

ORIGINAL PAPER

The Role of Echo cardiography in Diagnosis and Follow Up of Patients with Takotsubo Cardiomyopathy or Acute Ballooning Syndrome

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Background: The transient left ventricular apical ballooning syndrome, also known as takotsubo cardiomyopathy was first described in Japan approximately 20 years ago (Satoh and coworkers, 1991). It was later described elsewhere as well and is being increasingly recognized. Takotsubo Cardiomyopathy characterized by transient apical and midventricular LV dysfunction in the absence of significant coronary artery disease that is triggered by emotional or physical stress. Its name refers to a contraption used for catching octopuses and suggests the aspect assumed by the ventricle during the systole due to the typical regional wall motion abnormalities that occur after onset. Takotsubo cardiomyopathy occurring mainly in post-menopausal women, echocardiography in the Takotsubo cardiomyopathy reveals during its acute phase a ballooning resembling the octopus trap configuration—the apex and lateral ventricular segments are hypokinetic while the base is hyperkinetic - along with reduced ejection fraction. Ventricular function will usually recover within a few days/weeks. **Objective and purpose:** The objective of this study is to determine the role of echocardiography in detecting and establishing the diagnosis of Takotsubo cardiomyopathy in patients with suspect acute coronary syndrome and during the follow up period. **Patients and methods:** The study covered 12 adult patients the majority are women (92%) who were subjected to echocardiography evaluation as part of the clinical cardiological examination due to suspect acute coronary syndrome or Takotsubo Stress Cardiomyopathy. The patients were examined on an ultrasound machine Philips iE 33 xMatrix, ATL HDI and GE Vivid 7 equipped with all cardiologic probes for adults and multi-plan TEE probes. We evaluated clinical characteristics, LV systolic function, biomarkers, and prognosis in all patients. **Results:** Among all the patients referred for Echocardiographic evaluation for left ventricle motion abnormalities with suspect acute coronary syndrome, the echo exam revealed 12 patients with acute apical ballooning which involving the left ventricular apex and med-ventricle. The triggering factors were physical stress in 4 patients (33%) and emotional stress in 8 patients (67%). The initial symptom was chest pain (n=8, 67%) rather than dyspnea (n=4, 33%). An initial electrocardiogram (EKG) presented ST-elevation (n=10, 83%) and T-wave inversion (n=2, 17%), other data are shown on Table 2. Among the all patients 8 of them (66%) had normal EF by the 1st follow up (47 ± 51 days), and the rest 4 patients (34%) had normal EF

by 68 ± 96 days. **Conclusion:** Wide-spread uses of echocardiography has contributed to more frequent recognition of Takotsubo stress cardiomyopathy and highlight the central role of this noninvasive method from an echocardiographers' perspective. **KEY WORDS:** TAKOTSUBO STRESS CARDIOMYOPATHY, ECHOCARDIOGRAPHY, ACUTE BALLOONING SYNDROME.

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1. INTRODUCTION

The transient left ventricular apical ballooning syndrome, also known as takotsubo cardiomyopathy, is a recently described novel acute cardiac syndrome (1, 2, 3, 4, 5, 6, 7, 8). The syndrome is characterized by peculiar, yet characteristic, transient regional systolic dysfunction involving the left ventricular apex and mid-ventricle with hyperkinesis of the basal left ventricular segments. **Takotsubo cardiomyopathy** was first described in Japan approximately 20 years ago (Satoh and coworkers, 1991). It was later described elsewhere as well and is being increasingly recognized. Takotsubo Cardiomyopathy characterized by transient apical and mid-ventricular LV dysfunction in the absence of significant coronary

artery disease that is triggered by emotional or physical stress. Its name refers to a contraption used for catching octopuses and suggests the aspect assumed by the ventricle during the systole due to the typical regional wall motion abnormalities that occur after onset. Since its first description, this condition has been increasingly recognized: many articles have been reported on this condition and are available on Medline/PubMed. However, certain reports identifying presumed “new” entities (such as apical ballooning syndrome, ampulla cardiomyopathy, broken heart syndrome) characterized by nearly the same clinical features of TC. Precise incidence is unknown, however up to 2.5% of all patients presenting with an initial clinically suspected acute coronary syndrome (ACS) (1, 9, 10, 11, 12, 12, 13, 14, 15, 16, 17, 18, 19, 20).

