Despite its higher resolution, OCT may not be the optimal imaging modality to detect a MB, mainly because of its limited penetration and rapid OCT fiber pullback and image acquisition (20 mm/s vs. 0.5 mm/s in IVUS). For this reason, we also performed OCT manually with the lens stationary at the MB segment.

In conclusion, in patients with MB documented angiographically and by IVUS, OCT detected a sharp border and heterogeneous, signal-poor fusiform area indicative of arterial tunneling through the myocardium that was distinct from the echolucent muscle band found on IVUS.

Zi Ye, MM
Yan Lai, MM
Gary S. Mintz, MD
Yian Yao, MM
Jiani Tang, MM
Yu Luo, MD
Jiming Li, MD
Yunkai Wang, MD
Junbo Ge, MD
Xuebo Liu, MD*

*Shanghai East Hospital
Tongji University School of Medicine
Jimo Road 150
Shanghai 200120
China
E-mail: liuxuebo70@126.com

http://dx.doi.org/10.1016/j.jcmg.2015.05.006

Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose. Drs. Ye and Lai contributed equally to this work.

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Independent Impact of RV Involvement on In-Hospital Outcome of Patients With Takotsubo Syndrome

Takotsubo syndrome (TTS) is an acute clinical condition characterized by transient left ventricular dysfunction and reversible heart failure, the pathogenetic mechanism of which remains unclear. Although left ventricular apical ballooning is the most frequent morphological pattern, other variant forms have been described (1). In addition, right ventricular involvement (RVi), characterized by the presence of right ventricular (RV) apical dysfunction (biventricular ballooning), has been documented using echocardiography or cardiac magnetic resonance imaging. However, the prevalence, clinical profile, and in-hospital course of TTS patients with RVi are still not well defined. To date, although RVi has been associated with a higher complication rate (2), no correlation with short-term cardiac morbidity or mortality has been reported. The aim of this study was to describe the prevalence and prognostic impact of RVi in TTS.

TTS patients with typical left ventricular apical ballooning enrolled in the Tako-tsubo Italian Network from January 2002 to June 2014 were included. Eleven hospitals contributed by providing data from a minimum of 11 to a maximum of 32 patients for each center. Patients presenting more than 24 h after symptom onset were excluded. The structure and methods of the Tako-tsubo Italian Network have been previously published (2). Data were prospectively recorded on a standardized form including information on patient demographics, pre-existing comorbidities, signs and symptoms at presentation, medical history, trigger events (emotional or physical), ST-segment elevation changes on admission, and clinical observations during hospitalization. The Charlson comorbidity index was calculated. Blood samples were collected every 6 h to measure peak troponin I concentrations in the acute phase. Brain natriuretic peptide (BNP) levels were also recorded daily during the acute phase. Standard transthoracic 2-dimensional echocardiography was performed within 6 h of hospital admission. The echocardiography transducer was adjusted to the level of the RV chamber to achieve optimal visualization of RV size and endocardial borders. To define RVi, the RV wall motion was evaluated qualitatively by visual assessment, in the parasternal long axis, apical, and subcostal 4-chamber views. All patients underwent coronary angiography and left ventriculography within 24 h of symptom onset to confirm the TTS diagnosis. Acute heart failure, cardiogenic shock, and in-hospital mortality were considered major adverse events. The study was approved by the local ethics committee, and all patients gave consent for the use of their medical records for research purposes.

The study population included 339 patients (mean age 69.7 ± 11.2 years; 91.7% female patients). RVi was observed in 56 patients (16.5% of the overall population). Demographic, clinical, electrocardiographic, and echocardiographic features of the overall population and a comparison at univariate analysis of the same variables in patients with and without RVi are reported in **Table 1**. In the overall population, acute heart failure was the most frequent major adverse event (n = 57, 16.8%). Cardiogenic shock and in-hospital death occurred in 23 (6.8%) and 6 (1.8%) patients, respectively.

