



## Beirut Explosion Induced Takotsubo Cardiomyopathy: A Case Report

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**Abstract**

**Background:** *Takotsubo cardiomyopathy (TTC) is a novel acute cardiac syndrome mimicking myocardial infarction involving transient, reversible left ventricular dysfunction, presenting with acute chest pain and dyspnea, electrographic changes (namely ST segment elevations and/or T wave inversions), with minimal elevations of cardiac enzymes but without evidence of significant coronary artery stenosis on coronary angiography. It mainly affects post-menopausal women and is often but not always preceded by emotional or physical triggers. Presented here is a case of Beirut's blast (fourth biggest explosion in history) induced Takotsubo cardiomyopathy.*

**Case Summary:** *An 80 years old white female with past medical history significant for hypertension, dyslipidemia and prediabetes presented to the emergency department (ED) two days after Beirut's explosion complaining of acute retrosternal chest pain with dyspnea on exertion. The pain started the day following the explosion and increased in intensity up until her presentation. While in the ED, our patient was hemodynamically stable. Her electrocardiogram was significant for T wave inversions in leads II, III, AVF, V2-V6 and T wave flattening in leads I, AVL. An echocardiogram was done and showed diffuse mid left ventricular hypokinesia and global apical ballooning and akinesia, sparing of the basal segments, and an ejection fraction of 30-35 %, consistent with apical ballooning syndrome. Cardiac catheterization was done 1 week after the presentation due to the catastrophic situation of the city and showed normal coronary arteries and normal LV gram with no evidence of wall motion abnormality. Our patient was subsequently diagnosed with Takotsubo cardiomyopathy and was treated with a beta blocker and an angiotensin receptor blocker.*

**Conclusion:** *Takotsubo Cardiomyopathy can be the result of major disasters such as Beirut's explosion. Early recognition and treatment of this disease in such circumstances is imperative to obtain better patient outcomes and minimize the consumption of limited medical resources during major catastrophic events.*

**Keywords:** *Takotsubo cardiomyopathy, Beirut's explosion, apical ballooning, ammonium nitrate.*

## Introduction and Background

Takotsubo cardiomyopathy was first reported by a Japanese cardiovascular scientist and has since gained worldwide knowledge as independent entity [1]. It is characterized by transient left ventricular systolic dysfunction with transient hypokinesia or akinesia of Left ventricle mid-segment (with or without apical involvement) that are beyond single coronary artery distribution. The main presenting symptoms are acute chest pain (83%) and dyspnea (20%), mimicking acute coronary syndrome. It is accompanied by ECG changes mainly ST elevations (71%), T wave inversions (61%) or both, along with mild elevations of troponin levels. The hallmark of Takotsubo is the absence of acute significant coronary artery disease on coronary angiography. It mainly affects post-menopausal women above 50 years of age. Underlying pathophysiological mechanism is still not certainly clear, but main trigger is thought to be catecholamine cardiotoxicity with toxic high levels of catecholamines rather than coronary artery or microvascular disease [2]. Commonly reported triggering emotional stressors range from the death of a loved one, social events like as public speaking and less commonly cocaine use, lightning strike and others [3]. TTC has also been described post some natural disasters such as a major earthquakes[4]. To date, Takotsubo cardiomyopathy has only been described in two patients after a dramatic explosion of an ammonium nitrate factory in Toulouse, France. [5] Here, we present the second case of Takotsubo cardiomyopathy following the Ammonium nitrate induced horrific explosion in Beirut.

The patient gave us consent to write the case report and we explained to her that her personal information is protected and her name or other personal information will not be written.

