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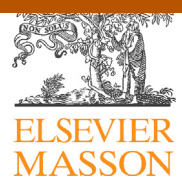

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CLINICAL RESEARCH

Management of Takotsubo cardiomyopathy in non-academic hospitals in France: The Observational French SyndromEs of TakoTsubo (OFSETT) study

Prise en charge du syndrome de Takotsubo dans les hôpitaux non universitaires français : Observatoire français des syndromes de Takotsubo (OFSETT)

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Abbreviations: ACS, acute coronary syndromes; BNP, brain natriuretic peptide; ECG, electrocardiography; IQR, interquartile range; MRI, magnetic resonance imaging; NT-proBNP, N-terminal prohormone brain natriuretic peptide; OFSETT, Observatory of French SyndromEs of TakoTsubo; SD, standard deviation; TTC, Takotsubo cardiomyopathy; ULN, upper limit of normal.

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KEYWORDS
Takotsubo cardiomyopathy;
ST-segment elevation;
B-type natriuretic peptide

Summary
Background. — Takotsubo cardiomyopathy (TTC) is a rare condition characterized by a sudden temporary weakening of the heart. TTC can mimic acute myocardial infarction and is associated with a minimal release of myocardial biomarkers in the absence of obstructive coronary artery disease.
Aims. — To provide an extensive description of patients admitted to hospital for TTC throughout France and to study the management and outcomes of these patients.
Methods. — In 14 non-academic hospitals, we collected clinical, electrocardiographic, biological, psychological and therapeutic data in patients with a diagnosis of TTC according to the Mayo Clinic criteria.
Results. — Of 117 patients, 91.5% were women, mean ± SD age was 71.4 ± 12.1 years and the prevalence of risk factors was high (hypertension: 57.9%, dyslipidaemia: 33.0%, diabetes: 11.5%, obesity: 11.5%). The most common initial symptoms were chest pain (80.5%) and dyspnoea (24.1%). A triggering psychological event was detected in 64.3% of patients. ST-segment elevation was found in 41.7% of patients and T-wave inversion in 71.6%. Anterior leads were most frequently associated with ST-segment elevation, whereas T-wave inversion was more commonly associated with lateral leads, and Q-waves with septal leads. The ratio of peak B-type natriuretic peptide (BNP) or N-terminal prohormone BNP (NT-proBNP) level to peak troponin level was 1.01. No deaths occurred during the hospital phase. After 1 year of follow-up, 3 of 109 (2.8%) patients with available data died, including one cardiovascular death. Rehospitalizations occurred in 17.4% of patients: 2.8% due to acute heart failure and 14.7% due to non-cardiovascular causes. There was no recurrence of TTC.
Conclusions. — This observational study of TTC included primarily women with atherosclerotic risk factors and mental stress. T-wave inversion was more common than ST-segment elevation. There were few adverse cardiovascular outcomes in these patients after 1-year follow-up.

MOTS CLÉS
Syndrome de Takotsubo ;
Sus-décalage ST ;
B-type natriuretic peptide

Résumé
Contexte. — Le syndrome de Takotsubo est une affection rare caractérisée par un affaiblissement temporaire soudain du cœur. Le syndrome de Takotsubo peut simuler un infarctus du myocarde aigu et est associé à une élévation minime des biomarqueurs de nécrose myocardique en l'absence de maladie coronaire obstructive.
Buts. — Fournir une description extensive d'une population de patients admis pour un syndrome de Takotsubo sur le territoire français et d'étudier la prise en charge et l'évolution de ces patients.
Méthodes. — Nous avons rassemblé les données cliniques, électrocardiographiques, biologiques, psychologiques et thérapeutiques chez des patients admis pour un syndrome de Takotsubo sur les critères diagnostiques de la Mayo Clinic, dans 14 hôpitaux non universitaires de France.

