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## CASE REPORT: TAKOTSUBO SYNDROME AND THE IMPORTANCE OF CARDIAC MAGNETIC RESONANCE IMAGING IN THIS CONTEXT

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**Abstract:** Takotsubo Syndrome is a clinically important disease that can mimic an acute myocardial infarction (AMI) and is usually related to a stressful event. It usually occurs in women of post-menopause. There are diagnostic criteria. Supportive and symptomatic medication forms the basis of treatment, and the patient usually shows improvement in left ventricular function within a few days or weeks. The exact pathophysiological mechanism remains unclear. The aim of this investigation is to present a case study related to Takotsubo Syndrome. We present a case of a 52-year-old woman who presented with chest pain after a stressful family episode. The patient had unobstructed coronary arteries on cardiac catheterization and the presence left ventricular dysfunction on ventriculography. He had a good evolution and improved ventricular function within 4 days.

**Keywords:** Troponin; Ejection fraction; Electrocardiogram; Takotsubo cardiomyopathy

## INTRODUCTION

Takotsubo Syndrome is a clinically important disease that can mimic an acute myocardial infarction (AMI). Generally, after a “stressful event”, patients present with acute chest pain and dyspnea, accompanied by changes in the electrocardiogram and an increase in biomarkers of myocardial damage. As it is not a common cause of Acute Coronary Syndrome, its prevalence may be underestimated and recognizing the disease is important to provide adequate management to the affected population. (Singh, 2022)

It is estimated that around 7% of all patients with suspected AMI are actually Takotsubo. The syndrome predominates in female patients, of post-menopausal age, over 50, who have experienced some recent physical or emotional stress (Singh, 2022).

The aim of this research is to present a case study related to Takotsubo Syndrome in order to bring evidence to this diagnosis, discuss the

clinical particularities, with the aim of expanding knowledge and improving health conditions for the population.

## METHODOLOGY

This case report is characterized as descriptive, exploratory, with a qualitative approach (de Pereira et al. 2018; Estrela, 2018; Yin, 2015; Toassi, 2021), where the stages of identification, diagnosis and treatment of a patient with Takotsubo Syndrome are presented.

The data described was collected and disclosed after the patient read, agreed to and signed the informed consent form (ICF), authorizing this report and the collection of information from her medical records. In addition, this study was approved by the institution's Ethics Committee as requested by the Ministry of Health.

The precepts related to participant privacy, data confidentiality and human dignity were respected. In this way, following resolution 466/2012, the principles of the Research Ethics Committee and, specifically, for case studies involving people, by letter CONEP/2018.

## CASE REPORT

A.M.F.S, 52 years old, was admitted to the hospital in her city of origin reporting chest pain of the squeezing type, radiating to the left upper limb, which had started around 5 days ago and had worsened minutes before admission. He also reported a stressful episode in recent days. She had also been vomiting. She had high blood pressure and was taking Atenolol 25 mg in the morning and Hydrochlorothiazide 25 mg in the morning, showing good pressure control. She also had a diagnosis of Generalized Anxiety Disorder, without treatment. He denied using drugs or other illicit substances. He denied a recent infection and a history of arrhythmia, palpitation or tachycardia. See below the image (Figure 1) showing the ECG performed on the patient's admission:

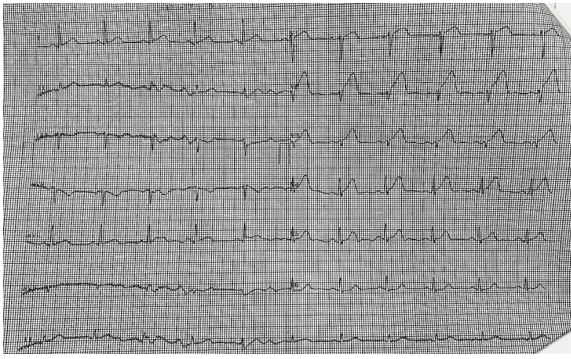


Figure 1: ECG on admission to the department of origin showing superelevation of V2, V3 and V4

Source: Authors

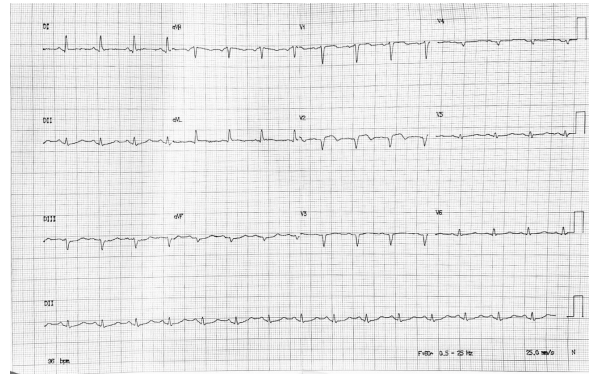


Figure 2- ECG showing plus minus.

