MEDPHARMRES
pISSN : 1859-1779 | eISSN : 2615-9139

Original Article
MedPharmRes 2024;8(1):64-73
https://doi.org/10.32895/UMP.MPR.8.1.7

Clinical characteristics and risk factors of in-hospital mortality in patients with Takotsubo syndrome

Vu Hoang Vu[1,2], Thanh Cong Nguyen[2,*], Binh Thi Hai Nguyen[2], Hoa Tran[1,2], and Binh Quang Truong[1,2]

[1]*Faculty of Medicine, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam*
[2]*Interventional Cardiology Department, University Medical Center Ho Chi Minh City, Ho Chi Minh City, Vietnam*

Abstract

Introduction: Takotsubo cardiomyopathy is a condition of transient systolic dysfunction triggered by emotional or physical stress. Nowadays, Takotsubo cardiomyopathy is gaining attention and has been detected more frequently. However, there is no collected data on Vietnamese subjects. This study aims to describe the clinical characteristics of patients diagnosed with Takotsubo cardiomyopathy and determine of rates and independent risk factors for in-hospital mortality.

Methods: A retrospective andobservational study was conducted at the University Medical Center Ho Chi Minh City, involved 103 patients diagnosed with Takotsubo cardiomyopathy between January 2015 and June 2022. The diagnosis was made based on the revised Mayo Clinic diagnostic criteria.

Results: The average age of the study population was 71.2±15.3 years, with females accounting for 64.1% of the patients. The most common comorbidities among the patients were hypertension (57.3%), diabetes mellitus (30.1%), ischemic heart disease (15.5%), and chronic obstructive pulmonary disease (15.5%). Acute heart failure was observed in 30.1% of the patients, while ventricular arrhythmias were present in 17.6% of cases. The majority of triggers were attributed to physical factors, including infection (37.9%), respiratory failure (18.4%), postoperative status (3.9%), and acute neurological disease (2.9%). The in-hospital mortality rate was 17.5%, and the independent risk factors were identified as acute heart failure (OR=20.657, 95%CI 2.306–185.008, p=0.007) and respiratory failure (OR=10.397, 95% CI 1.117–96.795, p=0.040).

Conclusions: Takotsubo cardiomyopathy patients have many comorbidities and are often triggered by physical factors. The in-hospital mortality rate is significant, with acute heart failure and respiratory failure identified as independent risk factors.

Keywords: Takotsubo cardiomyopathy; risk factors; hospital mortality; prognosis; hospitalization

1. INTRODUCTION

Takotsubo cardiomyopathy (also known as stress cardiomyopathy, apical ballooning syndrome, broken-heart syndrome) was first described in Japan in 1990, characterized by transient apical dyskinesia, resembling acute myocardial infarction but without evidence of coronary occlusion or unstable atherosclerotic plaque [1], [2]. The term “Takotsubo”

Received: Jun 8, 2023 / Revised: Aug 14, 2023 / Accepted: Sep 21, 2023
*Corresponding author: Thanh Cong Nguyen. Interventional Cardiology Department, University Medical Center Ho Chi Minh City, Ho Chi Minh City, Vietnam.
E-mail: thanh.nc@umc.edu.vn

is derived from the Japanese word for an octopus trap, which simulates the image of the ballooning ventricle. Takotsubo cardiomyopathy occurs in 1.7%–2.2% of cases with clinical suspicion of acute coronary syndrome or ST-segment elevation myocardial infarction [3]. The pathogenesis of Takotsubo cardiomyopathy is not fully understood, but some recognized hypotheses include high level of catecholamines, microvascular dysfunction, and coronary artery spasm [4]–[7]. In most cases, left ventricular systolic function recovers in 1–4 weeks [4],[6]–[8]. In-hospital mortality ranges from 0% to 8%, and the risk of major cardiovascular events is considered to be comparable to acute coronary syndromes with independent predictors of older, decreased ejection fraction, increased troponin, physical predisposing factor, apical aneurysm, cardiogenic shock, cardiac arrest at the time of diagnosis [9]–[14]. The recurrence rate is about 1.8% per year [11]. In general, the long-term prognosis is better than that of acute myocardial [15].

The number of patients diagnosed with Takotsubo cardiomyopathy is increasing [16], but most of them are retrospective analyzes and small sample sizes. In Vietnam, there have been case reports but no study has been conducted. This study aims to examine the clinical features of Takotsubo cardiomyopathy, and to determine the rate and independent risk factors of in-hospital mortality in patients diagnosed with this condition. Our aspiration is that our findings will offer valuable contributions and enhance the strategies for diagnosis and treatment of this disease.