Résultats. — Cent dix-sept patients ont été inclus. Les patients étaient en majorité des femmes (91,5 %) d'âge moyen 71,4 ± 12,1 ans, présentant fréquemment des facteurs de risque cardiovasculaire (hypertension : 57,9 %, dyslipidémie : 33,0 %, diabète : 11,5 %, obésité : 11,5 %). Les principaux symptômes à l'admission étaient la douleur thoracique (80,5 %) et la dyspnée (24,1 %). Un événement psychologique déclenchant était identifié chez 64,3 % des patients. Le sus-décalage du segment ST était retrouvé chez 41,7 % des patients et une inversion de l'onde T dans 71,6 % des cas. Les dérivations antérieures étaient les plus souvent concernées en cas de sus-décalage du ST, les dérivations latérales en cas d'inversion de l'onde T et les dérivations septales en cas d'onde Q. Le rapport BNP ou NT-proBNP/troponine était de 1,01. Il n'y avait aucun décès hospitalier. Après un an de suivi, trois patients (2,8 %) étaient décédés dont un décès de cause cardiovasculaire. Des réhospitalisations ont été observées chez 2,8 % des patients pour insuffisance cardiaque aiguë, et pour raisons non cardiovasculaires chez 14,7 % de ceux-ci. Il n'y a pas eu de récidive de syndrome de Takotsubo.
Conclusions. — Cet observatoire du syndrome de Takotsubo a inclus des femmes ayant de nombreux facteurs de risque cardiovasculaire et un facteur aigu de stress mental. L'électrocardiogramme montrait dans moins de la moitié des cas un sus-décalage ST et plus fréquemment une inversion de l'onde T. Il y avait peu de complications cardiovasculaires après un suivi d'un an.

Introduction

Takotsubo cardiomyopathy (TTC) is a cardiac syndrome characterized by transient left ventricular dysfunction, electrocardiographic changes that can mimic acute myocardial infarction, and a minimal release of myocardial biomarkers in the absence of obstructive coronary artery disease [1—4]. Observational data from cohorts of patients presenting with acute TTC provide the opportunity to improve the knowledge of this syndrome. While data from some observational studies have been particularly helpful [5—7], others suffer from a relative lack of representativeness [6] or are highly representative but did not collect extensive clinical data [5]. Mansencal et al. provided epidemiological data on TTC in the Paris area [7]; however, there are no nationwide data on the management of this disease.

The Observational French SyndromEs of TakoTsubo (OFSETT) was designed to collect extensive nationwide data from patients hospitalized for TTC with a follow-up of 1 year. A distinctive feature of OFSETT is the comprehensive data collected in terms of clinical, electrocardiographic, biological and psychological aspects, and the treatment of these patients. The aims of OFSETT were to provide detailed description of the population of patients admitted for TTC throughout France.

Methods

Study design

OFSETT was a multicentre observational study of TTC diagnosed in French non-academic hospitals (Appendix A). The study prospectively included consecutive patients with TTC from December 2010 to December 2011. To increase the number of patients included, the study also collected data retrospectively from the hospital records of patients admitted with this syndrome from November 2005 to November 2010 in the same centres.

The cardiologists who participated in the study were not supposed to modify their therapeutic approach for these patients in any way. Patients provided written informed consent to participate. The study was conducted in accordance with good clinical practice, French law and the French data protection law. The data recorded and the way they were handled and stored were reviewed and approved by the Comité consultatif sur le traitement de l'information en matière de recherche dans le domaine de la santé (No. CCTIRS: 10.067) and the Commission nationale informatique et liberté (No. CNIL: 910131).

Patients and centres

Eligible patients were ≥18 years of age and met the Mayo Clinic diagnostic criteria for TTC [8], namely: transient hypokinesis, akinesis or dyskinesis of the left ventricular mid-segments with or without apical involvement; regional wall motion abnormalities extend beyond a single epicardial vascular distribution; a stressful trigger is often, but not always, present; the absence of obstructive coronary disease or angiographic evidence of acute plaque rupture; appearance of new electrocardiographic (ECG) abnormalities (ST-segment elevation and/or T-wave inversion) or a modest elevation in cardiac troponin; and the absence of pheochromocytoma or myocarditis. No exclusion criteria were applied. All patients underwent coronary angiography on admission.