Source: Authors

See Figure 1 for the ECG showing V2, V3 and V4 elevation - corresponding to anterior wall AMI. After the result, the professional administered aspirin and clopidogrel and immediately contacted the referral hospital, since there were no hemodynamics at the initial point of care.

She was accepted and admitted to our service 2 hours after the event. The patient remained under surveillance in the emergency room. On admission, she was eupneic on room air, oriented, hemodynamically stable, reporting persistent chest pain, with BP=140X60, RR= 21 irm, HR= 88 bpm and a physical examination without alterations. A chest pain protocol was opened, an ECG was performed 5 minutes after the patient's admission and a team of cardiologists and hemodynamicists were already waiting to perform coronary catheterization. In addition, laboratory tests were taken, including troponin (with a result >25000) and a chest X-ray which was within normal limits. Figure 2 shows the ECG obtained on the patient's admission:

See Figure 2 for a biphasic t-wave (plus/minus) in leads V2 and V3, electrocardiographic changes associated with critical stenosis of the anterior descending artery.

The patient underwent cardiac catheterization via puncture of the radial artery, under local anesthesia with 2% lidocaine in the styloid process of the right wrist. Selective catheterization of the coronary arteries - contrast injection with image acquisition in classic projections. Left ventriculography. The procedure was uneventful and the results are shown below in Chart 1:

### CARDIAC CATHETERIZATION TECHNIQUE VIA THE RADIAL ARTERY

#### CINECORONARIOGRAPHY

Co-dominance.

1- The right coronary artery supplies the posterior portion of the left ventricle and has no obstructive lesions. It emits:

The posterior descending branch has no obstructive lesions.

2- Left coronary artery trunk without obstructive lesions. Trifurcated:

a. The anterior descending artery reaches the apex cordis and has no obstructive lesions. It emits:

First septal branch of minor importance has no obstructive lesions

b. Circumflex artery emits:

Medium-caliber atrio-ventricular pathway with no obstructive lesions. Left marginal branch of great importance with no obstructive lesions. Posterior ventricular and posterior descending branches of great importance with no obstructive lesions.

c. Moderately important diagonalis branch without obstructive lesions.

## VENTRICULOGRAPHY

The left ventricle had normal volume, antero-apical and infero-apical akinesia. Moderate segmental systolic dysfunction is estimated. The mitral valve is competent.

## CONCLUSION

Coronary circulation without obstructive lesions.

The left ventricle had normal volume, antero-apical and infero-apical akinesia. Moderate segmental systolic dysfunction is estimated. The mitral valve is competent.

Table 1: Results of the patient's coronary angiography and ventriculography

Source: Authors

Chart 1 shows that coronary angiography did not reveal any obstructive lesions, ventriculography showed antero-apical and infero-apical akinesia.

Finally, the patient remained in intensive care for a further 2 days and was referred to a ward for continuity of care. She underwent an echocardiogram, which was within normal limits, and was discharged 4 days after admission. Cardiac magnetic resonance imaging was not carried out, although it was indicated, as it is not available in the service in question. However, the diagnosis of Takotsubo Syndrome was questioned, and the patient was then referred for outpatient care.

## RESULTS AND DISCUSSION

Takotsubo syndrome, also known as transient left ventricular (LV) apical ballooning or broken heart syndrome, is a stress-induced cardiomyopathy that can mimic acute myocardial infarction (AMI). The patient in this report, for example, presented with chest pain and an ischemic pattern on the electrocardiogram, with V2, V3 and V4 elevation. In addition, the syndrome can also cause an increase in biomarkers such as troponin and brain natriuretic peptide (BNP) (Diaz-navarro 2021).

It is estimated that around 7% of all patients with suspected AMI are actually Takotsubo. The syndrome predominates in post-menopausal women over the age of 50

who have experienced some recent physical or emotional stress. At this stage of a woman's life, the loss of the effects of oestrogen can lead to an exacerbation of central neuronal effects and also of cardiac cells, making it possible to reduce the production of cardioprotective substances. In younger patients, however, broken heart syndrome is more likely to affect males or be an "atypical" case. (Singh, 2022; Silva, 2018)

Its pathophysiology is still poorly defined, and currently the most accepted theories are the release of catecholamines that lead to cardiotoxicity and microvascular dysfunction, as well as neuroendocrine action, possibly involving the cognitive centers of the brain and the Hypothalamic-Pituitary-Adrenal (HPA) axis. An acute and severe stressful situation, whether psychological or physical, activates the HPA axis and increases circulating and myocardial levels of catecholamines, and this sudden sympathetic activation results in a response from the sympathetic nervous system and the cardiovascular system, which, due to the elevated levels of catecholamines, suffers myocardial dysfunction due to stunning and microvascular spasm (Amin Hz, et al., 2020; Diaz-navarro 2021).