2. MATERIALS AND METHODS

2.1. Study design and participants

An observational and retrospective study was conducted at University Medical Center Ho Chi Minh City. The subjects of the were patients older than 18 years of age who were diagnosed and treated for Takotsubo cardiomyopathy between January 2015 and June 2022.

We selected research subjects by searching from the electronic medical record system of University Medical Center Ho Chi Minh City with the keywords “Takotsubo”, and “stress cardiomyopathy”. The Mayo Clinic criteria (2008) used to diagnose Takotsubo cardiomyopathy includes: (1) Transient hypokinesis, dyskinesis or akinesis of the ventricular walls, with or without the apical region, disproportionate to the dominant coronary artery; (2) Absence of significant coronary artery stenosis or acute atherosclerotic lesion; (3) New electrocardiographic abnormalities (either elevated ST-segment and/or T-wave changes) or elevation in cardiac troponin; and (4) Absence of pheochromocytoma or myocarditis [17].

2.2. Sample size

We utilized the sample size formula,

$$n \geq \frac{Z^2_{1-\frac{\alpha}{2}}(1-p)p}{d^2},$$

to estimate a ratio. In this formula, α symbolized a type 1 error, preset at α=0.05, d indicated the estimated error, fixed at d=0.05, and p referred to the estimated proportion. We chose a value of p=5.69%, corresponding to the in-hospital mortality rate derived from a registry analysis of 28,079 patients in the United States who had been diagnosed with Takotsubo cardiomyopathy in 2013–2014 [18]. Consequently, we calculated the minimum number of subjects for the study is 83.

2.3. Data collection

The investigator collected information on demographic, clinical symptoms, laboratory findings, coronary angiography results, treatment and major cardiovascular events occurring during period of hospitalization (all-cause mortality, thromboembolic events, neurological events) according to the available data collection. Comorbidities, including hypertension, coronary artery disease, diabetes mellitus, chronic kidney disease, neuropathy (ischemic stroke and cerebral hemorrhage), and chronic obstructive pulmonary disease, were identified based on the patient’s medical history. Acute heart failure was characterized by symptoms of heart failure, resulting from congestion or reduced cardiac output, with a sudden or unplanned onset, necessitating emergency hospitalization [19]. In Takotsubo syndrome, acute heart failure primarily manifests as left ventricular systolic dysfunction, with potential progression to acute pulmonary edema or

cardiogenic shock. Acute respiratory failure was diagnosed based on clinical symptoms, including dyspnea, cyanosis, sweating, tachycardia, hypotension, and impaired consciousness. Additionally, arterial blood gas analysis with PaO_2 (arterial partial pressure of oxygen) <60 mmHg and/or pCO_2 (arterial partial pressure of carbon dioxide) >45 mmHg under room air conditions was employed to support the diagnosis [20]. The primary clinical outcome was all-cause in-hospital mortality, meticulously recorded through electronic medical records. This encompasses cases of patient death during hospitalization, as well as situations where severe illness prompted relatives to opt for home care, facilitating end-of-life care at home.

2.4. Statistical method

Data were analyzed using SPSS software version 22.0. Qualitative variables are described by frequency and percentages. Chi-squared test or Fisher's exact test were used to compare proportions. Continuous variables were tested for normal distribution using the Shapiro-Wilk test, presented as mean±SD (for normal distribution) or median with a 25%–75% interquartile range (for non-normal distribution). The mean of the death and surviving groups was compared using the t-test, and the median of the two groups was compared using the Mann-Whitney U test. Logistic regression analysis was used to identify risk factors for in-hospital mortality. The multivariable model was constructed using variables that showed significance at $p<0.2$ level in relation to in-hospital mortality.

Statistical significance was determined using a two-sided p-value threshold of less than 0.05, reflecting a high level of confidence in the obtained results.

2.5. Ethical considerations

This study did not affect the process of the patient's diagnosis, treatment and follow-up and approved by the local ethics committee of University Medical Center at Ho Chi Minh City, number 544/HĐĐĐ-ĐHYD.

3. RESULTS

During the research period, we collected 103 cases diagnosed with Takotsubo cardiomyopathy. The average age of the study population was 71.2, female accounted for 64.1%. Common comorbidities included: hypertension (57.3%), diabetes mellitus (31.2%), chronic ischemic heart disease (15.5%), chronic lung disease (15.5%), cerebrovascular disease (9.7%), cancer (6.8%). Common clinical symptoms were dyspnea (57.3%) and chest pain (36.9%) (Table 1).