Centres selected to participate were required to have a cardiac intensive care unit and a catheterization laboratory available 24/7 and to perform >1000 percutaneous coronary interventions per year. Of 83 non-academic hospitals with interventional cardiology facilities in France, 30 fulfilled these criteria and 14 agreed to participate.

Data collection

A computerized case record form was completed for each eligible patient, based on hospital records and

additional specific questionnaires. The following data were collected: medical history and presenting characteristics (clinical characteristics including psychological assessment, electrocardiographic, echocardiographic and angiographic characteristics); cardiac biomarkers (troponin and B-type natriuretic peptide [BNP] or N-terminal prohormone BNP [NT-proBNP]); and treatment at admission and at discharge. Patients were followed up for 1 year. The outcomes were in-hospital complications, all-cause death, cardiac rehospitalization (including recurrence of TTC and heart failure) and non-cardiac rehospitalization at 1 year.

Definitions

Peak cardiac troponin and peak BNP or NT-proBNP levels are expressed as multiples of the upper limit of normal (ULN) — defined as the 99th percentile — in each biological laboratory because the ULN of these tests can differ by laboratory and type of reagent used. The ratio of peak BNP or NT-proBNP increase (multiple of the ULN) to peak troponin increase (multiple of the ULN) was calculated for each patient with available data.

The triggering stressor event was assessed in each patient. Physical stress was defined as the force applied to a given area of biological tissue, and included surgical procedures such as cholecystectomy, colonoscopy, difficult urinary catheterization, pacemaker implantation and electrical cardioversion [9,10]. Mental stress (emotionally induced stress) included the death, severe illness or injury of a loved one; the receipt of bad news; a severe argument; an assault; public speaking; financial loss; a car accident; and natural disasters [9,11].

Statistical analysis

Categorical variables are expressed as counts and percentages and comparisons were made using the Chi-square test or Fisher's exact test. Continuous variables are expressed as means and standard deviations (SDs) or medians and interquartile ranges (IQRs) and comparisons were made with Student's *t* test or the Mann-Whitney U test. For all tests, statistical significance was set at $P < 0.05$. The data were analysed using Stata SE 10 (Stata Statistical Software: Release 10 [2007]; StataCorp LP, College Station, Texas, USA).

Results

The study population comprised 117 patients, 56 of whom were enrolled prospectively and 61 retrospectively. Most of the patients were women (91.5%), the mean ± SD age was 71.4 ± 12.1 years and the prevalence of risk factors was high (Table 1). The only significant difference between the retrospective and prospective groups was more frequent prevalence of diabetes mellitus in the prospective group ($P = 0.03$). The most common initial symptoms were chest pain (80.5%) and dyspnoea (24.1%). A triggering event was detected in 64.3% of patients. Among patients for whom a triggering event was detected, mental stress was found in 70.4% and physical stress in 26.1%.

