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International Journal of Cardiology 141 (2010) 297–303

International Journal of Cardiology

www.elsevier.com/locate/ijcard

Stress cardiomyopathy: Clinical and ventriculographic characteristics in 107 North American subjects

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Received 27 July 2008; accepted 4 December 2008
Available online 19 January 2009

Abstract

Background: Stress cardiomyopathy (SCM) is a newly described reversible cardiomyopathy of largely unclear etiology. We studied SCM in a large cohort to gain further insights.
Methods: We retrospectively identified 114 cases of SCM from among 12,150 consecutive North American patients diagnosed as Troponin-positive acute coronary syndrome, from January 2000 through December 2007, at two 24-h coronary angioplasty-capable centers. Left ventriculographic wall contractility was analyzed and scored in 107 patients on the right anterior oblique view.
Results: In 107 patients (66±14 years, 99 females), variable regional contractility or "ballooning" was observed including: postero-basal, 1%; basal+mid-ventricular, 1%; diaphragmatic, 2%; localized apical, 2%; antero-lateral, 11%; complete mid-ventricular, 29%; and classical variant, 54%. The localized and complete mid-ventricular variants ($n=45$, 40 females) had a younger median age at presentation (64 vs. 71 years, $p=0.008$) and higher median LV ejection fraction (45% vs. 35%, $p=0.006$) than the classical or tako-tsubo variants ($n=58$, 55 females) with similar baseline exposure to stressors, risk factor and in-hospital complications. Frequency of involvement and mean contractile score (dysfunction) of the antero-lateral segment was significantly ($p<0.05$) greater in the order, antero-lateral > diaphragmatic > apical > basal.
Conclusion: From a single large cohort of SCM, evidence on significant individual variation in clinical and morphological pattern was confirmed. Frequency and vulnerability to transient dysfunction differs within segments with antero-lateral involvement significantly greater than diaphragmatic, apical, basal-anterior and basal-posterior LV segments. Further studies in phenotype should be undertaken for proper identification, classification and pathophysiological implications.

Keywords: Apical ballooning syndrome; Stress cardiomyopathy; Tako-tsubo cardiomyopathy; Transient left ventricular ballooning syndrome

1. Introduction

A transient pattern of ventricular dysfunction called stress cardiomyopathy (SCM) or left ventricular (LV) apical ballooning syndrome in post-menopausal women has been recently described that has a characteristic LV apical (ballooning) morphology resembling a Japanese octopus trap [1]. Since the original description of typical "apical" ballooning in 1990 [2,3], newer atypical variants with the mid-ventricular and basal involvement have been reported in small cohorts [4–6], but a morphological analysis across the disease spectrum has not been done in larger cohorts. Stressors (physiological and psychological) seem to play a major role yet the evidence implicating a conclusive basis of myocardial injury lacks [7].

Proper characterization of the clinical spectrum would affect the recognition, classification and differential diagnosis as the syndrome mimics myocardial infarction and such study

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doi:10.1016/j.ijcard.2008.12.043

may also aid in understanding its pathophysiological basis. In the present study, we retrospectively analyzed a cohort of 107 North American subjects with SCM to gain greater insights into its clinical spectrum.

2. Study population and methods

Consecutive charts and angiographic data of 12,150 (60% males) admissions (January 2000 through December 2007) diagnosed with Troponin-positive acute coronary syndrome and, who underwent angiography at two university-affiliated community-based hospitals, were retrospectively searched. The hospitals have well equipped 24-h coronary angioplasty infrastructure for routine performance of immediate and early invasive procedures. Cut-off for Troponin T positivity used is 0.1 ng/ml (ELISA, Roche Diagnostics; Germany).

Patients were classified as having SCM only if they satisfied all of the 3 criteria:

1) Presence of transient LV akinesias, hypokinesias or dyskinesias with wall motion abnormalities (WMAs) extending beyond a single epicardial vascular distribution accompanied with, new EKG changes or troponin elevation.
2) Absence of ≥50% luminal narrowing or acute plaque rupture or an intracoronary thrombus in the major epicardial arteries documented on contrast arteriography.
3) Absence of myocarditis, known cardiomyopathy, recent cardiac procedure/trauma, pheochromocytoma, recent head injury, recent seizures, intracranial hemorrhage, and acute ischemic stroke.