The median serum concentrations for high-sensitivity troponin T (hs TnT) and NT-ProBNP were 224.0 ng/mL (interquartile range: 61.8–655.0 ng/mL) and 3,511.0 ng/L (interquartile range: 509.0–1,4015.0 ng/L), respectively. Some arrhythmias recorded on electrocardiogram included: atrial fibrillation (12.8%), ventricular tachycardia (17.6%), ST segment elevation (41.2%), ST segment depression (20.0%), T-wave inversion (28.1%). The most affected location of dyskinesia is the apex (76.0%). Coronary angiography results showed that 89.5% of cases were non-obstructive or insignificant stenosis. 28.2% of patients had acute heart failure, of which cardiogenic shock accounted for 21.4% (Table 2). The common triggering factors were infection (37.95%), respiratory failure (18.4%). Psychological stress accounted for only 1.9%. In nearly half of cases, triggering factors was undetermined (43.7%).

The records show that 37.9% of patients received invasive mechanical ventilation, 7.8% of patients received renal replacement therapy. The pharmacologic agents used for acute hemodynamic instability were: dobutamine (23.3%), adrenaline (17.6%), noradrenaline (40.8%). The number of patients who died from all causes in the hospital was 18, accounting for 17.5%. No cases of neurological and thromboembolic events were recorded (Table 3). The results of logistic regression analysis showed that the independent risk factors of death included: acute heart failure (OR=20.657, 95%CI 2.306–185.008, p=0.007) and respiratory failure (OR=10.397, 95% CI 1.117–96.795, p=0.040) (Table 4).

4. DISCUSSION

To our knowledge, this is the first study conducted in Vietnam on Takotsubo cardiomyopathy. The study results demonstrated that Takotsubo cardiomyopathy was prevalent

https://doi.org/10.32895/UMP.MPR.8.1.7

Table 1. Baseline characteristics of patients with Takotsubo syndrome

Variables	All (n=103)	Survived (n=85)	Death (n=18)	p-value
Age (year)	71.2±15.3	69.7±15.8	78.3±10.7	0.030
Women (n [%])	66 (64.1)	52 (61.2)	14 (77.8)	0.182
Chronic medical conditions				
Hypertension (n [%])	59 (57.3)	46 (54.1)	13 (72.2)	0.158
Chronic ischemic heart disease (n [%])	16 (15.5)	12 (14.1)	4 (22.2)	0.389
Heart failure (n [%])	16 (15.5)	14 (16.5)	2 (11.1)	0.569
Diabetes mellitus (n [%])	31 (30.1)	25 (29.4)	6 (33.3)	0.742
Chronic renal failure (n [%])	18 (17.5)	12 (14.1)	6 (33.3)	0.051
Neurological disease (n [%])	10 (9.7)	7 (8.2)	3 (16.7)	0.273
COPD (n [%])	16 (15.5)	12 (14.1)	4 (22.2)	0.389
Cancer (n [%])	7 (6.8)	3 (3.5)	4 (22.2)	0.004
Smoker (n [%])	9 (8.7)	8 (9.4)	1 (5.6)	0.599
Alcohol drinking (n [%])	5 (4.9)	4 (4.7)	1 (5.6)	0.879
General condition of patient at the time of diagnosis				
Chest pain (n [%])	38 (36.9)	31 (36.5)	7 (38.9)	0.870
Dyspnea (n [%])	59 (57.3)	43 (50.6)	16 (88.9)	0.003
Syncope (n [%])	1 (1.0)	1 (1.2)	0 (0.0)	0.644
Heart rate (bpm)	100.7±24.3	96.6±22.5	119.1±23.7	<0.001
Blood pressure (mmHg)	119.6±24.6	122.7±20.6	124.7±33.5	0.330
Respiratory rate (bpm)	20.0 (19.0–20.0)	20.0 (19.0–20.0)	20.0 (19.0–23.0)	0.127
Temperature (C degrees)	37.0 (37.0–37.0)	37.0 (37.0–37.0)	37.0 (37.0–37.4)	0.179
Weigh (kg)	54.0±11.1	53.6±11.3	55.9±10.5	0.513
Heigh (cm)	156.5±9.5	156.5±9.8	156.7±8.2	0.962
BMI (kg/m^2)	22.0±4.3	21.9±4.5	22.7±3.2	0.573
Respiratory failure (n [%])	19 (18.4)	11 (12.9)	8 (44.4)	0.020
Acute heart failure	31 (30.1)	20 (23.5)	11 (61.1)	0.002

COPD, chronic obstructive pulmonary disease; BMI, body mass index.

in women and the elderly, often with coexisting medical conditions. Physical factors were the most frequent triggers. Patients diagnosed with Takotsubo cardiomyopathy had a poor prognosis, with a high in-hospital mortality rate, particularly in cases of acute heart failure and respiratory failure.