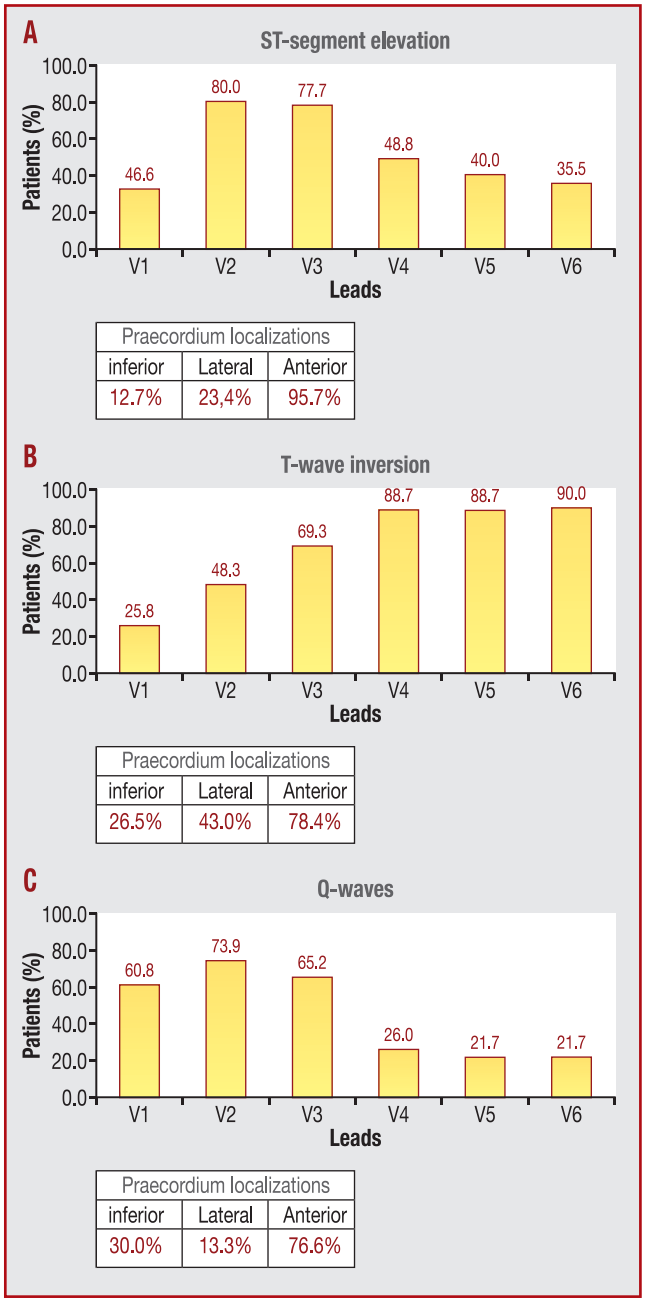

Figure 1. Precordium electrocardiographic lead positions for: (A) ST-segment elevation, (B) T-wave inversion and (C) Q-waves.

ST-segment elevation was found in 45/117 (41.7%) patients and T-wave inversion in 78/117 (71.6%) patients. Q-wave was present in 30/117 (29.1%) patients. The precordium localizations by lead number are shown in Fig. 1. Anterior leads were most frequently associated with ST-segment elevation, whereas T-wave inversion was more commonly associated with lateral leads and Q-waves with septal leads.

Cardiac biomarkers

Data on cardiac biomarkers are shown in Table 2. Among the 35 patients who had sufficient data to calculate the ratio BNP (or NT-proBNP)/troponin, the median increase of

Table 1 Baseline characteristics.

