Description of a Patient Suspected of Myocardial Infarction With Normal Coronary Artery: A Case Report of Takotsubo Cardiomyopathy

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Abstract- Takotsubo cardiomyopathy (TC) is characterized by transient systolic dysfunction, presenting with electrocardiographic (ECG) changes and mimicking acute coronary syndrome (ACS). Studies have shown that 95% of patients have changes in ECG. ECG changes in TC syndrome may be similar to myocardial infarction (MI). ECG changes can be seen in the form of ST-segment elevation or deep T-wave inversion. TC can be considered a special form of ACS. TC is not a benign entity, and conduction abnormalities can occur. The acute phase can be predicted based on decreased EF and arrhythmia. Different treatments are used in the acute phase of TC, depending on the hemodynamic condition. Our case elucidates the importance of age, female gender, symptoms, such as stress and emotion, clinical manifestations, ECG characteristics, and echocardiography in TC. This paper describes a case of TC from a hospital affiliated to Rafsanjan University of Medical Sciences. The case was a 75-year-old woman with no history of cardiovascular diseases who has been admitted to the hospital with myocardial infarction.

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Keywords: Takotsubo cardiomyopathy; Acute coronary syndrome; Myocardial infarction

Introduction

TC, also known as stress cardiomyopathy or broken heart syndrome, is an acute, reversible condition that involves dramatic left ventricular apical akinesis and mimics ACS (1). TC is not consonant with the coronary artery supply region and show no identifiable coronary artery lesions in coronary angiography. TC is generally thought to have a good prognosis; however, some studies have reported the prevalence of life-threatening arrhythmias to be 13.5%, with a mortality rate of 44% (1). TC, with a prevalence of 2-3%, is one of the most serious diseases that must be distinguished from ACS (2). This report describes a 75-year-old woman with TC triggered by emotional stress. The insights from this study can help us correctly diagnose patients suffering from this disorder and be familiar with its clinical characteristics.

Case Report

A 75-year-old woman (height: 165 cm, weight: 75 kg, and BMI: 27.5) was brought to our hospital with a history of chest pain, headache, nausea, vomiting, and hypertension lasting for 1 hour. She had hypertension with no history of cardiovascular diseases. She had been under emotional stress for 1 month. At presentation, pulse rate was 98 beats/min, blood pressure (BP) was 240/110 mm Hg, body temperature (BT) was 36.3° C, and respiratory rate (RR) was 20 breaths/min. The baseline ECG showed sinus rhythm with ST elevation in leads DI, DII, aVL, V2-V6, and ST depression in DIII, suggesting an acute anterolateral MI (Figure 1). She received aspirin 325 mg, clopidogrel 600 mg, atorvastatin 80 mg, and heparin 5000 µ. She was immediately transferred to cardiac cath for primary percutaneous coronary

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intervention (PCI). Coronary angiography was normal, with no signs of a culprit lesion (Figure 2A and B). Echocardiography showed apical akinesia with an ejection fraction of 40% (Figure 3A and B). Serial cardiac enzyme measurements exhibited a high level of troponin T after 12 hours. Serial ECG showed T-wave inversion in leads DI, DII, aVL, and V1-V6 after 48 hours. TC was diagnosed for the patient due to: 1) ECG changes in the form of ST-segment elevation in anterolateral leads that was normalized 3 weeks later (transient reversible ECG abnormality), 2) LV (Left ventricle) transient regional wall motion abnormality (apical ballooning), 3) absence of culprit atherosclerotic LAD lesion (the left coronary artery), and 4) increased cardiac troponin. The patient was then treated with captopril 25 mg tablets twice daily, carvedilol 12.5 mg tablets twice daily (bid), ASA 80 mg tablets daily, and atorvastatin 40 mg tablets daily for 48 hours in the hospital after controlling hypertension. The patient was discharged with the same prescription. The patient underwent echocardiography 3-4 weeks later, and ECG was taken again. Echocardiography showed normal left ventricular wall function 3-4 weeks after the discharge with ejection fraction (EF) of 55% and partially reverted ECG. The results of the laboratory tests and echocardiography are presented in Table 1. The patient was followed up for three months, and her EF and ECG were normal after 3 months.