## Case

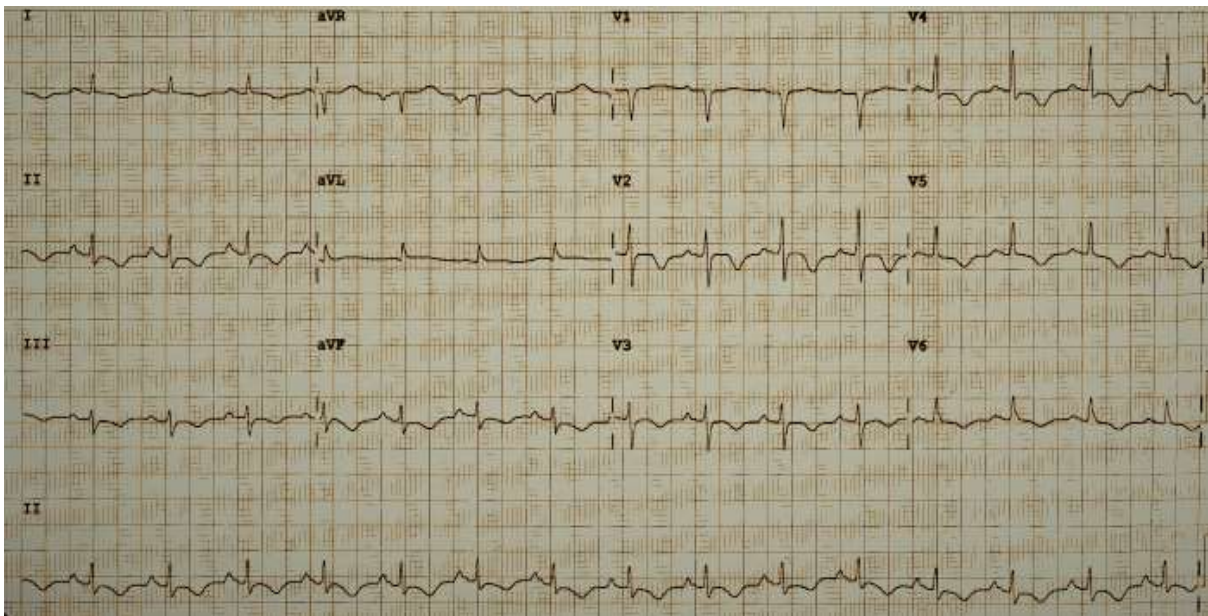
An 80 years old Caucasian female with hypertension, dyslipidemia, prediabetes and age-related macular degeneration presented to the Emergency department with acute retrosternal chest pain associated with dyspnea on exertion. Her chest pain started the day following Beirut's blast, was retrosternal, non-radiating, not alleviated by any movement, associated with dyspnea on minimal exertion and increased in intensity up until her presentation. She reports no previous history of similar episode or any previous cardiac history. She denies any other respiratory, gastro-intestinal or urinary symptoms. The blast left her with multiple mild bruises on her lower limbs. She has no allergies. Our patient denied smoking of any kind but reported social drinking. She denied any illicit drug use. She

follows a regular healthy diet and has a normal body mass index (BMI) of 21.1. She is not married and does not have any children. She used to work as a public relation officer in the Lebanese Army, then went to be the secretary of the Lebanese minister of communication, and stopped working around 25 years ago. Her family history is only significant for chronic bronchitis in her father. Our patient reported day to day mild chronic stress prior to the explosion but no other significant acute stressor, emotional or physical trauma. Her medications prior to admission include 20 mg atorvastatin oral tablet once daily for hyperlipidemia, 160mg valsartan oral tablet once daily for hypertension, metformin 1000 mg oral half tablet once daily for prediabetes and multivitamins for age-related macular degeneration. All medications were continued during hospitalization except for metformin that was replaced with a rapid acting insulin scale.

In the emergency department, our patient was hemodynamically stable with vital signs as following: afebrile with a temperature of 37.1°C, heart rate of 94 beats/min, blood pressure of 104/78 mmHg, respiratory rate of 18 breaths/min and an oxygen saturation of 97% on room air. On physical examination our patient was conscious, cooperative and oriented to people, place and time. She was not in acute distress. Her skin examination revealed multiple mild bruises bilaterally on lower limbs due to the blast and otherwise warm skin with no apparent rashes. The bruises were clean, non-erythematous and contained no pus. Her head was normocephalic and did not show any signs of bleeding or trauma. Her neck was supple, non-tender with no jugular venous distension noted. Lung auscultation showed good bilateral air entry with no crackles or wheezing. Cardiovascular examination revealed regular rate and rhythm with normal heart sounds, no murmurs and no apparent lower limb edema were noted. Her abdomen was soft, non-tender with no apparent masses or hepatosplenomegaly and no appreciated bruits. Neurological examination showed intact cranial nerves 2-12 examination, with grossly normal motor, sensory and reflex examination bilaterally.

