

Sudden cardiac arrest in takotsubo cardiomyopathy – a case study

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Abstract

We present a 59-year-old woman who was admitted to hospital after sudden cardiac arrest due to ventricular fibrillation. Finally takotsubo syndrome was diagnosed. In the acute phase of takotsubo syndrome life-threatening ventricular arrhythmias and significant hemodynamic disorders may occur due to strong adrenergic stimulation and myocardial ischemia. It has been proved that the occurrence of torsade de pointes tachycardia in the acute phase of takotsubo cardiomyopathy is associated with QT prolongation. There are no clear guidelines on pharmacological treatment and implantable cardioverter defibrillator implantation after a past takotsubo episode. Takotsubo cardiomyopathy has not been entirely explained as an etiological disease.

Key words: takotsubo cardiomyopathy, sudden cardiac death.

Introduction

ST-elevation myocardial infarction (STEMI) constitutes more than 30% of all cases of acute coronary syndromes [1]. In the pathogenesis of atherosclerotic plaque, thrombus is the dominant cause of myocardial infarction, arising from the damage site, especially a broken plaque, leading to coronary artery closure, blood flow collapse, and, consequently, to myocardial necrosis. Takotsubo syndrome constitutes about 2% of all STEMI cases, with most of them occurring in postmenopausal women, after strong emotional or physical stress [2]. The terminology includes numerous names of this syndrome: takotsubo cardiomyopathy, apical ballooning syndrome, transient left ventricular apical ballooning syndrome, transient catecholamine cardiomyopathy, neurogenic myocardial stunning. There are dynamic ST-T segment changes recorded in the electrocardiogram, like in ischemia, and there are some transient contractility disorders shown in echocardiography. Long-term observation in takotsubo syndrome is unburdened in general, but in the acute phase – due to strong adrenergic stimulation and myocardial ischemia – may lead to life-threatening ventricular arrhythmias and significant hemodynamic disorders.

Case report

A 59-year-old woman was admitted to an intensive cardiac unit (ICU) after sudden cardiac arrest due to ventricular fibrillation, with effective resuscitation having been provided by emergency medical services. Typical chest pain occurred after severe emotional stress caused by a difficult family situation, being the reason for calling the rescue service. Previously, she was treated for diabetes mellitus and chronic obstructive pulmonary disease, with episodes of paroxysmal supraventricular tachycardia also being recorded. At the time of admission to the ICU, the patient was unconscious; the physical examination showed hypotension of 66/40 mm Hg, sinus tachycardia 110 beats per minute, in addition to bronchospastic symptoms having been recorded, with the Glasgow scale assessment of the neurological state scoring 8. She was treated with mechanical ventilation, catecholamines, bronchodilating medicines, antibiotic therapy and functional insulin therapy. Sinus rhythm, supraventricular extrasystoles and changes of T waves were found in the electrocardiogram (Figure 1). Corrected QT interval calculated with Bazett's formula was 550 ms. Dilated apex and mid-ventricular segment akinesis were recorded in echocardiography. Left ventricular ejection fraction was

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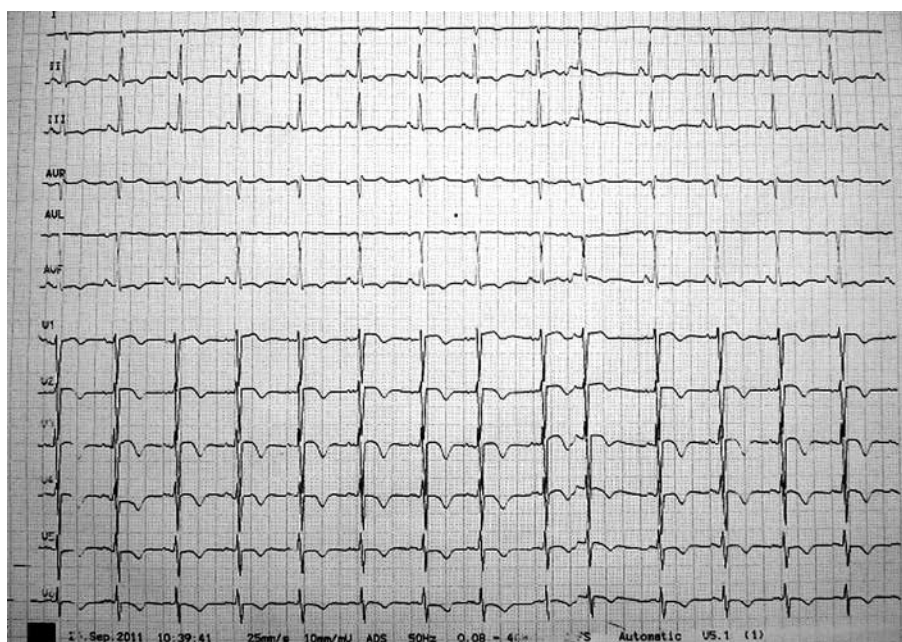