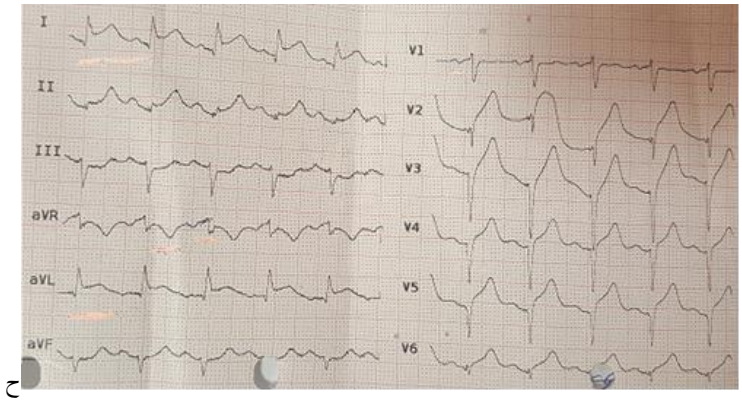

Figure 1. The ECG showed sinus rhythm with ST elevation in leads DI, DII, aVL, V2 through V6 and ST depression in DIII

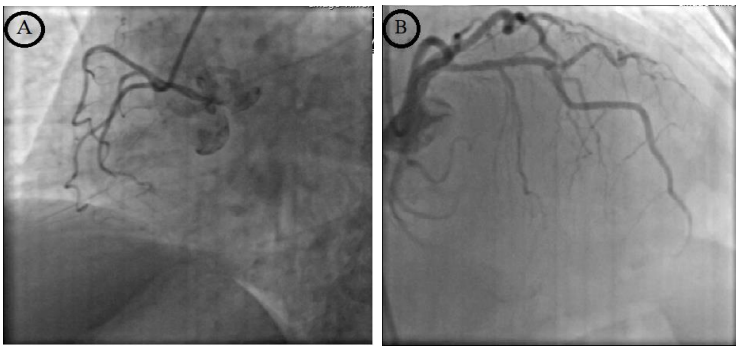

Figure 2. Coronary angiogram showed non-obstructive coronary artery disease in right (A) and left coronary (B) artery territories

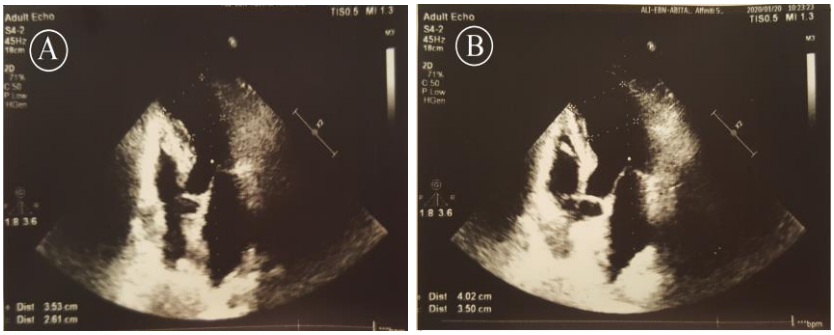

Figure 3. Echocardiogram showing ventricle at the end of systole (A) and at the end of diastole (B)