An initial electrocardiogram (EKG) showed T wave inversions in leads II, III, AVF, V2-V6 and T wave flattening in leads I, AVL. The initial laboratory work-up were significant for an elevated high-sensitivity Troponin T of 278 ng/L (normal <14), CKMB of 10 ng/mL (normal <2.8) and a CPK of 254 U/L (normal <140). Other laboratory findings including complete blood count, electrolytes (including calcium, magnesium and phosphate), Creatinine, PT, PTT, INR were within normal limits.

Transthoracic echocardiography done on the day of presentation revealed diffuse mid left ventricular hypokinesia and global apical akinesia with preserved thickness of the myocardium, sparing of the basal segments, and an ejection fraction of 30-35 %.



**Figure 1.** Twelve-leads ECG done on admission showing T wave inversions in leads II, III, aVF, V2-V6 and T wave flattening in leads I, aVL.



**Figure 2.** Trans-thoracic echocardiography, upon presentation, in the para-sternal long axis showing the akinesia of mid antero-septal and mid infero-lateral walls.



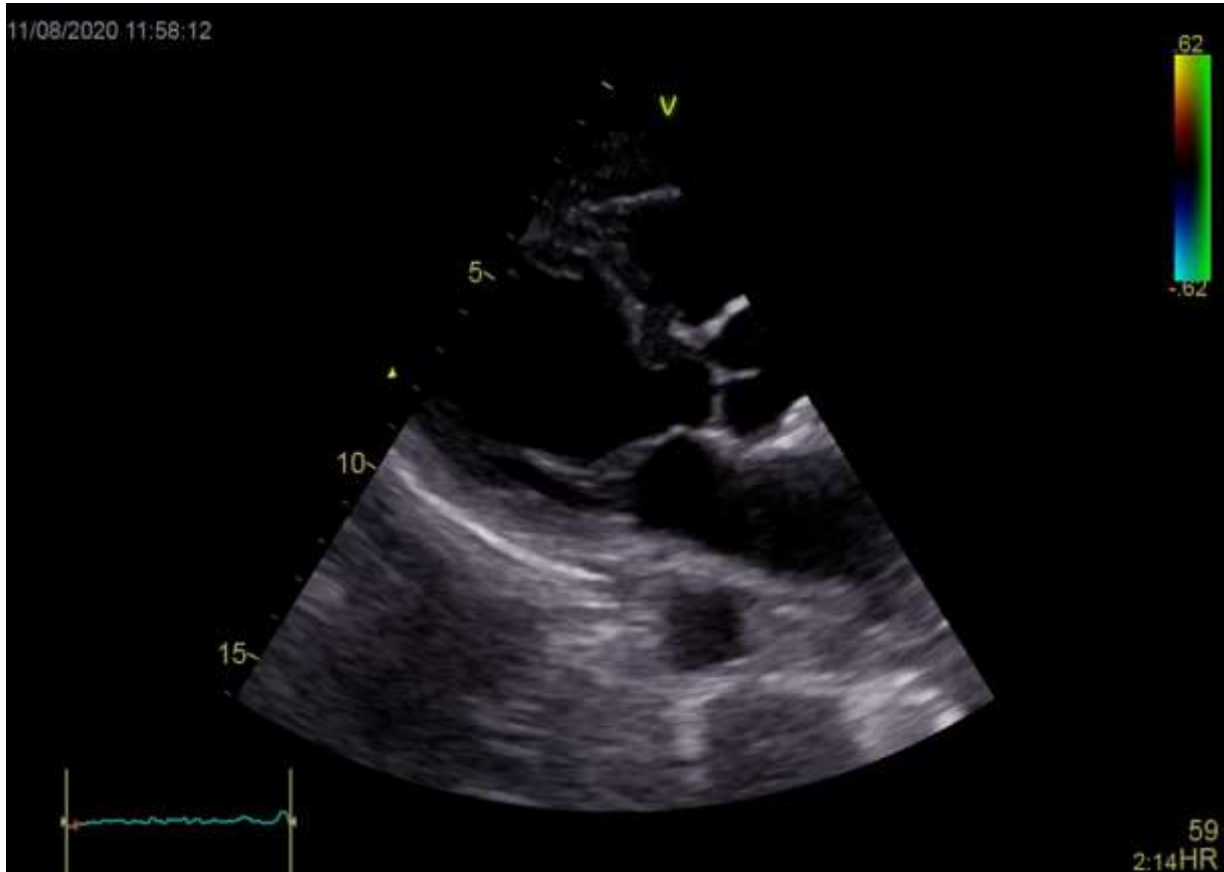
**Figure 3.** Trans-thoracic echocardiography, upon presentation, in the four-chamber view showing mid to apical infero-septal and antero-lateral akinesia with apical ballooning.