4.1. Clinical characteristics

According to many previous reports, Takotsubo cardiomyopathy was commonly seen in women, accounting for about 90%, and the average age was 67–70, of which 80% were over 50 years old [11],[21],[22]. However, men accounted for a higher percentage (35.9%) in our study. More recent studies have also shown that the number of men diagnosed with Takotsubo cardiomyopathy is increasing, particularly in the Asian race, and are strongly associated with physical triggers [23]. The increasing prevalence of coronary angiography also results in higher detection of the disease in man compared to before [24].

Diagnosis of Takotsubo cardiomyopathy remains a challenge in practice because of the overlapping manifestations with acute coronary syndromes such as chest pain, elevation of cardiac enzymes and ST-T changes on electrocardiogram [17]. Therefore, coronary and ventricular angiography plays an important role in the diagnosis. 73.7% of patients underwent coronary angiography, the remaining cases were mainly due to clinical conditions not suitable for the procedure (acute renal failure, hemodynamic disorders, coagulopathy...). We used modified Mayo Clinic diagnostic criteria (2008), which

Table 2. Subclinical characteristics: analyses, electrocardiography, and imaging

Variables	All (n=103)	Survived (n=85)	Death (n=18)	p-value
Analytical results				
Creatinine (mg/dL)	1.0 (0.8–1.3)	1.0 (0.8–1.3)	1.1 (0.9–1.5)	0.623
eGFR (mL/min per 1.73 m^2)	63.3±28.0	64.9±27.6	55.5±29.4	0.207
Sodium (mmol/L)	135.0 (131.0–138.0	135.0 (131.0–138.0)	133.0 (129.0–138.0)	0.385
Potassium (mmol/L)	3.7 (3.3–4.1)	3.7 (3.3–4.1)	3.6 (3.4–4.5)	0.660
AST (U/L)	44.0 (27.0–68.5)	44.0 (29.0–68.5)	41.0 (26.0–72.5)	0.679
ALT (U/L)	27.0 (15.5–51.0)	28.0 (15.5–49.5)	24.5 (15.8–57.3)	0.873
CRP (mg/L) (n=80)	28.1 (5.8–150.5)	21.5 (5.2–145.3)	119.1 (23.4–215.8)	0.048
PCT (ng/mL) (n=66)	0.9 (0.3–3.7)	1.0 (0.3–3.9)	0.8 (0.4–2.0)	0.795
Hgb (g/L)	122.1±22.9	122.7±20.6	119.1±32.2	0.555
WBC (G/L)	11.9 (8.1–16.5)	11.9 (8.1–17.0)	13.1 (7.3–14.6)	0.829
PLT (G/L)	273.2±122.2	268.8±115.8	295.5±152.8	0.482
hs Tn T (ng/L) (n=100)	224.0 (61.8–655.0)	214.0 (61.6–563.3)	297.0 (58.4–1,678.5)	0.554
NT-proBNP (ng/L) (n=87)	3,511.0 (509.0–14,015.0)	3,550.0 (467.8–12,244.5)	1,886 (575.0–33,586.0)	0.566
Electrocardiography (n=86)				
Atrial fibrillation (n [%])	11 (12.8)	7 (9.5)	4 (33.3)	0.043
Ventricular arrhythmia (n [%])	15 (17.6)	13 (17.6)	2 (16.7)	0.939
ST elevation (n [%])	35 (41.2)	29 (39.2)	6 (54.5)	0.334
ST depression (n [%])	16 (18.6)	15 (20.2)	1 (8.3)	0.450
T-wave changes (n [%])	23 (28.4)	21 (30.0)	2 (18.2)	0.720
Site of wall motion abnormalities in echocardiography (n=87)				
Apical type (n [%])	73 (84.9)	62 (82.7)	11 (91.7)	0.431
Basal type (n [%])	3 (3.4)	3 (4.0)	0 (0.0)	1.000
Midventricular type (n [%])	6 (6.9)	6 (8.0)	0 (0.0)	0.590
Others (n [%])	18 (18.8)	17 (22.7)	1 (8.3)	0.446
EF (%)	40.9±12.9	40.7±12.5	41.5±15.7	0.862
Coronary angiography (n=76)				
Normal (n [%])	46 (60.5)	41 (62.1)	5 (50.0)	0.034
Insignificant stenosis (n [%])	22 (28.9)	20 (30.3)	2 (20.0)	
Significant stenosis (n [%])	8 (10.5)	5 (7.6)	3 (30.0)	

eGFR, estimated glomerular filtration rate; AST, aspartate transaminase; ALT, alanine transaminase; CRP, C-reactive protein; PCT, procalcitonin; Hgb, hemoglobin; WBC, white blood cell; PLT, platelet; hs TnT, high-sensitivity troponin T; NT-proBNP, N-terminal pro-B-type natriuretic peptide; EF, ejection fraction.