Table 1. The laboratory and echocardiographic findings of the patient

Variable			Normal reference range
Hematology test	WBC	12.300	4000-10000 *1000/cumm
	RBC	5.67	3.9-5.6 mil/cumm
	Hemoglobin	15.9	12-16 g/dl
	Hematocrit (HCT)	47.6	36-46 %
	MCV	84.0	76-96 FL
	MCH	28.0	26-34 Pg
	MCHC	33.4	32-37 g/dl
	PLAT	261	150-450 *1000/cumm
	NA	138	135-145 meq/l
	K	5.0	3.8-5 meq/l
	BUN	33.0	17-43 mg/dl
	CR	1.0	0.7-1.4 mg/dl
	BS	149.0	<180 mg/dl
	Triglyceride	110.0	10-190
	Cholesterol	221.0	150-250
	LDL- Cholesterol	168.0	Up to 150
	HDL- Cholesterol	31.0	29-80
	SGOT	61.0	Up to 31
	SGPT	17.0	Up to 31
	ALKP	230.0	64-306
	CPK	174	24-170
	Troponin (Baseline)	negative	<0.5 ng/ml
	Troponin (12 hours later)	positive	<0.5 ng/ml
	Troponin (24 hours later)	positive	<0.5 ng/ml
Echocardiogram	END-systole mid (Left ventricle)	2.61	2.3-3.4 cm
	END-systole apex (Left ventricle)	3.53	2.3-3.4 cm
	END-diastole mid (Left ventricle)	3.50	3.5-5.4 cm
	END-diastole apex (Left ventricle)	4.02	3.5-5.4 cm
	Left atrium	3.5	1.9-3.9 cm
	Aortic root	2.6	2.0-3.7 cm
	END- diastole (Right ventricle)	2.1	0.9-2.6 cm
	LV. septum diastole (Thickness)	0.9	0.6-1.1 cm
	LV. post wall diastole (Thickness)	0.9	0.6-1.1 cm
	EF (Ejection fraction)	40	55-70

Discussion

In the past decade, international research institutions have focused on TC to address the unresolved questions and complexities (3). Few studies have reported this syndrome in Iran. Concerning genetic differences, we present clinical symptoms and the course of TC in an Iranian female patient. Patients with TC have common features that must be identified and examined. Ninety percent of these patients are female, and most of them are over 50 years.

Several types of TC have been reported: 1) Apical TC, the most frequently classical type of TC is LV apical ballooning, which is characterized by midventricular and apical stunning and is accompanied by basal hypercontraction. 2) Apical TC with "nipple sign", in which a tiny apical portion of the LV is hypercontractile in apical TC. 3) Midventricular TC, which is characterized by midventricular stunning with basal and apical hypercontraction. 4) Basal TC, which is a counterpart of the apical type, with basal stunning, midventricular, and apical hypercontraction. 5) Focal TC, which occurs with focal stunning, most frequently in anterolateral or posterolateral segments (4).

ECG changes can be seen in the form of ST-segment elevation or deep T-wave inversion (5). In addition to ST-

segment elevation, other symptoms include chest pain, pulmonary edema, and hypotension. However, the most common presentation is ST-segment elevation. In TC syndrome, ST-segment elevation is usually less pronounced compared to ST-elevation myocardial infarction (STEMI). There are no reciprocal ST-segment changes and abnormal Q waves in TC, but QT prolongation has been reported (6). Namgung showed that two common ECG findings were ST-segment elevation and T-wave inversion, which continued for several months. QT prolongation was observed in 97% of the patients. These findings were similar to the observations made in the present study (7) that indicated the LV function was recovered after three weeks. Left ventricular dysfunction usually lasts for several days or weeks (6). The acute phase can be predicted based on EF reduction, the incidence of arrhythmia, and the rate of left ventricular outflow tract (LVOT) obstruction.

TC should be considered as acute heart failure syndrome. Templin *et al*., showed that TC is an acute heart failure syndrome associated with a significant risk for complications (8). Nearly one-fifth of all patients with TC in Templin *et al.*,'s study experienced serious complications in the hospital. Left ventricular systolic function was somewhat reduced in patients with TC compared to patients with ACS, and the acute phase of TC varies from low to very high risk (8). This finding indicates the risk of complications in the acute phase of TC that were previously underestimated and highlights the need for further TC monitoring and management. Due to the relatively rapid improvement in the left ventricular function in some TC patients, this disease has been considered a global benign disease.