From the initially selected 226 patients who were screened on the basis of, a lack of obstructive coronary artery disease (≥50% luminal stenosis or plaque rupture or thrombus) *and* transient nature of LV wall akinesias, hypokinesias or dyskinesias, we excluded 96 patients for other diagnosis. Patients ($n=16$) in whom either a left anterior oblique (LAO) ventriculography done at presentation or a two-dimensional trans-thoracic echocardiogram done at presentation were not available were also excluded, as LV septal and lateral wall evaluation could not be done in these patients. The final study group comprised of 114 SCM patients and they satisfied all the 3 aforementioned criteria. All had coronary arteriographic data but ventriculographic data was available in 107 patients, diagnosis being made on an echocardiographic evidence of typical WMAs in the rest ($n=7$). In patients with ventriculographic data ($n=107$), all had right anterior oblique (RAO) films for offline reading. Clinical data including major coronary risk factors, EKG and laboratory data were retrospectively collected from computerized individual charts. EKGs at presentation were analyzed specifically for arrhythmias, ST elevation (>1 mm in ≥2 contiguous leads), T inversions (>3 mm in ≥3 contiguous leads), presence of deep and wide q waves, non-specific ST-T changes and QTc intervals. Diabetes mellitus and systemic arterial hypertension states were defined on the basis of chart documentation and/or use of relevant therapeutic agents. Hyperlipidemia was defined as ≥150 mg/dl of documented fasting low-density lipoprotein value, chart documentation of diagnosis or use of lipid-lowering agents. 2D transthoracic echocardiographic films were analyzed off-line for initial (available in $n=59$) and follow-up ($n=114$) ejection fractions (Simpson rule) [8]. Presence of transient right ventricular wall hypokinesias in absence of pulmonary hypertension (doppler pulmonary acceleration time <90 ms or presence of a right ventricular or atrial gradient >30 mm Hg) was used as the definition for right ventricle dysfunction related to SCM.

Coronary arteriography was carried out at presentation in 104 patients, on day 2 of presentation in 7 patients, on day 3 in 1 patient, on day 7 in 1 patient and on day 11 in 1 patient.

Ventriculograms at presentation was analyzed by the authors on the 30° RAO view. Numerical visual scoring of contractile function was done in a standard manner [9] for five LV segments (antero-basal, antero-lateral, apical, diaphragmatic, and postero-basal) with a score of 1 = normal contraction, 2 = mild hypokinesis, 3 = severe hypokinesis, 4 = akinesis, and 5 = dyskinesis. Ventriculographic ejection fraction was estimated using monoplane area–length method [10] and mitral regurgitation was graded using Sellers' method [11]. Variants were defined as "classical" by the presence of apical WMAs associated with mid-ventricular segmental involvement and sparing of basal segments. Mid-ventricular variants were defined by predominant involvement of mid-ventricular segments (antero-lateral and diaphragmatic on RAO view) with a preserved contractility of apical and basal segments. Regional or localized variants were named on the basis of RAO ventriculographic segmental involvement.

Institutional review board permission was obtained prior to initiating the study.

3. Statistical analysis

Continuous variables are expressed as mean±SD unless stated otherwise. Categorical variables were expressed as frequencies and compared using the Fisher's exact test while univariate comparison of continuous variables was done using t test. A p value (2-tailed) of <0.05 was considered to be statistically significant. GraphPad Prism® 5 for Windows version 5.01 was the statistical software used.

4. Results

4.1. Presenting characteristics, EKG findings, echocardiographic features

Presenting clinical variables are summarized in Table 1. All patients lived within 90-mile radius of the hospitals. Majority of the population was white (98%) and chest pain, shortness of breath and new EKG abnormalities were the most common modes of presentation. A preceding,