is also the most popular diagnostic tool. In most cases, the exclusion of myocarditis and pheochromocytoma is based on clinical signs rather than on imaging and pathology. We recorded 10.5% of patients with significant coronary artery. This rate has fluctuated from 10%–24% in previous reports [11],[25],[26]. The Mayo Clinic diagnostic criteria (2008) have not adequately assessed situations of Takotsubo cardiomyopathy with significant coronary artery stenosis [17]. Some reports have documented the coexistence of Takotsubo cardiomyopathy and acute coronary syndrome, and the acute coronary syndrome itself may be a trigger for Takotsubo cardiomyopathy [26]–[28]. In the setting of regional dyskinesia consistent with coronary artery lesions, cardiac magnetic resonance imaging (MRI) helps differentiate from acute cor-

https://doi.org/10.32895/UMP.MPR.8.1.7

Table 3. Triggering factors and treatment characteristics

Variables	All (n=103)	Survived (n=85)	Death (n=18)	p-value
Triggering factors				
Infection (n [%])	39 (37.9)	29 (34.1)	10 (55.6)	0.088
Acute neurological disease (n [%])	3 (2.9)	2 (2.4)	1 (5.6)	0.442
Post-surgery (n [%])	4 (3.9)	3 (3.5)	1 (5.6)	0.542
Psychological stress (n [%])	2 (1.9)	2 (2.4)	0 (0.0)	1.000
Unknown (n [%])	45 (43.7)	41 (48.2)	4 (22.2)	0.066
Treatment				
Invasive mechanical ventilation (n [%])	39 (37.9)	24 (28.2)	15 (83.3)	<0.001
Renal replacement therapy (n [%])	8 (7.8)	3 (3.5)	5 (27.8)	0.004
Dobutamin (n [%])	24 (23.3)	15 (17.6)	9 (50.0)	0.003
Adrenalin (n [%])	18 (17.6)	8 (9.4)	10 (55.6)	<0.001
Noradrenalin (n [%])	42 (40.8)	28 (32.9)	14 (77.8)	<0.001
Nitro glyceryl (n [%])	7 (6.8)	6 (7.1)	1 (5.6)	1.000
Diuretic (n [%])	32 (31.1)	28 (32.9)	4 (22.2)	0.576
Antiplatelet (n [%])	32 (31.1)	27 (31.8)	5 (27.8)	0.740
Statin (n [%])	45 (43.7)	37 (43.5)	8 (44.4)	0.943
ACEi (n [%])	18 (17.5)	16 (18.8)	2 (11.1)	0.434
ARB (n [%])	22 (21.4)	21 (24.7)	1 (5.6)	0.072
ARNI (n [%])	3 (2.9)	3 (3.5)	0 (0.0)	1.000
Beta channel blocker (n [%])	18 (17.5)	17 (20.0)	1 (5.6)	0.186
Duration of treatment, day	10 (4.0–20.0)	13.5 (3.0–21.0)	11.5 (5.5–19.0)	0.790

ACEi, angiotensin converting enzyme inhibitors; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor.

Table 4. Independent risk factors of in-hospital mortality

Variables	OR	95% CI	p-value
Age	1.059	0.976–1.160	0.218
Female	0.208	0.029–1.472	0.116
Hypertension	1.729	0.234–12.774	0.591
Atrial fibrillation	5.679	0.714–45.202	0.101
Chronic kidney disease	3.362	0.351–32.217	0.293
Cancer	7.860	0.413–149.534	0.170
Infection	3.550	0.562–22.413	0.178
Acute heart failure	20.657	2.306–185.008	0.007
Acute respiratory failure	10.397	1.117–96.795	0.040

OR, odds ratio; CI, confidence interval.

onary syndromes and myocarditis. Recently, the InterTAK standard was able to overcome the limitations of the Mayo Clinic diagnostic criteria [29].

Common clinical symptoms in patients diagnosed with Takotsubo cardiomyopathy are chest pain, dyspnea, and syncope [12]. Therefore, it is difficult to distinguish from acute coronary syndrome in the initial approach. In our study, the proportion of patients with syncope was less (1.0%), probably due to cognitive impairment and serious acute comorbidities such as pneumonia, infarction. cerebral hemorrhage, post-operative status....

The physical triggers were found more often than the psychological ones, with the highest percentage being infection (37.9%). In fact, it is difficult to fully assess the psychological stress of patients due to severe illness, cognitive disturbances, communication and cultural problems. We also recorded 43.7% cases of unknown trigger. Many other studies have also had similar results, especially men are often associated with physical stress, while women are often associated with mental stress [2],[3],[11].

