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Case Report

Successful rescue of one patient with acute myocardial infarction-like takotsubo cardiomyopathy accompanied by cardiogenic shock

Yanjun Cao*, Lianlian Mei*, Hongyu Zhang, Baohua Qiu, Zhiguo Wu, Yanchun Liao

*Department of Cardiology, Tianjin Baodi Hospital, Baodi Clinical College of Tianjin Medical University, Tianjin, China. *Equal contributors.*

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Abstract: In this study, we report on one 55-year-old male patient that was initially diagnosed with acute myocardial infarction (AMI). Percutaneous coronary intervention (PCI) was performed but coronary angiography revealed a normal coronary artery. Thus, we were alerted that this patient might suffer from takotsubo cardiomyopathy. Further disease history questioning revealed that this patient had obvious psychological and physical stress attached before onset, therefore, we immediately performed left ventricular imaging and echocardiography (ECG), confirming takotsubo cardiomyopathy. After giving β-blockers, angiotensin converting enzyme inhibitor (ACEI), diuretics, and anticoagulant drugs, the patient's disease condition worsened and progressed to cardiogenic shock. The on-duty doctor wrongly applied dopamine, progressively aggravating cardiogenic shock. After withdrawing from dopamine, an intra-aortic balloon pump (IABP) was applied and the amount of β-blockers was increased, gradually correcting cardiogenic shock. The patient improved and was discharged after a 21-day hospitalization. Our 10-month follow up showed that the patient had completely returned to normal.

Keywords: Takotsubo cardiomyopathy, stress cardiomyopathy, acute myocardial infarction, diagnosis, treatment, prognosis

Introduction

Takotsubo cardiomyopathy, also known as left ventricular apical ballooning syndrome, broken heart syndrome, and stress or ampulla cardiomyopathy, is acute but reversible left ventricular dysfunction triggered by acute emotional or physical stress in the absence of significant coronary artery disease [1, 2]. Since its first description in Japan by Sato et al. in 1990 [3], Takotsubo cardiomyopathy has increasingly been recognized and has gained broad attention [4]. In 2006, the new definition and classification of cardiomyopathy, by the American Heart Association (AHA), classified it as primary acquired cardiomyopathy [5]. In 2008, the European Society of Cardiology (ESC) classified it as undetermined cardiomyopathy [6]. However, after 27 years of extensive efforts toward a better understanding of this disorder, currently, it is not rare but its pathogenesis is not yet clear. Its diagnostic criteria and treatment methods also need to be further studied and improved [7-9]. Moreover, the majority of takotsubo cardiomyopathy patients have clinical presentations similar to that of acute coronary syndrome (ACS) in symptoms, signs, electrocardiographic findings, and changes of cardiac biomarkers [1, 2] and are expected to account for 1-2% of all cases of suspected AMI [10, 11]. Therefore, it is often misdiagnosed as AMI and applied incorrect or even harmful treatment programs, causing serious clinical consequences [1, 9]. The patient reported in this study was initially misdiagnosed as acute myocardial infarction and was only aware of the possibility of takotsubo cardiomyopathy when coronary angiography showed normal results. Furthermore, this patient was mistakenly applied dopamine when cardiogenic shock occurred, worsening his condition. This case should remind clinicians that each case diagnosed with ACS, especially AMI, should be considered for the possibility of takotsubo cardiomyopathy. A de-