In the current study, the presence of clear and acute changes in the ECG, along with the severity of symptoms, led to the diagnosis of MI in the patient who underwent emergency catheterization. Studies have shown that 95% of patients have changes in ECG. ECG changes in TC syndrome may be similar to MI. However, ECG criteria alone are not sufficient to diagnose STEMI. The development QTc (Corrected QT Interval) prolongation in the patient can cause torsades de pointes, ventricular fibrillation, and even death (9,10). Physicians should look for clinical symptoms and findings, especially in postmenopausal women with a recent history of acute stress to discriminate between TC and ACS (11).

Reviews have identified and updated new criteria for TC. Seven new criteria have been proposed for TC diagnosis: 1) Transient regional wall motion abnormalities of LV or RV myocardium, 2) The regional wall motion abnormalities that often result in circumferential dysfunction of the ventricular segments, 3) The absence of culprit atherosclerotic coronary artery disease, 4) New and reversible ECG abnormalities, 5) Significantly elevated serum natriuretic peptide during the acute phase, 6) Positive small elevation in cardiac troponin, and 7) The recovery of ventricular systolic function at a 3-6-month follow-up (5).

In the present study, stress was the main cause of TC. Some physical stressors, such as myocarditis, can trigger TC (12). Some therapeutic procedures, such as stressful surgical procedures, can also induce TC. Pergolini *et al*., reported 8 cases of TC which occurred after mitral valve replacement (MVR) (13). Psycho-physical stress is always present in surgeries, especially in emergencies, and can be one of the triggers (14). However, the exact mechanism of stress is not well understood. It is not clear why a particularly stressful event causes TC at one time, while sometimes it does not do so under the same condition (15).

In some reports, stressful events have not always been evident (16). Positive emotions and positive life events have also been implicated in the occurrence of TC (17). However, studies suggested stress and emotion as powerful factors affecting TC as they are assumed to be triggered by sympathetic stimuli, which in turn trigger TC. Some studies have suggested sympathetic overactivity as the pathogenesis of TC. Exposure to catecholamine and beta-receptor agonists can accelerate all TC features, including reversible cardiac dysfunction and cardiac isoenzyme elevation (18). High levels of catecholamines lead to direct toxic effects on cardiomyocytes because of the high density of sympathetic receptors in the LV (18).

No specific treatment has been recommended for TC and LV dysfunction because heart function will usually become normal within a few weeks. Standard medical care is mostly provided in a supportive manner, depending on the patients' heart condition (19).

TC recurs in 10% of the patients. However, the mortality rate of this disease in the acute phase is 4-5%. Although the prognosis of patients with TC is generally good, clinical symptoms must be considered to manage these patients. Patients with persistent ST-segment elevation (PSTE) were admitted with elevated troponin levels and longer hospital stays. So far, no treatment has been helpful for TC. Beta-blockers or magnesium can prevent arrhythmias related to QT prolongation (6).

A different treatment is used in the acute phase, depending on the hemodynamic condition. Excessive sympathetic activation should be prevented in stable conditions by combining alpha and beta-blockade.

Dynamic left ventricular obstruction is treated by beta-blockers. In addition, phenylephrine can be taken by patients with obstruction and severe hypotension. The use of a balloon pump inside the aorta should be considered for patients with unstable hemodynamic status. It is necessary to conduct randomized clinical trials on treatment strategies because it is not clear how to manage chronic TC (20).

Our study highlights the role of stress, adulthood, and gender and confirms the results of previous studies. Considering the variety of clinical symptoms and lack of evidence for TC, further studies and reviews are suggested.

TC is a rare type of cardiomyopathy, and many factors may affect it. The role of stress, emotions, old age, and female gender are highlighted. The syndrome may manifest by clinical manifestations, ECG features, and diverse echocardiography, which must be differentiated from ACS. Therefore, further studies may help us understand this rare syndrome.