2. RESEARCH OBJECTIVES

The objective of this study is to determine the role of echo cardiography TTE and TEE in establishing the diagnosis of Takotsubo Cardiomyopathy or acute ballooning syndrome in patients with suspect acute coronary syndrome, by investigating the wall motion abnormalities of the left ventricle and identifying a transient left ventricular apical ballooning syndrome during the acute phase of symptoms as a part of clinical cardiological investigation. Also to reveal the importance of echo cardiography in the follow up period in those patients. The evaluation of wall motion abnormalities of the left ventricle obtained by echo cardiography (TTE and TEE) as a noninvasive diagnostic method. Also to determine whether echo cardiography can be considered as a reliable diagnostic and follow up modality in detecting and assessing patients with suspect Takotsubo Cardiomyopathy or Acute Ballooning Syndrome (Figure 1 and 2).

3. PATIENTS AND METHODS

The study includes 12 adult patients; the majorities were women, who were



FIGURE 1 and 2. The Echocardiographic finding of transient left ventricular apical ballooning syndrome involving the left ventricular apex and mid-ventricle in the absence of obstructive epicardial coronary disease.

subjected to echo cardiography as part of the clinical cardiological examination. The patients were examined on an ultrasound machine Philips iE 33 xMatrix, ATL HDI and GE Vived 7 equipped with all cardiological probes for adults and multi-plan TEE probes. The evaluation of wall motion abnormalities of the all left ventricle 17 segments were obtained by echo cardiography (TTE and TEE) as a noninvasive diagnostic method in order to establish the diagnosis of Takotsubo cardiomyopathy. In establishing the diagnosis of Takotsubo

cardiomyopathy the criteria of Mayo Clinic were used (Table 1).

4. RESULTS

Among all the patients referred for Echo cardiographic evaluation for left ventricle motion abnormalities with suspect acute coronary syndrome, the echo exam revealed 12 patients with acute apical ballooning which involving the left ventricular apex and med-ventricle in absence of obstructive epicardial coronary artery disease. According to Mayo clinic criteria those patients has Takotsubo cardiomyopathy–Acute Apical Ballooning Syndrome. The triggering factors were physical stress in 4 patients (33%) and emotional stress in 8 patients (67%). The initial symptom was chest pain (n=8, 67%) rather than dyspnea (n=4, 33%). An initial electrocardiogram (ECG) presented ST-elevation (n=10, 83%) and T-wave inversion (n=2, 17%), other data are shown on Table 2. Takotsubo cardiomyopathy is difficult to distinguish from acute coronary syndrome on first presentation. The syndrome more often affects postmenopausal women (92%) (mean age 66 years). The blood laboratory findings shows relatively mild elevation of cardiac enzyme and biomarkers levels. Among the all patients 8 of them (66%) had normal EF by

1	Transient akinesis or dyskinesia of the left ventricular apical and mid-ventricular segments with regional wall-motion abnormalities extending beyond a single epicardial vascular distribution.
2	Absence of obstructive coronary disease or angiographic evidence of acute plaque rupture.
3	New electrocardiographic abnormalities (either ST-segment elevation or T-wave inversion).
4	Absence of Recent significant head trauma, Intracranial bleeding, Pheochromocytoma, Obstructive epicardial coronary artery disease, Myocarditis, Hypertrophic cardiomyopathy.

TABLE 1. Proposed Mayo Criteria for the Clinical Diagnosis of the Transient Left Ventricular Apical Ballooning Syndrome:

the 1st follow up (47 ± 51 days), and the rest 4 patients (34%) had normal EF by 68 ± 96 days.

Age, y†	66
Women, %	92
Chest pain, %	67
ST-segment elevation, %	83
ST-segment elevation in precordial leads, %	83
Elevation of cardiac enzyme levels, %	88
Pathological Q wave, %	34
Mean QTc, ms	500
Initial average LVEF†	0.46 ± 0.10
Follow up LVEF†	0.61 ± 0.10
Heart failure or pulmonary edema, %	1
Coronary stenosis > 50%, %	0
Spontaneous multi vessel spasm, %	0
Preceding emotional stressor, %	67
Preceding physiological stressor, %	33
In-hospital mortality, %	0
Documented full recovery, n/n %	12/12 (100)
Documented recurrence, n/n %	0

TABLE 2. Demographic, Clinical characteristics and Echo cardiographic data

5. DISCUSSION

Takotsubo cardiomyopathy, also called stress-induced cardiomyopathy, apical ballooning syndrome, or broken heart syndrome, is a transient systolic dysfunction of the ventricles in the absence of significant coronary artery disease. Since its first description in Japan (Satoh and coworkers, 1991), this syndrome has been increasingly recognized and many articles have been reported on this condition and are available on PubMed and EMBASE data bases. The clinical presentation of patients ultimately diagnosed with Takotsubo cardiomyopathy is usually indistinguishable from that of acute coronary syndrome. The etiology of takotsubo cardiomyopathy remains uncertain and it is likely that multiple factors are involved. Although pathophysiology remains unclear, suspicion of catecholamines mediated myocardial stunning is highly favored as myocardial function returns to normal within days to a few weeks.