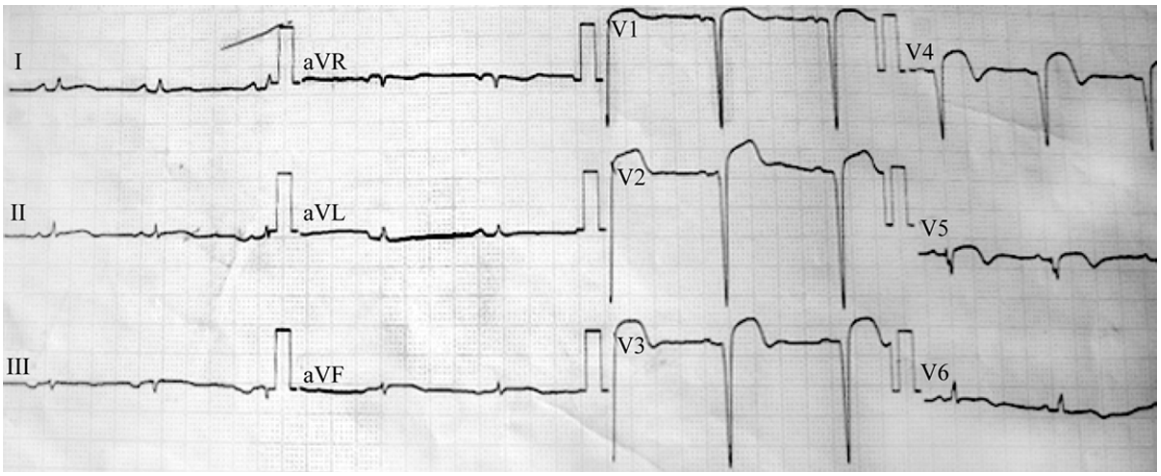

Figure 1. ECG at early onset: sinus rhythm, V1~V5 show QS wave, arch of ST segment increase by 0.1~0.5 mv.

tailed history of the disease should be collected along with necessary auxiliary examinations, standard diagnosis, and treatment.

Case report

The 55-year-old male patient was admitted mainly due to "intermittent precordial pain for 7 hours which was aggravated and combined with sweating for 3 hours". The patient felt sudden precordial pain, 7 hours before admission, which radioactively expanded toward the left shoulder and back, lasting for about 10 minutes. The symptoms automatically remitted after rest. Symptoms with the same characteristics reoccurred 3 hours before admission but persisted severely, along with sweating and a sense of dying. Therefore, the patient was sent to our hospital. This study was conducted in accordance with the Declaration of Helsinki and with approval from the Ethics Committee of Tianjin Medical University. Written informed consent was obtained from each participant.

Disease history retrospection

One week before onset, the patient (wheat harvester) went out to work day and night (harvesting wheat during daytime and rushing to another location during nighttime). On the fourth night of travel, he was met by robbers and escaped but remained scared and panicked for the next three days. Furthermore, being in charge of cash, he kept smoking and dared not sleep due to continuous precaution. After having experienced continuous mental stress and physical exertion for seven days, he finally returned home and disease onset began.

Previous history

The patient had been normally healthy without hypertension, hyperlipemia, or diabetes but with a history of smoking for 30 years, 20 cigarettes per day.

Physical examination on admission showed blood pressure (BP) 110/78 mmHg, facial appearance of acute illness, no jugular engorgement, clear lung breathing sounds, and no dry and wet rales; non-expanded heart boundary, heart rate 70 times/min, regular rhythm, low and blunt heart beating sounds, and no noise in valve areas; no pericardial friction sound and no edema in both lower extremities. On admission, echocardiography (ECG) revealed sinus rhythm, low voltage, V1~V5 appearing with QS wave type, and ST V1~V5 arch elevated by 0.1~0.5 mv (**Figure 1**). Myocardial enzymes were creatine kinase 7468 U/L (24-195 U/L), creatine kinase isoenzyme 639.5 U/L (0-25 U/L), and troponin I 10.8 ng/mL (0-0.1 ng/mL). Post-admission diagnosis was coronary atherosclerotic heart disease, acute extensive anterior myocardial infarction, and cardiac function Grade I (Killip).