Figure 1. Electrocardiogram. Sinus rhythm 96 per minute. ST segment elevation in leads V1–V3 with positive-negative T waves in these leads. ST suppression up to 1 mm in II, III, aVF with negative T waves in these leads. Negative T waves in leads V4–V6

about 40%. Increase in the concentration of troponin T to a maximum value of 0.21 ng/ml (norm: 0.00–0.03 ng/ml) was recorded in the biochemical examination, with the levels of creatine phosphokinase (CPK), creatine kinase MB (CK-MB) and potassium remaining in normal correct ranges. Computed tomography (CT) excluded bleeding to the central nervous system. Cardiac arrest due to ventricular fibrillation in the course of acute coronary syndrome was diagnosed, and urgent coronary angiography was performed, with no atherosclerotic plaques being found in this examination. Acetylsalicylic acid, clopidogrel, low molecular mass heparin, β -adrenergic antagonist, angiotensin-converting enzyme inhibitor and statin were applied. The patient recovered 14 days after the sudden cardiac arrest, with full respiratory efficiency returning after 21 days of hospitalization. Complete withdrawal of left ventricular contractility disturbances and return of normal systolic left ventricular function were observed in echocardiography. The level of troponin T concentration returned to the normal range. Anginal chest pain did not occur during the remaining time of hospitalization, with the patient's hemodynamic condition being stable. Because of the history of supraventricular tachycardia and having undergone ventricular fibrillation, an electrophysiological study and radiofrequency ablation of focal paroxysmal atrial tachycardia substratum were performed. Ventricular arrhythmia was not released during the programmed ventricle stimulation. The patient was discharged after five weeks' hospitalization to be treated with acetylsalicylic acid 75 mg, clopidogrel 75 mg for 12 months, bisoprolol 5 mg per day, ramipril 2.5 mg per day.

Discussion

Typical features of acute coronary syndrome dominate in the clinical presentation in the initial phase of takotsubo syndrome. The presented patient was admitted to hospital after sudden cardiac arrest with ventricular fibrillation, with ECG showing changes characteristic of myocardial ischemia. The laboratory examination showed a mild increase in the concentration of troponin T, while extensive left ventricle contractility disorders were noted in echocardiography, disproportionately extensive in relation to the slight growth in myocardial necrosis markers. Angiography examination, however, showed no coronary artery stenosis. The described case of acute coronary syndrome met the Mayo Clinic criteria of takotsubo syndrome. The Mayo Clinic criteria for takotsubo are as follows: transient akinesis or dyskinesis of the left ventricular apical and mid-ventricular segments with regional wall-motion abnormalities extending beyond a single epicardial vascular distribution, absence of an obstructive coronary disease or angiographic evidence of acute plaque rupture, new ECG abnormalities: ST-segment elevation or T-wave inversion, absence of recent significant head trauma, intracranial bleeding, pheochromocytoma, hypertrophic cardiomyopathy and myocarditis [2]. In the Polish literature, a large cohort of takotsubo cardiomyopathy (31 patients) was published by Opolski *et al.*, with women constituting almost 93.5% of patients in the cited study [3]. Takotsubo syndrome etiology remains unclear as yet. Reasons for the disorders have been observed during transient simultaneous

spasms of all coronary arteries or microvascular dysfunction as a consequence of the overflow effect of catecholamines [4–7]. Some attempts were made at correlating the specific course of the left anterior descending artery (LAD) along the apical diaphragmatic surface of the left ventricle [8].

Sudden cardiac arrest was the first manifestation of takotsubo cardiomyopathy in the presented woman. Associated with catecholaminemia, emotional stress was a triggering factor of the disease. Intensified activation of the sympathetic nervous system leads to increased myocardial cell automatism and intensification of the intracellular calcium cations flow [9]. The increased intracellular calcium level may mediate cardiac arrhythmias [10]. Most takotsubo patients recover in a few days or weeks. In general, the long-term prognosis is good. However, the acute stage of the disease, when strong adrenergic stimulation is activated and myocardial ischemia has arisen, may lead to life-threatening ventricular arrhythmias and critical hemodynamic disorders. The in-hospital average mortality rate from takotsubo cardiomyopathy is 2.5%, being associated with complications such as cardiogenic shock, ventricular arrhythmias (for example torsade de pointes (TdP), ventricular fibrillation), left ventricle rupture, thrombotic and embolic events caused by left ventricle parietal clot, or multiorgan insufficiency [11].