The diagnosis of Takotsubo cardiomyopathy is confirmed by presence of

all four Mayo Clinic diagnostic criteria mentioned in Table 1. The most authors of the published studies Sharkey et al., Akashi et al., Bybee et al., Kawai et al., Abe et al., Desmet et al., Kurisu et al., Tsuchihashi et al., Inoue et al., Ibanz et al., Ito et al., Igora et al., Matsuoka et al., are almost sharing the following findings: the prevalence of Takotsubo cardiomyopathy is estimated to range between 0.7 to 2.5%. Female postmenopausal predominance is 90.7%. The mean age of 62 to 76 years. The ECG finding present ST-segment elevation in the precordial leads with chest pain. The lab. Findings shows relatively minor or mild elevation of cardiac enzyme and biomarkers levels. In all patients an episode of emotional or physiologic stress frequently precedes presentation with the syndrome. The Hospital mortality rates range from 0–8% and are lower than for myocardial infarction as the risk for recurrence episodes, Sharkey et al. reports 5% of patients had recurrence of Takotsubo Cardiomyopathy within 4.4 years of initial event. Long-term survival is similar to an age-matched and gender-matched population. Regnante et al. observed a trend in the time of year when Takotsubo cardiomyopathy was most often diagnosed. The pathogenesis of the Takotsubo cardiomyopathy is still unknown. Many explanations have been proposed including multi-vessel coronary vasospasm, abnormalities in coronary microvascular function and catecholamines mediated cardio-toxicity provoked by emotional or physical stress. Bybee et al. reported on patterns of abnormal coronary flow in the absence of obstructive coronary artery disease in patients with stress-related myocardial dysfunction. Wittstein et al. noted multi-vessel coronary vasospasm on cardiac catheterization in 70% of Takotsubo cardiomyopathy patients. Sharkey et al. could not explain diffuse wall motion abnormalities by vasospasm of any single coronary artery. Catecholaminergic or adrenoceptor-hyperactive cardiomyopathy may be the cause of this cardiomyopathy. In all, management of Takotsubo Cardiomyopathy is primarily empirical and needs to be individualized for each patient.

6. CONCLUSION

Takotsubo cardiomyopathy is an important entity to be recognized. Differential diagnosis should be considered among postmenopausal women presenting with characteristic signs and symptoms of an acute coronary syndrome after an emotional or physical stressor. Many explanations have been proposed including multi-vessel coronary vasospasm, abnormalities in coronary microvascular function and catecholamine mediated cardio-toxicity provoked by emotional or physical stress but the cause of the syndrome is not yet known. ST-segment changes and cardiac biomarkers elevations may or may not be evident. Despite the absence of obstructive epicardial coronary artery disease, clinical presentation in patients with the syndrome is similar to that of patients with ST-segment elevation myocardial infarction. Coronary angiography typically reveals no significant coronary lesions to account for the marked left ventricular wall motion abnormalities. The left ventricular apical ballooning is transient and the majority of patient myocardial function returns to normal within days to a few weeks. Patients with the syndrome seem to have a favorable intra hospital prognosis despite the development of acute left sided heart failure and hemodynamic instability. A large systematic review found patients with TCM tend to have a lower incidence of traditional cardiac risk factors, such as hypertension, hyperlipidemia, diabetes, smoking, or positive family history for cardiovascular disease. Treatment is aimed at supportive measures including reducing anxiety, alleviating pain, maintaining heart contractility, monitoring fluid balance, and preventing and treating complications. Medical management mainly consists of symptomatic therapy with aspirin, ACE inhibitors, beta-blockers, and diuretics. With supportive care, prognosis is favorable. Clinicians should consider this syndrome in the differential diagnosis of patients presenting with chest pain, especially in post-menopausal women with a recent history of emotional or physical stress. Widespread use of echo cardiography has contributed to more frequent recognition of Takotsubo stress cardiomy-

opathy and highlights the central role of this noninvasive method from an echocardiographers' perspective.

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