**Figure 4.** Trans-thoracic echocardiography, upon presentation, in the two-chamber view at the level of the apex showing diffuse apical akinesia and ballooning.

A multidisciplinary team approach decided to postpone left heart catheterization until patient is cleared by infectious disease team for suspicion of Tuberculosis in addition to the catheterization lab being damaged by the explosion, especially that the patient's symptoms improved on medical therapy and was hemodynamically stable. Coronary angiography performed five days after presentation showed normal coronary arteries with no coronary artery disease. Left ventricular angiography was completely normal with no evidence of wall motion abnormality.

A repeat echocardiography on the day of the angiogram revealed complete resolution of wall motion abnormalities observed with normalization of ejection fraction to 60-65%.



**Figure 5.** Trans-thoracic echocardiography at day five of admission, in para-sternal long axis view showing normalization of the wall motion abnormalities, with normal ejection fraction.

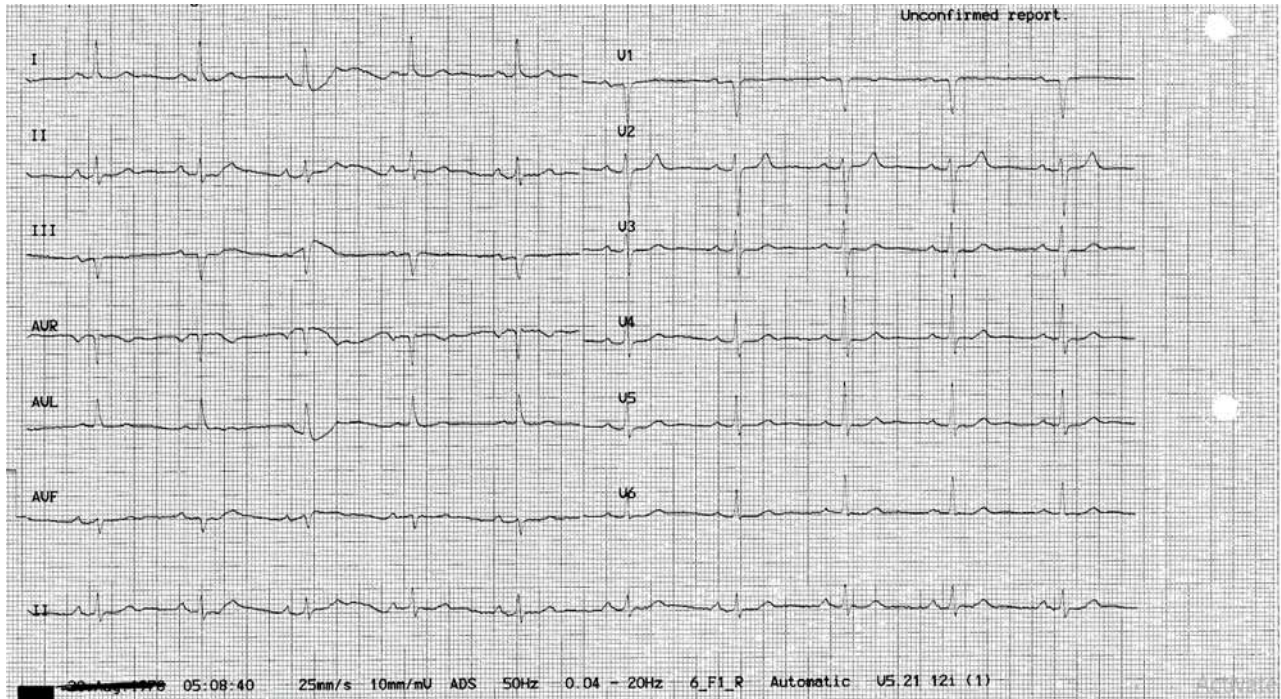




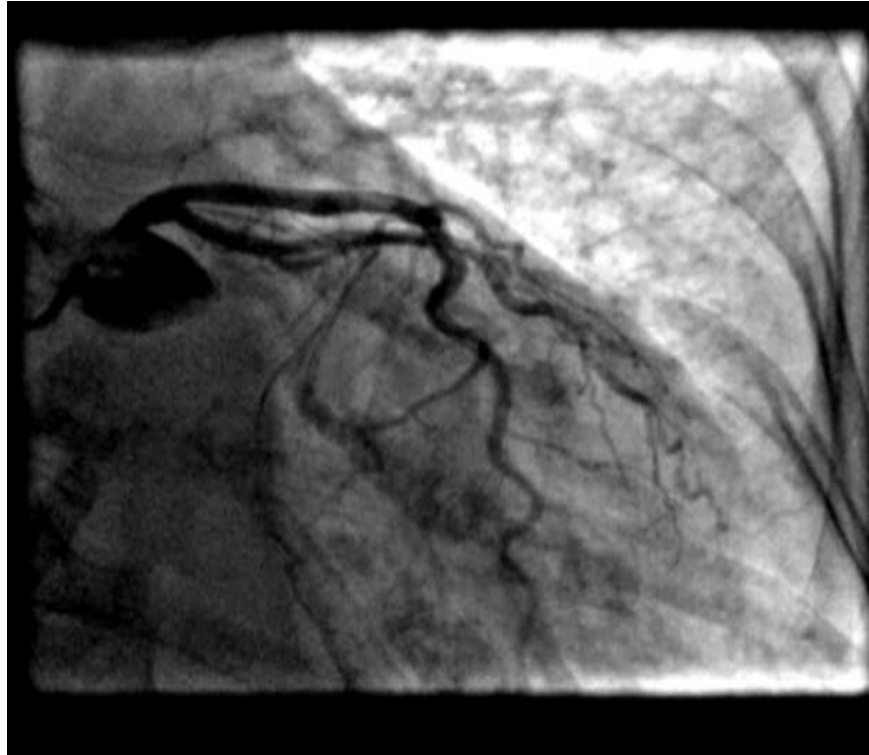
**Figure 6.** Trans-thoracic echocardiography at day five of admission, in four-chamber view showing normalization of the wall motion abnormalities, with normal ejection fraction.



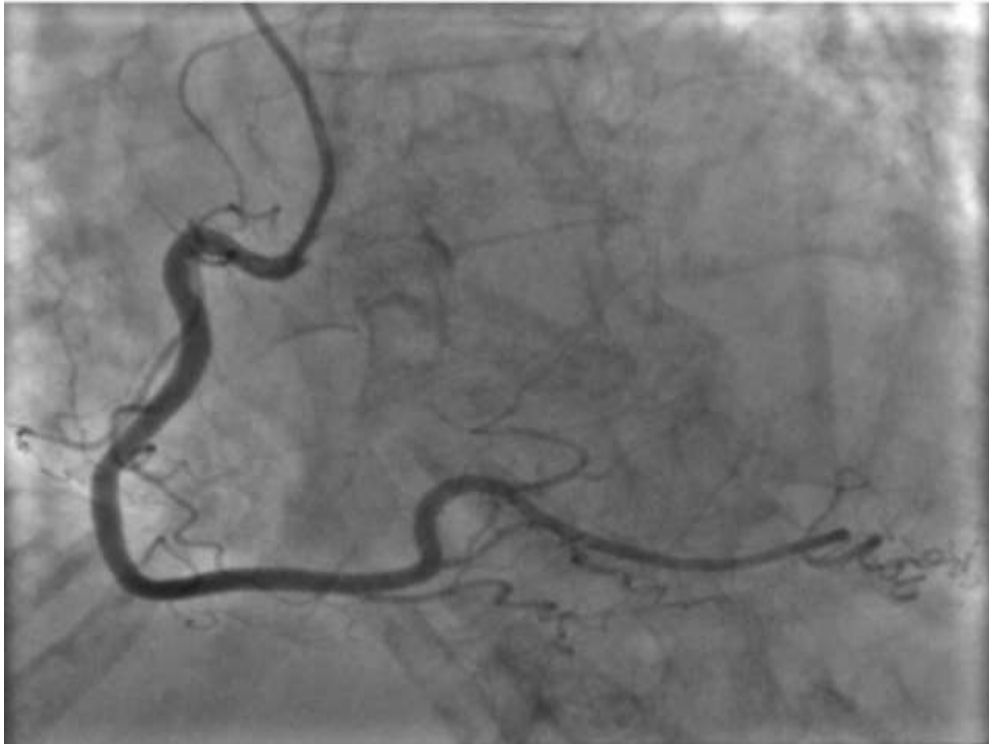
**Figure 7.** Trans-thoracic echocardiography at day five of admission, in two-chamber view showing normalization of the wall motion abnormalities, with normal ejection fraction.



