complete physical examination was performed for all subjects, and body mass index (BMI, kg/m^2) and body surface area (BSA, m^2) were calculated. Venous blood samples were taken in the morning after a 12-hour fast and dyslipidemia was evaluated. Known coronary artery disease, hypogonadism, diabetes mellitus, uncontrolled hypertension, malignancy, renal or hepatic insufficiency, and selective phosphodiesterase type-5 inhibitor treatment in the previous 3 months were the exclusion criteria.

Baseline Echocardiography and Deformation Analysis

Echocardiographic examinations were performed in accordance with the recommendations of the American Society of Echocardiography guidelines[3] using an ultrasound system (Vivid 7; General Electric, Horten, Norway). Left ventricular (LV) internal dimensions (end-diastolic LV diameter and end-systolic LV diameter) and wall thickness of the ventricular septum and posterior wall were measured at the mid-chordal level. LV end-diastolic and end-systolic volumes and ejection fraction (EF) were measured at the apical 2-chamber and 4-chamber views. EF was calculated using modified Simpson's method. The left atrial (LA) volume was measured using the biplane area length method and indexed to body surface area. Using pulsed Doppler method the peak early (E) and late (A) diastolic velocities, deceleration time (DecT) from the peak to baseline of the early diastolic transmittal flow velocity were calculated. The ratio of early diastolic to late diastolic mitral inflow velocities (E/A) was computed. Mitral annulus velocities were acquired from the septal and lateral annulus using tissue Doppler imaging. The means of peak early (Em) diastolic motion velocities were calculated. E/Em was used as a proxy for LV filling pressures. All measurements were carried out during 3 cardiac cycles and then averaged. Three consecutive cardiac cycles were used for each of 3 standard apical (2-, 3-, and 4-chamber) views and were stored for offline LV and LA strain analysis, using EchoPAC software (GE Ultrasound, Horten, Norway). The endocardial border, defined manually by a point-and-click approach and automated tracking algorithm developed by the software, followed the endocardium. Visual confirmation of tracking was achieved and segments with scarce tracking were refused after failed manual adjustment. Global longitudinal strain (GLS) and global systolic strain rate (GSRs), the global diastolic strain rate during the early (GSRe) and late (GSRa) phase of diastole were analyzed. LA peak strain just before mitral valve opening was accepted as LA reservoir (LA-Res), and LA strain just before atrial contraction (onset of the P-wave on electrocardiography) was accepted as LA-Pump. Also, LA strain rate during ventricular systole (LA-SRs), LA-SRe during ventricular passive filling, and LA-SRa during active atrial contraction were calculated for LA function evaluation.

Main Outcome Measures

Cardiac deformation parameters, namely strain and strain rate were analyzed in a group of men with IIEF questionnaire and Doppler-proved arteriogenic ED.

Statistical Analysis

Since there is no cut-off value for deformation parameters, data divided into 2 groups according to mean PSV. Patients with PSV <20 cm/sn formed Group 1 and patients with PSV ≥20 cm/sn formed Group 2. The groups were compared. Data are expressed to mean ± SD for continuous variables and as percentages for categorical variables. Categorical variables were studied using the χ^2 test or Fisher exact test, as appropriate. Nonparametric tests also were used if necessary (Mann-Whitney U test). Spearman's test was used for correlation analysis. A P value <.05 was considered significant for all analyses. All the statistical tests were performed using SPSS 16 (SPSS Inc, Chicago, IL, USA). Inter-observer agreement of echocardiographic parameters obtained from 2D-STE data was calculated using a Bland-Altman analysis and intra-class correlation coefficient was used to assess intra-observer agreement. Intra-observer variability was determined by repeating the global strain and strain rate measurements on 16 patients by the same observer on 2 occasions separated by at least 1 month.

RESULTS

Sixty—four men diagnosed with arteriogenic ED (mean age of 56 ± 4 years) with an average duration of ED of 24.4 ± 13 months were recruited for the study. The average IIEF-5 score