The median serum concentrations for hs TnT and NT-ProBNP were 224.0 ng/mL and 3,511.0 ng/L, respectively. Most studies found myocardial cell necrosis in Takotsubo cardiomyopathy, but degree of troponin increase was lower

compared to acute myocardial infarction (approximately 7.7 times upper limit of normal), and may help predict major cardiovascular events [11]. The concentration of diuretic peptides was increased in 82.9% of cases, often higher than in acute coronary syndromes (approximately 6.12 times the upper limit of normal) [11].

The abnormalities on the electrocardiogram were ST elevation (41.2%), ST depression (20.0%), T wave changes (28.4%), predominantly in the anterior thoracic leads. Regional movement disorder in the apex accounted for the highest rate (76.0%), this is also the classic form of Takotsubo cardiomyopathy. Some other locations were also recorded: the base of the heart (3.1%), the middle of the heart (6.3%), other areas (18.8%). This result was similar to many previous studies [11],[30],[31].

There were 17.6% of patients with ventricular arrhythmias (ventricular tachycardia, torsade de pointes, ventricular fibrillation) and 28.2% of patients with acute heart failure. The incidence of cardiogenic shock was 21.4%, higher than in other studies (about 5%–10%) [11],[32]. These complications are life-threatening in patients with Takotsubo cardiomyopathy and require prompt diagnosis and management.

4.2. In-hospital mortality and independent risk factors

Left ventricular systolic function recovers within 1–4 weeks in most patients with a diagnosis of Takotsubo cardiomyopathy [4],[6]–[8], however, serious complications during hospitalization have been reported similar to acute coronary syndrome [11]. Specifically, the rate of major cardiovascular events (cardiogenic shock, requiring for vasopressors, cardiac arrest, death) related with Takotsubo cardiomyopathy was comparable to that of acute myocardial infarction (38.2% vs. 32.6%) [32]. In-hospital mortality ranges from 0% to 8% [6],[7],[11],[33]. In our study, the all-cause in-hospital mortality rate was 17.5%, higher than previously reported. This may be due to: (1) the high rate of patients with cardiogenic shock (21.4%) and requiring intensive care: invasive mechanical ventilation (37.9%), renal replacement therapy (7.8%), dobutamine (23.3%), noradrenalin (40.8%); (2) a high proportion of males, most of the triggers appearing during hospitalization and are related to physical problems such as infections, stroke, post-surgery, etc. Patients with triggers related to physical stress have a worse prognosis than psychological stress [3],[34]. Furthermore, the analysis results showed that the severe events of Takotsubo cardiomyopathy were mainly due to left ventricular systolic dysfunction and arrhythmias. No cases of cardiac rupture, neurological events or thromboembolic events were recorded.

The independent risk factors of major events from Takotsubo cardiomyopathy were identified as: older age, multiple chronic comorbidities, physical triggers, acute neuropathy, elevated cardiac enzymes >10 times upper limit, ejection fraction <45%, right ventricular dysfunction, cardiogenic shock, arrhythmia [9]–[14],[35]. Some reports have shown that men have higher mortality rates than women [34],[36]. In our study, the independent risk factor for all-cause in-hospital mortality were acute heart failure and respiratory failure. Differences between studies are due to differences in study population characteristics, sample size and statistical methods.

4.3. Limitations

This study had some limitations. Since this study was an observational, retrospective, and non-control study design, it had certain disadvantages. 35.9% of cases did not fully meet the Mayo clinic criteria, myocarditis and pheochromocytoma were ruled out based on clinical manifestations rather than imaging and pathology. The systematic standard was not used to identify trigger factors, especially psychological stress. Finally, the study was conducted in one center;therefore, it was not representative of the general population.

5. CONCLUSION

Our study showed that patients diagnosed with Takotsubo cardiomyopathy were mostly female and had many acute and chronic comorbidities. Triggers associated with physical stress were found more frequently than psychological stress. Common complications are acute heart failure and ventricular arrhythmias. In-hospital mortality was high with independent risk factors identified as acute heart failure and respiratory failure at diagnosis.

https://doi.org/10.32895/UMP.MPR.8.1.7

Acknowledgements

We would like to express our sincere appreciation to the leadership and medical staff of the Department of Cardiology and Department of Interventional Cardiology at the University Medical Center Ho Chi Minh City. We also acknowledge the contributions of the organizations and functional departments for providing the necessary resources and cooperation to make this research possible.