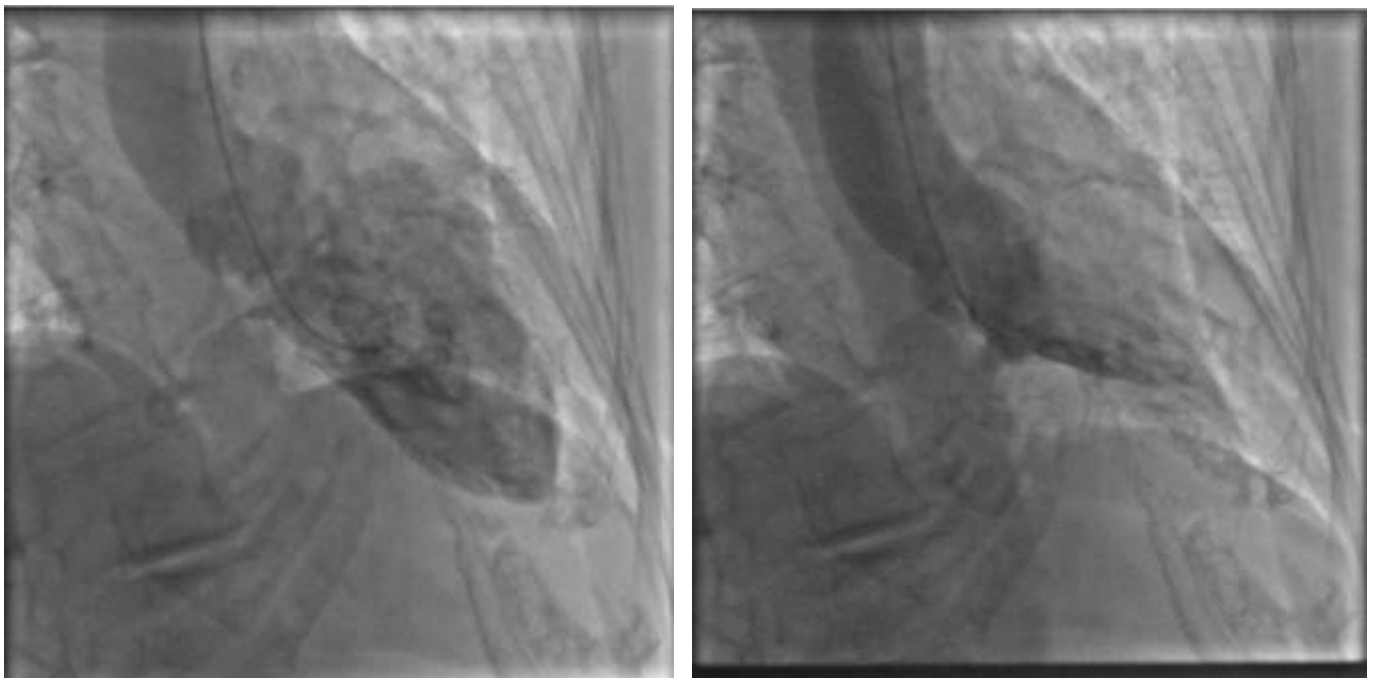
**Figure 8.** Twelve-leads ECG done 2 weeks later on follow up at the outpatient clinic showing complete resolution of T wave changes.