Characteristics	All OFSETT ($n=117$)	Prospective group ($n=56$)	Retrospective group ($n=61$)
Women	107/117 (91.5)	51/56 (91.1)	56/61 (91.8)
Age (years)	71.4 ± 12.1	70.5 ± 12.5	72.3 ± 11.8
Admission mode			
Mobile intensive care unit	56/114 (49.1)	31/54 (57.4)	25/60 (41.7)
Emergency department	34/114 (29.8)	14/54 (25.9)	20/60 (33.3)
Cardiovascular risk factors			
Hypertension	66/114 (57.9)	29/55 (52.7)	37/59 (62.7)
Diabetes mellitus	13/113 (11.5)	10/55 (18.2)	3/58 (5.2)[a]
Active smokers	6/111 (5.4)	5/54 (9.3)	1/59 (1.7)
Obesity (BMI ≥30 kg/m^2)	11/96 (11.5)	7/47 (14.9)	4/49 (8.2)
Dyslipidaemia	37/112 (33.0)	20/54 (37.0)	17/58 (29.3)
Psychiatric history	11/110 (10.0)	6/54 (11.1)	5/56 (8.9)
Medical history			
Previous stroke/TIA	7/113 (6.2)	4/54 (7.4)	3/59 (5.1)
Previous coronary heart disease	8/113 (7.1)	6/54 (11.1)	2/59 (3.4)
Peripheral artery disease	7/111 (6.3)	1/53 (1.9)	6/58 (10.3)
COPD	6/111 (5.4)	3/53 (5.7)	3/59 (5.1)
Chronic kidney disease	1/91 (1.1)	0/32 (0.0)	1/59 (1.7)
Symptoms at admission			
Chest pain	91/113 (80.5)	41/54 (75.9)	50/59 (84.7)
Dyspnoea	27/112 (24.1)	12/54 (22.2)	15/58 (25.9)
Syncope	7/114 (6.1)	4/54 (7.4)	3/60 (5.0)
Clinical examination			
Heart rate (beats/min)	82.5 ± 16.8	84.1 ± 14.4	80.9 ± 18.8
Systolic blood pressure (mmHg)	129.3 ± 23.2	129.3 ± 23.4	129.3 ± 23.2
Acute heart failure	7/113 (6.2)	2/53 (3.8)	5/60 (8.3)
Cardiogenic shock	4/112 (3.6)	2/52 (3.8)	2/60 (3.3)
Psychological events			
Identifiable	74/115 (64.3)	41/56 (73.2)	33/59 (55.9)
Mental stress[b]	50/71 (70.4)	25/38 (65.8)	25/33 (75.8)
Physical stress[b]	18/69 (26.1)	10/37 (27.0)	8/32 (25.0)

Data are *n*/N (%) or mean ± standard deviation. BMI: body mass index; COPD: chronic obstructive pulmonary disease; MICU: mobile intensive care unit; TIA: transient ischaemic attack.
[a] $P=0.03$ (all other between-group *P*-values were non-significant).
[b] Among subjects with an identifiable psychological event.

Table 2 Cardiac biomarkers.

Characteristics	All OFSETT	Prospective group	Retrospective group[a]
Peak troponin level (pg/mL; $n=117$)	4.9 (0.9—215)	4.4 (0.9—113)	5.2 (0.9—270)
Peak BNP level (pg/mL; $n=23$)	527 (285—1005)	482 (285—1005)	536 (238—1088)
Peak NT-proBNP level (pg/mL; $n=27$)	4735 (2329—12,156)	6292 (2351—11,684)	4363 (2329—12,300)
Peak troponin increase[b] ($n=108$)	9.0 (2.7—22.4)	10.4 (3.0—35.7)	6.2 (2.4—18.2)
Peak BNP or NT-proBNP increase[b] ($n=37$)	7.6 (3.6—14.5)	8.0 (3.5—23.5)	5.5 (3.4—11.7)
Peak BNP (or NT-proBNP) increase/peak troponin increase[b] ($n=35$)	1.01 (0.15—7.6)	1.03 (0.15—5.41)	0.92 (0.17—7.6)

Data are median (interquartile range).
[a] Between-group (prospective vs. retrospective) *P*-values (Mann-Whitney U test) were non-significant.
[b] Multiple of the upper limit of normal (99th percentile) in each biological laboratory.

Table 3 Echocardiographic, angiographic and ventriculographic characteristics.

Characteristics	All OFSETT ($n=117$)	Prospective group ($n=56$)	Retrospective group ($n=61$)[a]
Echocardiographic characteristics			
Typical pattern of TTC[b]	79 (67.5)	37 (66.1)	42 (68.9)
Atypical pattern of TTC[c]	37 (31.6)	18 (32.1)	19 (31.1)
Inverted TTC[d]	1 (0.9)	1 (1.8)	0 (0)
LVEF[b] (%)	41.7 ± 10.1	41.2 ± 10.8	42.2 ± 9.6
Angiographic and ventriculographic characteristics			
Normal coronary angiography	92 (76.9)	41 (71.4)	51 (82.0)
Non-significant abnormalities	25 (21.4)	15 (26.8)	10 (16.4)
LVEF[c] (%)	45.7 ± 12.2	45.1 ± 13.0	46.2 ± 11.8