Funding sources

Not applicable.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

ORCID

Vu Hoang Vu
https://orcid.org/0000-0001-5482-859X
Thanh Cong Nguyen
https://orcid.org/0009-0009-8293-8038
Binh Hai Thi Nguyen
https://orcid.org/0000-0003-0021-3084
Hoa Tran
https://orcid.org/0000-0001-8393-6442
Binh Quang Truong
https://orcid.org/0000-0003-4973-6919

Authors' contributions

Conceptualization: VH Vu, TC Nguyen, BTH Nguyen.
Methodology: VH Vu, TC Nguyen, BTH Nguyen.
Validation: VH Vu, TC Nguyen.
Writing - original draft: TC Nguyen, BTH Nguyen.
Writing - review & editing: VH Vu, TC Nguyen, BTH Nguyen, H Tran, BQ Truong.

Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

Ethics Approval

This study did not affect the process of the patient's diagnosis, treatment and follow-up and approved by the local ethics committee of University Medical Center at Ho Chi Minh City (number 544/HĐĐĐ-ĐHYD).

REFERENCES

1. Singh T, Khan H, Gamble DT, Scally C, Newby DE, Dawson D. Takotsubo syndrome: pathophysiology, emerging concepts, and clinical implications. Circulation. 2022;145(13):1002-19.
2. Amin HZ, Amin LZ, Pradipta A. Takotsubo cardiomyopathy: a brief review. J Med Life. 2020;13(1):3-7.
3. Gianni M, Dentali F, Grandi AM, Sumner G, Hiralal R, Lonn E. Apical ballooning syndrome or Takotsubo cardiomyopathy: a systematic review. Eurn Heart J. 2006;27(13):1523-9.
4. Wittstein IS, Thiemann DR, Lima JAC, Baughman KL, Schulman SP, Gerstenblith G, et al. Neurohumoral features of myocardial stunning due to sudden emotional stress. N Engl J Med. 2005;352(6):539-48.
5. Paur H, Wright PT, Sikkel MB, Tranter MH, Mansfield C, O'Gara P, et al. High levels of circulating epinephrine trigger apical cardiodepression in a β2-adrenergic receptor/G_i–dependent manner: a new model of Takotsubo cardiomyopathy. Circulation. 2012;126(6):697-706.
6. Sharkey SW, Lesser JR, Zenovich AG, Maron MS, Lindberg J, Longe TF, et al. Acute and reversible cardiomyopathy provoked by stress in women from the United States. Circulation. 2005;111(4):472-9.
7. Tsuchihashi K, Ueshima K, Uchida T, Oh-mura N, Kimura K, Owa M, et al. Transient left ventricular apical ballooning without coronary artery stenosis: a novel heart syndrome mimicking acute myocardial infarction. J Am Coll Cardiol. 2001;38(1):11-8.
8. Kurisu S, Sato H, Kawagoe T, Ishihara M, Shimatani Y, Nishioka K, et al. Tako-tsubo-like left ventricular dysfunction with ST-segment elevation: a novel cardiac syndrome mimicking acute myocardial infarction. Am Heart J. 2002;143(3):448-55.