Sudden cardiac death may be the first manifestation of takotsubo cardiomyopathy [12]. Syed *et al.* on the basis of current medical literature, estimated the frequencies of occurrence of different arrhythmias in takotsubo cardiomyopathy as follows: a prevalence of 2.2% of ventricular fibrillation, 1.2% of sustained ventricular tachycardia, 1% of non-sustained ventricular tachycardia, 0.5% of asystole, 2.9% of atrioventricular block, 1.3% of sinus node dysfunction, 4.7% of atrial fibrillation, and 1.1% of sudden cardiac death. These authors also reported that ventricular arrhythmias inducing out-hospital sudden cardiac arrest occurred in 1.1% of takotsubo cases [11]. Ventricular fibrillation (3.2%) and sustained ventricular tachycardia (6.4%) were observed as the most severe forms of arrhythmia in Opolski's study [3]. Moreover, the group with malignant arrhythmia showed significantly wider variation in R-R intervals (maximum R-R interval – minimum R-R interval) in the first 24 h of admission to the hospital [13]. What has also been recorded is an increase in the dispersion of QT, i.e. the difference between the maximum and the minimum QT intervals in a 12-lead ECG, which beside QT and QTc prolongation has been identified as an independent risk factor for sudden death [14–16]. It has been proved that the occurrence of TdP tachycardia in the acute phase of takotsubo cardiomyopathy is associated with QT prolongation, and a cut-off of QTc > 500 ms has a sensitivity of 82% and a specificity of 85% [17]. Additionally, patients with takotsubo cardiomyopathy and TdP had known risk factors for TdP, including

bradycardia, hypokalemia, recent conversion from atrial fibrillation to sinus rhythm, use of QT prolonging drugs, and congenital long QT syndrome [18]. It is believed that takotsubo cardiomyopathy is one of the causes of the acquired long QT syndrome and can be a trigger to be able to make overt silent or inapparent congenital long QT syndrome; therefore, all factors that can exacerbate the QT prolongation, i.e. electrolyte imbalances (hypokalemia, hypomagnesemia, hypocalcemia) and use of drugs that would prolong the QT interval, must be removed to prevent an onset of arrhythmia [19]. An implantable cardioverter defibrillator (ICD) implantation should be considered after an episode of sudden cardiac arrest due to ventricular fibrillation in case of takotsubo cardiomyopathy.

Following the recommendations for secondary prevention of sudden cardiac death, implantation of ICD is indicated after an episode of sudden cardiac arrest from ventricular fibrillation, if factors responsible for ventricular fibrillation (VF) are potentially not removable. The VF or sustained VT episodes which occur within 48 h of myocardial ischemia, considering the reversible cause, are not predictors of other incidents and they are not indications for ICD implantation [20]. A positive result of the programmed ventricular stimulation during an electrophysiology study has been recommended for qualification for ICD implantation. In the presented patient, because of endured sudden cardiac arrest and history of supraventricular arrhythmias, an electrophysiological study was performed and ventricular arrhythmia was not provoked. Some authors suggest that patients with takotsubo cardiomyopathy with risk factors for long QT syndrome, such as QTc > 500 ms, prior syncope, and previous cardiac arrest, may be considered for implantation of an ICD. However, there is no reference in current recommendations to treat patients using electrotherapy. Use of a wearable cardioverter-defibrillator in the acute phase of takotsubo cardiomyopathy, while the left ventricular ejection fraction is under 35%, is one therapeutic option [21].

Prevention of the recurrence of takotsubo cardiomyopathy is discussed in the literature widely. The predominant role of β -adrenergic drugs is suggested in the treatment of takotsubo disease to suppress harmful effects of the overflow of catecholamines, but reduced recurrence of the disease was not observed. Experimental studies carried out on animals have shown that β -blockers prevent the recurrence of takotsubo cardiomyopathy and play a protective role in dobutamine-induced stress situation. However, the usage of β -blockade did not fully prevent the recurrence of apical ballooning syndrome, and also all-cause mortality was higher than in the age – and sex-matched general population [22].

There is no clear guidance on pharmacological treatment after a past takotsubo episode in humans. There

is a discrepancy as to the use of β -blockers and double antiplatelet therapy. Fazio *et al.* revealed the limited usefulness of long-term treatment with β -blockers [23]. Because of lack of atherosclerotic plaques in coronary angiography, double antiplatelet therapy (acetylsalicylic acid and thienopyridines) for a period of 12 months may be questionable. The assumption is that takotsubo syndrome is an early abortive stage of ST elevation myocardial infarction with spontaneous reperfusion [24]. Different forms of instable atherosclerotic plaques have been shown in intracoronary ultrasonography with the virtual histology option, and erosive plaques constitute 50% of all cases [25]. In this situation the use of double antiplatelet therapy together with statin could be justifiable.

Conclusions

Takotsubo cardiomyopathy has not been entirely explained as an etiological disease. As a result, the treatment of this disease is not specific. Even though there is an increasing number of new observations of the course of the disease and more invasive procedures have been performed, there are no homogeneous recommendations of pharmacological treatment and prevention of subsequent episodes of takotsubo cardiomyopathy and arrhythmic events.

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