Data are *n*/N (%) or mean ± standard deviation. LVEF: left ventricular ejection fraction.
[a] Between-group (prospective vs. retrospective) *P*-values were non-significant.
[b] Apical ballooning of the left ventricle.
[c] Regional wall motion abnormalities involved apex and/or mid-ventricular segments.
[d] Basal ballooning of the left ventricle.

the peak troponin level was 9.0 (2.7—22.4) for BNP and 7.6 (3.6—14.5) for NT-proBNP levels. The median of the ratio of peak BNP (or NT-proBNP) to peak troponin was close to 1.

Echocardiographic, angiographic and ventriculographic characteristics

The typical pattern of TTC (apical ballooning) was observed in 67.5% of patients at echocardiography (Table 3). All 117 patients underwent coronary angiography and 89/117 (76.1%) had supplementary ventriculography. Coronary angiography results were normal in 76.9% of patients, while 21.4% had non-significant abnormalities and angiographically stable coronary stenosis. One patient had significant stenosis of a first diagonal and one patient had significant stenosis of an artery bisector of small calibre, but in these two cases, the regional wall motion abnormality did not correspond with the coronary artery distribution. Cardiac assessment with other imaging techniques was also undertaken in some patients: cardiac magnetic resonance imaging (MRI; $n=26$), myocardial scintigraphy ($n=5$) and computed tomography coronary angiography ($n=1$). These imaging techniques confirmed the diagnosis of TTC.

Medical treatments

At admission, one patient had received prehospital thrombolytic therapy administered in a mobile intensive care unit. No patients received thrombolysis while in hospital. Aspirin (93.3%), clopidogrel (83.0%) and statins (62.4%) were started at admission to hospital (Table 4). Aspirin and clopidogrel were maintained at discharge in 60.6 and 27.9% of patients, respectively. Psychological management was provided in 88 patients, most often by cardiologists (52 patients) and nurses (23 patients; Table 4). The intervention of a psychiatrist was justified in 12 patients and a psychologist in one patient.

Clinical outcome

No deaths occurred during hospitalization and there were no transfers to the psychiatric department. In-hospital events were mainly haemodynamic complications and cardiac rhythm disorders (7.2%), essentially supra-ventricular arrhythmia.

One-year follow-up data were available in 109/117 patients (93.2%). Three patients (2.8%) died, all in the retrospective group, one from a lung adenocarcinoma at 5 months, one from a pulmonary infection at 51 days and one from sudden death at 3 months. Cardiac rehospitalizations (all for heart failure) occurred in 2.8% of patients (1/54 [1.9%] in the retrospective group vs. 2/55 [3.6%] in the prospective group, $P=$ NS). Sixteen patients (14.7%) were rehospitalized for a non-cardiac reason (7/54 [13.0%] in the retrospective group vs. 9/55 [16.4%] in the prospective group, $P=$ NS). There was no recurrence of TTC.

Discussion

In OFSETT, the population of patients with TTC comprised mainly postmenopausal women with atherosclerotic risk factors who presented with chest pain and/or dyspnoea at admission, as has been reported in other observational studies [5,12]. Less than 50% of patients had ST-segment elevation. The clinical presentation of TTC was similar to that of acute coronary syndromes (ACS) [4]. However, the OFSETT population included fewer smokers (5.4%) and patients with diabetes mellitus (11.5%) than did patients with ACS in the FAST-MI study (34 and 21%, respectively) [13].

Patients in OFSETT presented with more mental stress than physical stress, contrary to the finding of Namgung in a study of Korean patients [14]. ST-segment elevation was present in less than half of our patients (and was more frequently found in anterior leads); T-wave inversion was the most common ECG abnormality (and was more frequently

Table 4 Medical treatment.