On multivariate analysis, RVi (hazard ratio [HR]: 2.561; 95% confidence interval [CI]: 1.227 to 5.346;

TABLE 1 Clinical Features and In-Hospital Outcomes of Patients With Apical TTS With and Without RVi

	Patients With RVi (n = 56; 16.5%)	Patients Without RVi (n = 283; 83.5%)	p Value
Age, yrs	67.7 ± 13.6	70.1 ± 10.6	0.145
Male	4 (7.1)	24 (8.5)	0.740
Systolic blood pressure, mm Hg	123.7 ± 20.4	125.2 ± 23.6	0.661
Heart rate, beats/min	89.1 ± 17.6	85.6 ± 18.8	0.203
Chest pain at presentation	42 (75.0)	227 (80.2)	0.371
Dyspnea at presentation	23 (41.1)	38 (13.4)	<0.001
COPD	14 (25.0)	34 (12.0)	0.019
Charlson comorbidity index	4.3 ± 1.9	3.8 ± 1.9	0.050
ST-segment elevation	29 (51.8)	192 (67.8)	0.031
Troponin I, ng/ml	1.5 ± 1.6	4.9 ± 9.9	0.013
Brain natriuretic peptide, pg/ml	1,080.3 ± 775.2	824.4 ± 441.8	<0.001
GFR, ml/min	66.8 ± 24.9	69.2 ± 23.6	0.627
Left ventricular ejection fraction, %	35.2 ± 7.0	36.2 ± 7.4	0.329
Wall motion score index	1.96 ± 0.28	1.84 ± 0.24	0.002
E/e′ ratio	11.7 ± 3.3	10.9 ± 2.6	0.064
Right ventricular fractional area change, %	32.3 ± 5.9	40.0 ± 11.0	<0.001
Systolic pulmonary artery pressure, mm Hg	43.9 ± 15.0	40.0 ± 5.8	0.001
TAPSE, mm	18.7 ± 4.0	20.0 ± 4.1	0.084
Moderate to severe mitral regurgitation	20 (35.7)	47 (16.6)	0.013
Left ventricular outflow tract obstruction	7 (12.5)	17 (6.0)	0.091
In-hospital major adverse events			
Acute heart failure	20 (35.7)	37 (13.1)	<0.001
Cardiogenic shock	3 (5.4)	20 (7.1)	0.779
Death	2 (3.6)	4 (1.4)	0.259

Values are mean ± SD or n (%).

COPD = chronic obstructive pulmonary disease; GFR = glomerular filtration rate; RVi = right ventricular involvement; TAPSE = tricuspid annular plane systolic excursion; TTS = Takotsubo syndrome.

p = 0.012), Charlson comorbidity index (HR: 1.275; 95% CI: 1.097 to 1.483; p = 0.002), and systolic pulmonary artery pressure (HR: 1.045; 95% CI: 1.014 to 1.077; p = 0.005) were independent correlates of acute heart failure. The same variables, RVi (HR: 2.327; 95% CI: 1.151 to 4.706; p = 0.019), Charlson comorbidity index (HR: 1.254; 95% CI: 1.088 to 1.444; p = 0.002), and systolic pulmonary artery pressure (HR: 1.047; 95% CI: 1.016 to 1.078; p = 0.002) remained independent predictors even if a composite endpoint including all major adverse events was considered.

The prevalence of extensive RVi in TTS patients with typical left ventricular apical ballooning is relatively low (16.5%). This patient subset has a different clinical profile characterized by significantly more frequent occurrence of dyspnea at onset, ST-segment elevation on the electrocardiogram, a greater number of pre-existing comorbidities (especially chronic obstructive pulmonary disease), higher Charlson comorbidity index score, higher wall motion score index, and more frequent occurrence of moderate to severe mitral regurgitation. Along with Charlson comorbidity index and systolic pulmonary artery pressure, RVi is an independent predictor of acute heart failure and of a composite endpoint including adverse events, such as acute heart failure, cardiogenic shock, and in-hospital mortality.

Echocardiography should be systematically performed in the acute phase of TTS to identify patients with RVi. This patient subset should be considered at higher risk and monitored more strictly to promptly start an appropriate therapeutic strategy.

Rodolfo Citro, MD, PhD*
Eduardo Bossone, MD, PhD
Guido Parodi, MD, PhD
Fausto Rigo, MD
Federico Nardi, MD
Gennaro Provenza, MD
Concetta Zito, MD, PhD
Giuseppina Novo, MD, PhD
Giovanni Vitale, MD
Costantina Prota, MD
Angelo Silverio, MD
Olga Vriz, MD
Antonello D'Andrea, MD, PhD
Francesco Antonini-Canterin, MD
Jorge Salerno-Uriarte, MD
Federico Piscione, MD
on behalf of the Tako-tsubo Italian Network Investigators

*Department of Heart Sciences
Experimental and Clinical Physiology Institute
University of Insubria
University Hospital "San Giovanni di
Dio e Ruggi d'Aragona"
Heart Tower Room 810
Largo Città di Ippocrate
Salerno 84131
Italy
E-mail: rodolfocitro@gmail.com

http://dx.doi.org/10.1016/j.jcmg.2015.06.005

Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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