**Figure 9.** Coronary angiography showing no significant coronary artery stenosis present on the left coronary arteries



**Figure 10.** Coronary angiography showing no significant coronary artery stenosis present on the Right coronary artery



**Figure 11.** LV gram done 5 days after presentation showing normal contractility with absence of apical ballooning.

During her hospital stay, the patient had complete resolution of her symptoms and was subsequently discharged on Bisoprolol 2.5 mg oral tablet once daily in addition to all her previous home medications with the same doses.

Two weeks later she followed-up with her cardiologist in the outpatient clinic, the patient denied any recurrent episodes of chest pain, dyspnea or palpitations. Her ECG normalized.

The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

## **Discussion**

Our patient was diagnosed with Takotsubo Cardiomyopathy based on the 2016 European Society of Cardiology Heart Failure Association diagnostic criteria for Takotsubo syndrome [6].

Takotsubo cardiomyopathy (TTC) usually occurs in elderly postmenopausal females after an acute stressor. The pathophysiology of TTC is not well established, though several possible causes such as catecholamine cardiotoxicity, metabolic disturbance, coronary microvascular impairment and multivessel epicardial coronary artery spasm have been proposed. [7]. Our patient was subjected to an extreme stressor on Tuesday, 4th of August 2020, that marked Beirut's explosion, one of the largest non-nuclear blasts in history. A sparked fire at Beirut port, ignited what was estimated around 2750 tons of ammonium nitrate (equivalent of 1500-3000 tons of TNT), killing more than 200 people, injuring thousands, leaving around 300,000 people temporarily homeless and flattened nearby residential and industrial buildings. Sending seismic waves with an estimated magnitude 3.3-4.5 earthquake, the blast is the worst single event the city has ever seen [8,9].

Our patient is an 80 years old female with multiple comorbidities that presented after the huge explosion with typical chest pain and was diagnosed with NSTEMI based on her symptoms, labs, ECG and imaging. However, the diagnosis changed from acute coronary syndrome to TTC when cardiac catheterization showed non obstructive coronary arteries and repeat TTE one week later showed resolution of all the wall motion abnormalities which was further confirmed by the LV angiography. Thus, we diagnosed our patient retrospectively with Takotsubo cardiomyopathy according to European guidelines.

Takotsubo Cardiomyopathy and ACS involving left-dominant left main or three vessel disease, can be hard to differentiate without coronary angiography. However, several differences can turn the direction towards either diagnosis. Elderly postmenopausal females constitute 90% of those affected with

Takotsubo cardiomyopathy [10]. BNP and NT-proBNP values are ones of the most useful biomarkers for differentiating the two entities. They are elevated beyond what is usually seen during acute coronary syndrome Median BNP >600 pg/m; and NT-proBNP > 4000 pg/ml and the ratio of BNP to peak troponin levels may differentiate Takotsubo syndrome from ACS [2,9]. 95% of TTC patients have ECG abnormalities in the acute phase, but no ECG characteristics can reliably discern Takotsubo syndrome from acute coronary syndrome.[2,11] The most important difference is made by coronary angiography or coronary CT-angiography where significant coronary artery stenosis or acute plaque rupture being more suggestive of ACS.

Takotsubo syndrome was previously labeled as MINOCA according to the ESC working group position paper on myocardial infarction with non-obstructive coronary arteries. However, AHA's most recent scientific statement provides a formal and updated definition for the broadly labelled term MINOCA, incorporating the Fourth Universal Definition of MI which excludes Takotsubo syndrome from the final diagnosis of MINOCA which was also adopted by the ESC 2020 guidelines of NSTEMI [12,13]. In addition, CMR is now considered one of the key diagnostic tools for the syndrome [14] where the absence of relevant late gadolinium enhancement with edema and associated specific wall motion abnormalities is a hallmark of Takotsubo syndrome [15,16]

## **Conclusion**

Major disasters with similar impact on the healthcare system as the Beirut explosion are not uncommon. During such events, the healthcare systems are overwhelmed and resources become limited due to the high number of patients presenting for acute care. In this case report, we shed the light on a case of Takotsubo cardiomyopathy which is a disease that is highly associated with high levels of stress such as major disasters where patients, mainly post-menopausal females, present with a clinical picture mimicking Acute Coronary Syndrome. It is important to consider this diagnosis early on to allow early and appropriate medical therapy for a better patient outcome and prevent unnecessary resource use in an already overwhelmed healthcare system.

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