Characteristics	All OFSETT ($n=117$)	Prospective group ($n=56$)	Retrospective group ($n=61$)
Treatment started at admission			
ACE inhibitors/ARB	78/104 (75.0)	35/49 (71.4)	43/55 (78.2)
Aspirin	97/103 (93.3)	48/49 (98.0)	49/54 (89.1)
Beta-blocker	78/103 (75.7)	40/50 (80.0)	38/53 (71.7)
Clopidogrel	88/106 (83.0)	44/50 (88.0)	44/56 (78.6)
Glyceryl trinitrate	13/101 (12.9)	6/50 (12.0)	7/51 (13.7)
LMWH/fondaparinux	79/108 (76.7)	37/48 (77.1)	42/55 (76.4)
Statin	63/101 (62.4)	30/48 (62.5)	33/53 (62.3)
Unfractionated heparin	26/100 (26.0)	7/46 (15.2)	19/54 (35.2)[a]
Treatment at discharge			
ACE inhibitors/ARB	84/105 (80.0)	40/49 (81.6)	44/56 (78.6)
Aspirin	66/109 (60.6)	31/50 (62.0)	35/59 (59.3)
Beta-blocker	80/108 (74.1)	43/50 (86.0)	37/58 (63.8)[b]
Clopidogrel	29/104 (27.9)	15/47 (32.9)	14/57 (24.6)
Glyceryl trinitrate	1/103 (1.0)	1/47 (2.1)	0/56 (0)
Statin	49/102 (48.0)	24/47 (51.1)	25/55 (45.5)
Psychological management			
By cardiologist	52/102 (51.0)	24/49 (49.0)	28/53 (52.8)
By nurse	23/90 (25.6)	12/44 (27.3)	11/46 (23.9)
By psychiatrist	12/99 (12.1)	6/48 (12.5)	6/51 (11.8)
By psychologist	1/97 (1.0)	0/46 (0)	1/51 (2.0)

Data are n/N (%). ACE: angiotensin-converting enzyme; ARB: angiotensin receptor blocker; LMWH: low-molecular-weight heparin.
[a] $P=0.02$ (prospective vs. retrospective).
[b] $P=0.008$ (prospective vs. retrospective).

found in lateral leads) and Q-waves were the least common ECG change (and the more frequently found in septal leads) — in contrast to that previously described in the literature. Two systematic reviews — by Pilgrim and Wyss [15] and Gianni et al. [1] — showed that ST-segment elevation was the most common ECG change in TTC (81.6 and 71.0%, respectively) followed by T-wave inversion (61.3 and 64.3%, respectively) and pathological Q-waves (31.1 and 31.8%, respectively). ST-segment elevation was also the common ECG finding in several other studies [5,7,12,16].

In the present study, peak cardiac troponin levels were modest compared to that observed in acute myocardial infarction [4,17—19]; and the ratio of BNP (or NT-proBNP) to troponin was 1.01. This ratio of around 1 is uncommon in acute myocardial infarction, where troponin elevation is higher than BNP elevation [17,18]. In a recent prospective multicentre report, which compared 62 patients with TTC to 90 with an ACS, Doyen et al. [20] observed that BNP levels were higher in patients with TTC but also that troponin levels were lower than those in patients with ST-segment elevation myocardial infarction, and similar to those in non-ST-segment elevation myocardial infarction. Therefore, the ratio of BNP to troponin levels may help to differentiate TTC from ST-segment elevation myocardial infarction [17,18]. Although many observational studies have reported a significant rise in troponin in patients with TTC, they did not measure BNP concentrations in their patients [5,12,21]. Some authors observed that BNP and NT-proBNP are substantially elevated and significantly increased during the first 24 hours after the onset of TTC, with slow and incomplete resolution during the 3 months thereafter; and the peak NT-proBNP concentration correlated with the severity of regional wall motion abnormality or systolic dysfunction assessed by echocardiography [22]. Ribeiro et al. suggested that BNP or NT-proBNP may also predict complications during hospitalization [23].