9. Pelliccia F, Pasceri V, Patti G, Tanzilli G, Speciale G, Gaudio C, et al. Long-term prognosis and outcome predictors in Takotsubo syndrome: a systematic review and meta-regression study. JACC: Heart Fail. 2019;7(2):143-54.
10. Ghadri JR, Wittstein IS, Prasad A, Sharkey S, Dote K, Akashi YJ, et al. International expert consensus document on Takotsubo syndrome (part II): diagnostic workup, outcome, and management. Eur Heart J. 2018;39(22):2047-62.
11. Templin C, Ghadri JR, Diekmann J, Christian Napp L, Bataiosu DR, Jaguszewski M, et al. Clinical features and outcomes of Takotsubo (stress) cardiomyopathy. N Engl J Med. 2015;373(10):929-38.
12. Di Vece D, Citro R, Cammann VL, Kato K, Gili S, Szawan KA, et al. Outcomes associated with cardiogenic shock in Takotsubo syndrome: results from the International Takotsubo Registry. Circulation. 2019;139(3):413-5.
13. Citro R, Radano I, Parodi G, Di Vece D, Zito C, Novo G, et al. Long-term outcome in patients with Takotsubo syndrome presenting with severely reduced left ventricular ejection fraction. Eur J Heart Fail. 2019;21(6):781-9.
14. Ghadri JR, Kato K, Cammann VL, Gili S, Jurisic S, Di Vece D, et al. Long-term prognosis of patients with Takotsubo syndrome. J Am Coll Cardiol. 2018;72(8):874-82.
15. Chiu S, Nayak R, Lin B, Duan L, Shen AYJ, Lee MS. Clinical characteristics and outcomes of patients with Takotsubo syndrome. Can J Cardiol. 2021;37(8):1191-7.
16. Ghadri JR, Wittstein IS, Prasad A, Sharkey S, Dote K, Akashi YJ, et al. International expert consensus document on Takotsubo syndrome (part I): clinical characteristics, diagnostic criteria, and pathophysiology. Eur Heart J. 2018;39(22):2032-46.
17. Prasad A, Lerman A, Rihal CS. Apical ballooning syndrome (Tako-tsubo or stress cardiomyopathy): a mimic of acute myocardial infarction. Am Heart J. 2008;155(3):408-17.
18. Yerasi C, Tripathi B, Banga S, McNown C, Jonnalagadda AK, Al-Qaisi S, et al. Predictors of 90-day readmission and in-hospital mortality in Takotsubo cardiomyopathy: an analysis of 28,079 index admissions. Cardiovasc Revasc Med. 2019;20(11):973-9.
19. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure: developed by the task force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur Heart J. 2021;42(36):3599-726.
20. Mirabile VS, Shebl E, Sankari A, Burns B. Respiratory failure. StatPearls, Treasure Island, FL: StatPearls; 2023.
21. 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(3):584-8.
22. Roshanzamir S, Showkathali R. Takotsubo cardiomyopathy a short review. Curr Cardiol Rev. 2013;9(3):191-6.
23. Aizawa K, Suzuki T. Takotsubo cardiomyopathy: Japanese perspective. Heart Fail Clin. 2013;9(2):243-7.
24. Ghadri JR, Ruschitzka F, Lüscher TF, Templin C. Takotsubo cardiomyopathy: still much more to learn. Heart. 2014;100(22):1804-12.
25. Winchester DE, Ragosta M, Taylor AM. Concurrence of angiographic coronary artery disease in patients with apical ballooning syndrome (Tako-tsubo cardiomyopathy). Catheter Cardiovasc Interv. 2008;72(5):612-6.
26. Kurisu S, Inoue I, Kawagoe T, Ishihara M, Shimatani Y, Nakama Y, et al. Prevalence of incidental coronary artery disease in Tako-tsubo cardiomyopathy. Coron Artery Dis. 2009;20(3):214-8.
27. Y-Hassan S, Böhm F. The causal link between spontaneous coronary artery dissection and Takotsubo syndrome: a case presented with both conditions. Int J Cardiol. 2016;203:828-31.
28. Redfors B, Råmunddal T, Shao Y, Omerovic E. Takotsubo triggered by acute myocardial infarction: a common but overlooked syndrome? J Geriatr Cardiol. 2014;11(2):171-3.
29. Fundão NHF, Ribeiro HB, Campos CM, Seleme VB, Soeiro AM, Vieira MLC, et al. The clinical course of Takotsubo syndrome diagnosed according to the InterTAK

 https://doi.org/10.32895/UMP.MPR.8.1.7

criteria. Int J Cardiovasc Sci. 2020;33(6):637-47.
30. Parkkonen O, Allonen J, Vaara S, Viitasalo M, Nieminen MS, Sinisalo J. Differences in ST-elevation and T-wave amplitudes do not reliably differentiate Takotsubo cardiomyopathy from acute anterior myocardial infarction. J Electrocardiol. 2014;47(5):692-9.
31. de Miguel IM, Núñez-Gil IJ, Pérez-Castellanos A, Uribarri A, Duran-Cambra A, Martín-García A, et al. Electrocardiographic characteristics and associated outcomes in patients with Takotsubo syndrome: insights from the RETAKO registry. Curr Probl Cardiol. 2021;46(8):100841.
32. Vallabhajosyula S, Barsness GW, Herrmann J, Anavekar NS, Gulati R, Prasad A. Comparison of complications and in-hospital mortality in Takotsubo (apical ballooning/stress) cardiomyopathy versus acute myocardial infarction. Am J Cardiol. 2020;132:29-35.
33. Bybee KA, Kara T, Prasad A, Lerman A, Barsness GW, Scott Wright R, et al. Systematic review: transient left ventricular apical ballooning: a syndrome that mimics ST-segment elevation myocardial infarction. Ann Intern Med. 2004;141(11):858-65.
34. Sobue Y, Watanabe E, Ichikawa T, Koshikawa M, Yamamoto M, Harada M, et al. Physically triggered Takotsubo cardiomyopathy has a higher in-hospital mortality rate. Int J Cardiol. 2017;235:87-93.
35. Citro R, Bossone E, Parodi G, Rigo F, Nardi F, Provenza G, et al. Independent impact of RV involvement on in-hospital outcome of patients with Takotsubo syndrome. JACC: Cardiovasc Imaging. 2016;9(7):894-5.
36. Brinjikji W, El-Sayed AM, Salka S. In-hospital mortality among patients with Takotsubo cardiomyopathy: a study of the National Inpatient Sample 2008 to 2009. Am Heart J. 2012;164(2):215-21.