Diagnosis and treatment

After admission, primary percutaneous coronary intervention (PCI) was performed and results of coronary angiography showed that left and right coronary arteries were normal (**Figure 2A** and **2B**). Therefore, we performed left ventricular angiography showing that the cardiac apex appeared to have spherical changes. Motions at the front lateral wall, diaphragm,

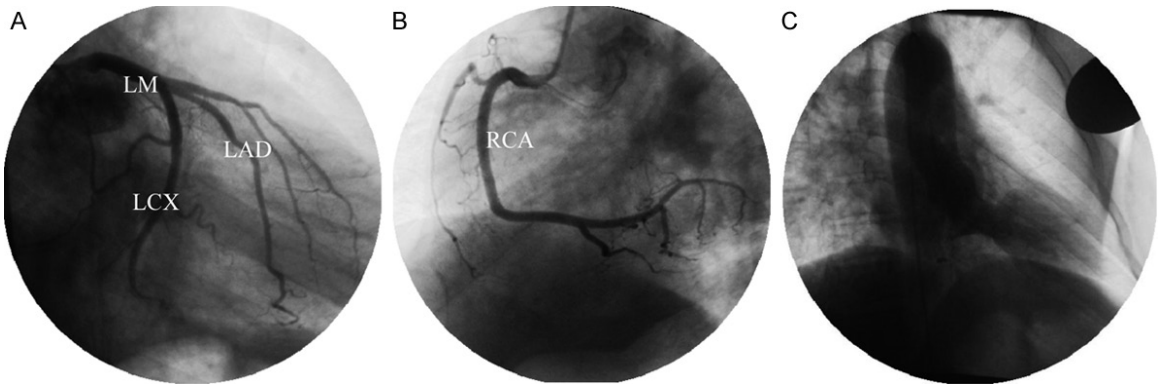

Figure 2. A, B: Emergency coronary angiography: left and right coronary arteries are both normal; C: Left ventricular angiography: in the systolic period, apex appears spherical changes (the motions at the anterior lateral wall, diaphragm, and apex disappear; however, motions at the left ventricular basal segment are significantly enhanced and constitute stenosis at the "left ventricular outflow").

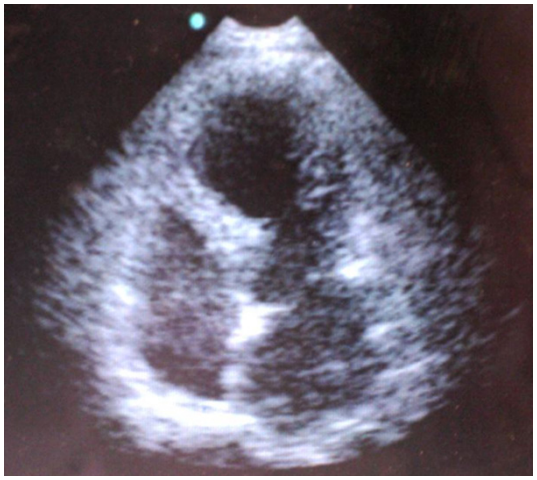

Figure 3. Echocardiography at early onset: in the apical four-chamber view, left ventricle exhibited one "gourd"-like shape in the systolic stage, namely the apex appeared spherical changes; the motions at the anterior lateral wall, diaphragm, and apex disappear; however, motions at the left ventricular basal segment are significantly enhanced.