Only one patient received prehospital fibrinolysis, indicating the merit of primary coronary angiography to avoid inappropriate fibrinolysis in these patients. The French Emergency Medical System has medical intensive care units that allow most patients with an ACS to be admitted quickly to a catheterization laboratory [13,24,25]. At admission, the treatment of TTC is similar to that of ACS, including administration of antiplatelet agents and low-molecular-weight heparin or fondaparinux in a cardiac intensive care unit. Once a diagnosis of TTC has been made, treatment usually involves standard heart failure therapy, such as angiotensin-converting enzyme inhibitors and beta-blockers [26], and suitable psychological care is given at discharge. In the present study, antiplatelet agents were maintained at discharge in many patients due to the lack of diagnosis confirmation; however, at subsequent follow-up with cardiologists these treatments were discontinued.

Few complications and no in-hospital deaths were observed in the present study, and there was no recurrence of TTC. Previous studies have also reported a good prognosis of TTC, with in-hospital complication rates ranging from 1.2 to 4.2% [1,27]. Recurrence rates range from 0 to 15% [6,28].

Rehospitalization for non-cardiovascular causes is common in this older population.

This study was conducted in non-academic hospitals because, nationwide, they take care of 61% of patients with an ACS and represent 32% of interventional cardiology activity [29].

Limitations

The need for a sufficient number of patients with TTC to enable statistical analysis in a short time required us to distinguish two phases (prospective and retrospective), with the associated risks of different data collection and treatment. Comparison of the two phases has, however, revealed no statistically significant differences to prevent the merging of the two cohorts, except for diabetes mellitus. The completeness of data collection also allowed a satisfactory analysis. Second, cardiac MRI was performed in only 22.2% of patients in OFSETT for logistical reasons. Cardiac MRI offers a significant advance, allowing the elimination of necrosis, confirming the disappearance of apical ballooning and the restoration of a normal left ventricular ejection fraction, and it would be regrettable not to gather such data in this field [30]. The usefulness of MRI is established in the assessment of left ventricular function and the detection of apical thrombus or right ventricular involvement [31,32]. Cardiac MRI can distinguish TTC from acute myocardial infarction [33] and its systematic use should be proposed. Third, as this was an observational study some of the data are incomplete. Less than 50% patients had BNP or NT-proBNP data. The measurement of BNP should be systematic since cardiac biomarker levels appear helpful for the diagnosis.

Conclusions

This observational study of TTC included primarily elderly women with high prevalence of atherosclerotic risk factors and mental stress who presented with chest pain and/or dyspnoea. Less than half of the patients had ST-segment elevation, but nearly three-quarters had T-wave inversion. There were few adverse cardiovascular outcomes in these patients after 1-year follow-up.

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Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. OFSETT participating sites, investigators and number of patients enrolled

Site	Investigator	Number of patients enrolled
Centre hospitalier d'Haguenau (Haguenau)	Dr Hanssen	27
Centre hospitalier Saint-Joseph — Saint-Luc (Lyon)	Dr Aupetit	23
Polyclinique les Fleurs (Olliuoles)	Dr Commeau	14
Centre hospitalier Bretagne-Atlantique (Vannes)	Dr Filippi	11
Centre hospitalier d'Annecy (Annecy)	Dr Belle	11
Centre hospitalier de Versailles — hôpital André-Mignot (Le Chesnay)	Dr Georges	10
Les hôpitaux de Chartres (Chartres)	Dr Albert	4
Centre hospitalier de Compiègne (Compiègne)	Dr Meimoun	4
Centre hospitalier de Vichy (Vichy)	Dr Marcaggi	4
Centre hospitalier Bretagne-Sud (Lorient)	Dr Baleynaud	3
Groupe hospitalier intercommunal Le Raincy-Montfermeil (Montfermeil)	Dr Cattan	2
Institut mutualiste Montsouris (Paris)	Dr Dibie	2
Centre hospitalier du Pays d'Aix (Aix-En-Provence)	Dr Barnay	1
Centre hospitalier du Mans (Le Mans)	Dr Legrand	1
Total		117

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