Clinically, after a "stressful event", patients present with acute chest pain and dyspnea, accompanied by changes in the electrocardiogram and, not uncommonly, an increase in biomarkers of myocardial damage, which is indistinguishable from an AMI. It is worth noting, however, that a third of patients do not recognize an identifiable stress factor. In extreme cases, it can lead to severe heart failure, cardiogenic shock or arrhythmias, requiring hemodynamic and sometimes ventilatory support (Singh, 2022; Diaz-navarro 2021).

Symptoms are due to transient abnormalities in left ventricular (LV) wall movement, with hypokinesia, or more frequently, akinesia of the mid-ventricular and apical segments,



as well as hypercontractility of the basal segments. There are atypical forms that affect other areas. There is often a severe decrease in LV ejection fraction and an increase in LV end-diastolic pressure, acutely compromising the systolic and diastolic function of this compartment. A striking feature of this syndrome is that quickly, within days to weeks, these LV wall motion abnormalities are recovered. (Santos, 2022)

In addition to acute stress, Takotsubo syndrome can result from prolonged previous stress, as well as major events that generate so-called “community stress”, such as earthquakes and pandemics. Neurological medical conditions, such as intracranial hemorrhage, pheochromocytoma and epilepsy, as well as severe acute critical illnesses, can also cause Takotsubo syndrome.

Other conditions include cancer patients living under constant stress, both psychological and physical, acute exacerbations of asthma or chronic obstructive pulmonary disease, procedures and exams such as endoscopy, cardioversion, among others. Mental health is also a crucial factor in the assessment of patients, as there is a high rate of mental illness, both acute and chronic, such as anxiety and depression, in patients diagnosed with Takotsubo, as well as in the patient reported. In addition, psychiatric or neurological disorders are 7 times more prevalent in this pathology when compared to acute coronary syndrome (Singh, 2022).

On the electrocardiogram, the most common abnormalities are ST elevation, T wave inversion and left bundle branch block. An increase in the plasma concentration of cardiac troponin is found, although lower than that found in AMI, as well as various pro- and anti-inflammatory cytokines. Concentrations of B-type natriuretic peptide (BNP) and its inactive N-terminal molecule (NT-proBNP) are also elevated and, compared to patients with

AMI, these values are higher. Echocardiography is a supportive diagnostic tool that can identify possible complications (Singh, 2022).

The similarities with acute coronary syndrome make the diagnosis of Takotsubo Syndrome a challenge, and generally this condition is only confirmed by unobstructed coronary arteries on cardiac catheterization and the presence of left ventricular dysfunction on ventriculography. (Singh, 2022) In the case reported here, the patient had dynamic ST segment alterations and there was a change in troponin. In addition, cardiac catheterization showed unobstructed coronary arteries and left ventricular dysfunction on ventriculography.

Various diagnostic criteria have been proposed for Takotsubo Syndrome. The Mayo diagnostic criteria are the most widely recognized. (Prasad A et al.; 2008) The Mayo criteria are listed below in Table 2:

These criteria have been challenged due to the finding that coronary artery disease can coexist in up to 29% of patients with takotsubo syndrome and that pheochromocytoma is more recently recognized as a trigger. A diagnostic score, called Inter-TAK, has therefore been developed as a medical aid in distinguishing this syndrome, but its performance is variable, so it is vital to analyze subtle differences in the clinic to avoid errors. It should be remembered that a hallmark of Takotsubo is the reversibility of systolic function in hours, days or weeks, as happened in the case reported here (Santos, 2022). Table 3 below shows the InterTAK criteria:

<p><b>Hipocinesia transitória, acinesia ou discinesia de segmentos médios ventriculares com ou sem envolvimento apical</b></p> <p>Anomalias regionais da contratilidade parietal podem estender-se além de uma única área vascular epicárdica</p> <p>O gatilho estressante é frequente, mas nem sempre, presente</p> <p><b>Novas anormalidades no ECG (elevação do segmento ST ou inversão da onda T) ou alterações modestas elevação nos níveis de troponina cardíaca</b></p> <p><b>Ausência de doença coronariana obstrutiva ou evidência angiográfica de ruptura aguda de placa</b></p> <p><b>Ausência de Feocromocitoma e Miocardite</b></p>
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Table 2- Mayo criteria