and cardiac apex also disappeared. However, motions at left ventricular basal segment exhibited sharp contrast, namely significantly enhanced motions resulting in stenosis at the "left ventricular outflow tract" (**Figure 2C**). The patient was then considered a stress cardiomyopathy case and was inspected by bedside echocardiography: in the apical four-chamber view, left ventricle exhibited one "gourd"-like shape in the systolic stage, namely the apex appeared to have spherical changes and motions at its front lateral wall, diaphragm, and cardiac apex disappeared. On the contrary, sternal long-axis view revealed that the basal segment exhibited significantly increased movement, resulting in stenosis at the left ventricular outflow tract. The rate of short-axis shortening (FS) obtained from cardiac apex and bottom on this view differed greatly (6.97% and 37.50%, respectively; **Figure 3**). The patient's disease history also supported a diagnosis of takotsubo cardiomyopathy. After admission, the patient was administrated β-blockers, angiotensin converting enzyme inhibitor (ACEI), diuretics, and anticoagulant drugs. On the third day of hospitalization, his blood pressure dropped (80/50 mmHg) and ineffective volume expansion therapy was ineffective. ACEI was then withdrawn and dopamine was intravenously dripped. Then, palpitations occurred, progressive decrease of blood pressure (70/40 mmHg), cold limbs, and heart rate increased (105~130 beats/min), showing characteristics of cardiogenic shock. Immediate bedside echocardiography revealed that apical FS decreased to -3.92%, suggesting local contradictory motions in the systolic period. Contraction at the basal segment became stronger and FS reached 40%. The patient was then withdrawn dopamine, intra-aortic balloon pump (IABP) was performed, and we increased metoprolol to 25 mg bid. On the 4th day, blood pressure began to gradually decrease. On the 9th day, his extremities became warmer, together with normal urine output. Blood pressure remained at 110/60 mmHg with stable conditions. Bedside echocardiography revealed motions at left ventricular wall recovered and those at ventricular septum recovered partially, thus, IABP was

removed. On the 21st day, bedside echocardiography revealed apical FS rose to 17.30% while basal FS decreased to 32.60%. On the 23rd day, the patient was discharged due to stable conditions.

After discharge, our 10-month follow up revealed that the patient had resumed normal daily activities. Sinus rhythm in ECG, appearing old anterior partition MI images (QSV1-V3 and TV1-V3 exhibited mild inversion); echocardiography showed apical and basal FS were restored to 19.49% and 31.10%, respectively.

Discussion

Takotsubo cardiomyopathy was first reported by Japanese scholars in 1990 and characterized by transient left ventricular dyssynchrony. Its typical performances are low apical position/weak apex and spherical expansion. However, the cardiac bottom exhibits high power, causing stenosis at left ventricular outflow tract. In left ventricular angiography, the systolic heart appears as the shape of a Japanese octopus-catching basket, namely takotsubo [3]. It's often induced by severe physical or emotional stress and clinical presentation may include symptoms of acute coronary syndrome, ECG abnormalities, and myocardial enzyme increase [1, 9, 12]. Although 90% of patients with takotsubo cardiomyopathy are female (80% are postmenopausal women), it also occurs in males [12]. Of all hospitalized patients with clinically suspicious acute coronary syndrome, 2% are takotsubo cardiomyopathy [13].

The pathogenesis of tako-tsubo cardiomyopathy is not clear yet but it is currently recognized as toxic effect of super-physiological dose of catecholamines on the heart, secreted by stress-induced sympathetic hyperthyroidism. Studies have found that adrenaline-b2AR-Gi signaling pathway can block toxic effects of catecholamines on the heart [14]. Before onset, such patients have existence of clear psychological or physical stress. Obviously, our case was caused by acute severe psychological stress and fatigue: 7 days and nights of continuous labor, 10 km escape from armed robbers, along with intense fright. These are typical triggering factors of takotsubo cardiomyopathy. From this case, it can be seen that catecholamines play an important role in the pathogenesis of this disease. This is confirmed by aggravation of the condition and apical contractive motions by the addition of dopamine on the third day, as well as by condition remission after withdrawal of drugs and β-blockers.

As for the appearance of specific apical low/no motion or even spherical changes while the basal segment is not involved, appearing high-motion status even as left ventricular outflow tract stenosis, and whether it's caused by different response of different-level coronary arteries or different distribution of myocardial β-receptor densities, the controversy remains and needs further study [15].