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References

1. Stiermaier T, Eitel C, Denef S, Desch S, Schuler G, Thiele H, et al. Prevalence and clinical significance of life-threatening arrhythmias in Takotsubo cardiomyopathy. J Am Coll Cardiol 2015;65:2148-50.
2. Kato K, Lyon AR, Ghadri JR, Templin C. Takotsubo syndrome: aetiology, presentation and treatment. Heart 2017;103:1461-9.
3. Bayon J, Santás-Älvarez M, Ocaranza-Sánchez R, González-Juanatey C. Assessment with intracoronary pressure and flow guidewire, at baseline and after intracoronary adenosine infusion, in a patient with Takotsubo syndrome. Rev Port Cardiol (Engl Ed) 2019;38:829.e1-829.e3.
4. Bridgman PG, Chan CW. The fifth takotsubo variant. Echocardiography 2017;34:122-3.
5. Lyon AR, Bossone E, Schneider B, Sechtem U, Citro R, Underwood SR, et al. Current state of knowledge on Takotsubo syndrome: a Position Statement from the Taskforce on Takotsubo Syndrome of the Heart Failure Association of the European Society of Cardiology. Eur J Heart Fail 2016;18:8-27.
6. Indolfi C, Spaccarotella C, Yasuda M, De Rosa S. The outlook of prognostic indicators for the Takotsubo syndrome. Int J Cardiol 2018;255:158-9.
7. Namgung J. Electrocardiographic findings in takotsubo cardiomyopathy: ECG evolution and its difference from the ECG of acute coronary syndrome. Clin Med Insights Cardiol 2014;8:29-34.
8. Templin C, Ghadri JR, Diekmann J, Napp LC, Bataiosu DR, Jaguszewski M, et al. Clinical features and outcomes of Takotsubo (stress) cardiomyopathy. N Engl J Med 2015;373:929-38.
9. Sharkey SW. Electrocardiogram mimics of acute ST-segment elevation myocardial infarction: insights from cardiac magnetic resonance imaging in patients with tako-tsubo (stress) cardiomyopathy. J Electrocardiol 2008;41:621-5.
10. Schneider B, Athanasiadis A, Stöllberger C, Pistner W, Schwab J, Gottwald U, et al. Gender differences in the manifestation of tako-tsubo cardiomyopathy. Int J Cardiol 2013;166:584-8.
11. Kono T, Sabbah HN. Takotsubo cardiomyopathy. Heart Fail Rev 2014;19:585-93.
12. Y-Hassan S, Settergren M, Henareh L. Sepsis-induced myocardial depression and takotsubo syndrome. Acute Card Care 2014;16:102-9.
13. Pergolini A, Zampi G, Casali G, Madeo A, Visconti CL, Cipullo PL, et al. Takotsubo syndrome after mitral valve replacement: case report and brief review of the literature. J Cardiothorac Vasc Anesth 2015;29:431-5.
14. Bybee KA, Kara T, Prasad A, Lerman A, Barsness GW, Wright RS, et al. Systematic review: transient left ventricular apical ballooning: a syndrome that mimics ST-segment elevation myocardial infarction. Ann Intern Med 2004;141:858-65.
15. Sharkey SW, Lesser JR, Maron BJ. Takotsubo (stress) cardiomyopathy. Circulation 2011;124:e460-e2.
16. Butman SM. Coughing- induced stress cardiomyopathy. Catheter Cardiovasc Interv 2010;76:388-90.
17. Ghadri JR, Sarcon A, Diekmann J, Bataiosu DR, Cammann VL, Jurisic S, et al. Happy heart syndrome: role of positive emotional stress in takotsubo syndrome. Eur Heart J 2016;37:2823-9.
18. Abraham J, Mudd JO, Kapur N, Klein K, Champion HC, Wittstein IS. Stress cardiomyopathy after intravenous administration of catecholamines and beta-receptor agonists. J Am Coll Cardiol 2009;53:1320-5.
19. Sharkey SW, Windenburg DC, Lesser JR, Maron MS, Hauser RG, Lesser JN, et al. Natural history and expansive clinical profile of stress (tako-tsubo) cardiomyopathy. J Am Coll Cardiol 2010;55:333-41.

20. Palecek T, Kuchynka P, Linhart A. Treatment of Takotsubo cardiomyopathy. Curr Pharm Des 2010;16:2905-9.