Source: Prasad A et al.; 2008

1	Patients present with transient lesions* ventricular dysfunction (hypokinesia, akinesia or dyskinesia) presenting as apical ballooning or basal or focal ventricular wall movement abnormalities. Right ventricular involvement may be present. In addition to these regional wall motion patterns, there may be transitions between all types. Regional contractility abnormality usually extends beyond a single epicardial vascular distribution; however, there may be rare cases in which regional motility abnormality is present in the subtended myocardial territory of a single coronary artery (focal takotsubo syndrome)*.
2	An emotional, physical or combined trigger can precede the event of takotsubo syndrome, but this is not mandatory
3	Neurological disorders (e.g. subarachnoid hemorrhage, stroke/transient ischemic attack or seizures) as well as pheochromocytoma can serve as a trigger
4	New ECG abnormalities are present (e.g. ST segment elevation, ST segment depression, T wave inversion, QTc interval prolongation); however, there are rare cases without any EC changes
5	Cardiac biomarker levels (troponin and creatine kinase) are moderately elevated in most cases; sign Excessive elevation of brain natriuretic peptide is typical
6	Significant coronary artery disease is not a contradiction in takotsubo syndrome
7	Patients have no evidence of infectious myocarditis**
8	Postmenopausal women are predominantly affected

Table 3- International takotsubo (InterTAK) - Diagnostic criteria for Takotsubo syndrome

\*Abnormalities in wall movement may remain for a prolonged period of time or documentation of recovery may not be possible. For example, death before evidence of recovery is captured.

\*\*Cardiac magnetic resonance imaging is recommended to rule out infectious myocarditis and with a diagnosis of takotsubo syndrome.

Source: Gadri et al., 2018

Criteria	Points
Female	25
Emotional trigger	24
Physical trigger	13
Absence of ST-segment depression (with the exception of aVR)	12
Psychiatric disorders	11
Neurological disorders	9
QT interval prolongation (women>460 milliseconds and men>440 milliseconds)	6

Table 4- InterTAK diagnostic score for Takotsubo Syndrome

Source: Ghadri; et al., 2018

Composed of 7 clinical parameters to which points are assigned according to importance with a maximum attainable score of 100 points Score greater than 70 points confers a 90% probability of takotsubo syndrome. (Ghadri; et all. 2018) Some differential diagnoses include Acute coronary syndrome, Cardiac syndrome X/microvascular angina, Prinzmetal's angina, Acute myocarditis, Cocaine cardiomyopathy, Cardiomyopathy associated with pheochromocytoma. (Ferri; et all. 2024)

Due to the marked similarity with acute coronary syndrome, a multimodal imaging approach is necessary to exclude possible differential diagnoses, and cardiac magnetic resonance imaging has played an extremely

important role. It can distinguish Takotsubo syndrome from AMI and myocarditis, for example. It detects both myocardial edema and acute inflammation. However, the availability of this test is limited in most services in our country (Singh, 2022).

Approximately 20% have in-hospital complications, including heart failure, shock, life-threatening arrhythmias, acute mitral regurgitation, LV outflow tract obstruction (LVOT), free wall rupture and death.(Ferri, et al. 2024)

Initially, patients should be treated for acute coronary syndrome until this hypothesis is ruled out.

After diagnosis, supportive care, such as eliminating the physical or emotional trigger, is important. Hemodynamically stable patients should be treated with diuretics, vasodilators and venodilators (nitroglycerin, nitroprusside). If cardiogenic shock develops, vasopressors and inotropes may be necessary. In addition, percutaneous and surgical mechanical circulatory support may be necessary.

In addition, chronic treatment includes guideline-oriented therapy for systolic heart failure (beta-blocker, ACE inhibitor, angiotensin II receptor blocker, aldosterone antagonist, SGLT2 inhibitor, angiotensin receptor-neprilysin inhibitor) until LV dysfunction resolves. This therapy can be considered in the long term if tolerated and if there are no contraindications.

The echocardiogram should be repeated (in 4 to 6 weeks) to ensure normalization of systolic function.(Ferri, et all. 2024) Takotsubo syndrome has a hospital mortality rate of 4 to 5% related to cardiogenic shock and cardiac arrest. Survivors may suffer long-term cardiac and non-cardiac health problems, with an increase in long-term mortality. (Lyon AR et al. 2021)

## **CONCLUSION**

The similarities with acute coronary syndrome make diagnosing Takotsubo Syndrome a challenge. Recognizing the disease is important in order to provide adequate management to the affected population.

As this condition is often underdiagnosed, it is of great importance to disseminate knowledge about its clinical, epidemiological and radiological characteristics and, to this end, new research and studies on the subject are needed.

The use of methods such as coronary cineangiography and ventriculography are the cornerstones for distinguishing between the two conditions in an acute emergency setting. However, when excluding other diagnoses, magnetic resonance imaging is of great value, which is why expanding its access is necessary.

## **CONFLICT OF INTEREST**

We declare that there is no conflict of interest.

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