Currently, takotsubo cardiomyopathy does not have uniform diagnostic criteria. In 2007, Prasad proposed four diagnostic annotations (one of which was further modified in 2008) and pointed out that meeting the following criteria can diagnose this disease [1]: (1) Transient left ventricular apical motion weakening or disappearing and involved scope is inconsistent with the blood supply area of single coronary artery; there are stress triggering factors in most cases; (2) Coronary angiography can exclude stenotic lesions and acute plaque rapture; (3) With newly appeared ECG abnormalities (ST-segment election or T-wave abnormality); (4) Excluding the following conditions: recent severe craniocerebral trauma, intracranial hemorrhage, pheochromocytoma, myocarditis, hypertrophic cardiomyopathy, etc. According to the above diagnostic criteria, our case can clearly be diagnosed as takotsubo cardiomyopathy. Usually, an increase of myocardial injury markers in takotsubo cardiomyopathy is slight, which doesn't match a large area of left ventricular dysfunction. Furthermore, the peaks are low and early and lack the characteristic curve changes of AMI [16]. However, myocardial injury markers increased significantly (creatine kinase 7468 U/L, creatine kinase isoenzyme 639.5 U/L, and troponin I 10.8 ng/mL) in our case and it was considered as the patient had acute severe psychological stress, fatigue, and a lot of smoking. Catecholamines were secreted in a large dose and toxic effects on the heart increased.

Takotsubo cardiomyopathy has no standardized therapeutic method, currently. Asymptomatic patients need no special treatment but patients with significant symptoms can be applied symptomatic and supportive treatment.

Due to the fact that high catecholamine stimulation and catecholamine toxicity may be important reasons for occurrence of this disease, early and long-term use of β-blockers should be proposed [17]. Patients with significant hemodynamic disorders such as cardiogenic shock can be treated with IABP and diuretics and ACEI/ARB can be used for heart failure. If necessary, inotropic drugs can be used while only phosphoric acid, a diesterase inhibitor, or levosimendan can be used [18], but b receptor agonists are prohibited. In this case, when cardiogenic shock occurred, dopamine was wrongly applied. His disease deteriorated, so he was timely withdrawn dopamine along with IABP and increasing β-blockers. Afterward, his condition greatly improved.

Normally, patients with takotsubo cardiomyopathy have good prognosis [19], and ventricular motion abnormalities in most patients can restore within a few days to several weeks. Few cases sustain for more than 3 months. Treatment and follow up of our case confirms that this disease is reversible to some extent. Although it may be serious enough to cause AMI, even cardiogenic shock, it's not coronary atherosclerosis. Appropriate treatment may result in good short-term prognosis, consistent with the literature [20].

Echocardiographic parameters are simple, fast, and effective methods for predicting severity of takotsubo cardiomyopathy [21]. Apical systolic function, in our case, gradually increased over time and FS values from the apex and bottom increased from 6.97% (the first day) to 17.30% (21st day), as well as to 19.49% in 10-month follow up. This demonstrates a significant recovery trend of low motion status in the left ventricular apex; the left ventricular basal FS value decreased from 37.50% (1st day) to 32.60% (21st day) and to 31.10% in 10-month follow up. This shows the weakening of high motion compensatory status and suggests that these two factors are reversible. Another prominent change is that apical FS on the 3rd day appeared negative, that is, contradictory motion occurred, at which time clinical application of dopamine coincides with the moment of emergence of cardiogenic shock. It is not difficult to see that echocardiography is of great value in observing and following up changes of cardiac structure and function in such patients. In order to reveal totally opposite segmental motion abnormalities in two sites of this disease, we first designed two FS parameters to measure systolic status of the apex and bottom. This plays a quantified auxiliary role in revealing pathological features and observing evolution of this disease.

Our reported case should remind clinicians that with rapid development of societies, increased living pressure and increased conflict may elevate incidence of takotsubo cardiomyopathy. Also, this case should remind clinicians that each case diagnosed with acute coronary syndrome, especially AMI, should be considered for the possibility of takotsubo cardiomyopathy. A detailed history of the disease should be collected along with necessary auxiliary examinations, standard diagnosis, and treatment.

Disclosure of conflict of interest

None.

Address correspondence to: Hongyu Zhang, Department of Cardiology, Tianjin Baodi Hospital, Baodi Clinical College of Tianjin Medical University, Tianjin 301800, China. Tel: +86 22 29262095; Fax: +86 22 29241700; E-mail: dochongyuzhang@163.com

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