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Original article

Impact of myocardial bridging on in-hospital outcome in patients with takotsubo syndrome

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ABSTRACT

Background: Prevalence of myocardial bridging of the left anterior descending coronary artery (LAD) in patients with takotsubo syndrome (TTS) has been demonstrated. However, the impact of myocardial bridging on in-hospital outcome has not been fully evaluated.
Methods: A total of 144 consecutive patients with TTS were enrolled. Coronary angiography and left ventriculography were performed in all patients and absence of obstructive coronary disease explaining the left ventricular contraction abnormality was confirmed. Myocardial bridging was diagnosed when a dynamic compression in systole, so-called "milking effect", was observed in the LAD. We evaluated differences in the clinical characteristics and in-hospital outcome between patients with and without myocardial bridging. Furthermore, multiple logistic regression analysis was performed to predict in-hospital death.
Results: Myocardial bridging was observed in 33 patients (23%). In-hospital death was more frequent in patients with myocardial bridging (21% vs. 6%, $p = 0.02$), which was due mainly to a higher non-cardiac death in those patients (15% vs. 5%, $p = 0.049$). Multiple logistic regression analysis demonstrated myocardial bridging (odds ratio = 12.0, 95% CI = 2.52–78.5, $p < 0.01$) as one of the independent predictors of in-hospital death.
Conclusion: Myocardial bridging is an independent predictor of in-hospital death in patients with TTS.

Introduction

The exact pathogenesis of takotsubo syndrome (TTS) is still unknown, although several hypotheses, such as catecholamine-mediated myocardial stunning, multivessel coronary spasm, and microvascular dysfunction, have been proposed [1]. Recently, an association between TTS and myocardial bridging of the left anterior descending coronary artery (LAD) has been reported [2–4]. Migliore et al. showed a high prevalence of myocardial bridging of the LAD in patients with TTS and proposed it as potential substrate in the pathogenesis of TTS [3]. On the other hand, Stiermaier et al. demonstrated no significant difference in prevalence of myocardial bridging between the TTS and control group [4]. However, there is little information about the impact of myocardial bridging on clinical outcomes in TTS patients. Furthermore, although some previous studies demonstrated clinical characteristics of TTS patients [5,6], there is no report regarding a relationship between myocardial bridging and TTS in Japan. Thus, the aim of the present study was to evaluate the prevalence of myocardial bridging in Japanese patients and the impact on in-hospital outcome in patients with TTS.

Methods

Patients and inclusion criteria

A total of 144 consecutive patients with TTS who were admitted to Chiba University Hospital, Chiba Emergency Medical Center, and Kimitsu Chuo Hospital from June 2007 to May 2015 were enrolled. TTS was diagnosed according to the following criteria [7]: (1) transient hypo-, a- or dyskinesis of the left ventricle; the regional

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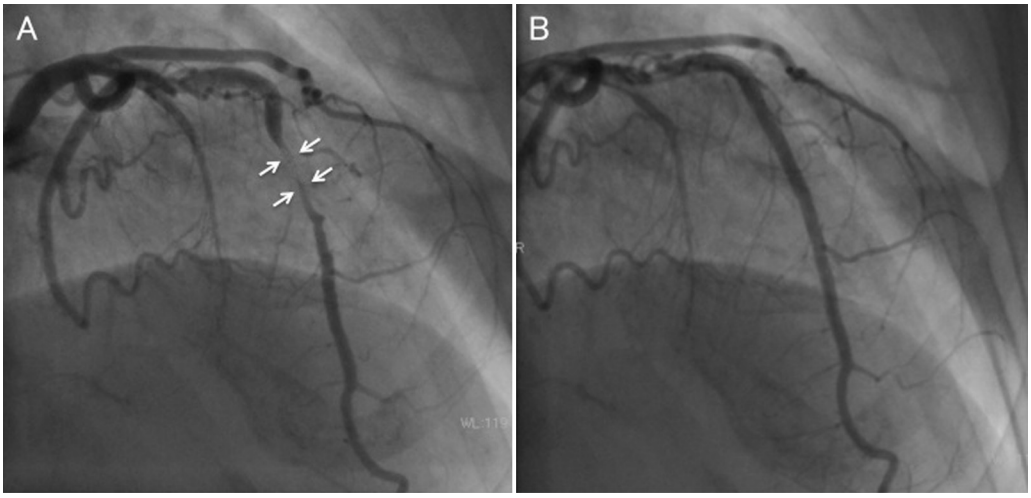

Fig. 1. Myocardial bridging in coronary angiography. Coronary angiography demonstrates dynamic compression in the left anterior descending coronary artery during systole (A) and complete decompression during diastole (B).

wall motion abnormalities extend beyond a single epicardial vascular distribution; (2) absence of obstructive coronary artery disease or angiographic evidence of acute plaque rupture; (3) new electrocardiographic abnormalities or modest elevation in cardiac troponin; and (4) absence of pheochromocytoma or myocarditis. Coronary angiography and left ventriculography were performed in all patients in acute phase and absence of obstructive coronary artery disease explaining the left ventricular contraction abnormality was confirmed. Myocardial bridging was diagnosed angiographically when a dynamic compression in systole, so-called "milking effect", was observed in the LAD (Fig. 1) [3]. All images were reviewed by 2 investigators blinded to the clinical information. Disagreements were resolved by consensus. Other clinical and laboratory information as well as in-hospital outcome were obtained from hospital charts that were reviewed by independent research personnel who were unaware of the objectives of the study. The ethics committee of Chiba University approved the study.

Statistical analysis

Continuous variables are presented as mean ± SD and were compared with Welch's test. Categorical variables are presented as counts and percentages, and were compared by Fisher's exact test. An association between clinical parameters and in-hospital death was examined by multiple logistic regression analysis. Explanatory variables were selected from clinical variables that had a p-value <0.10 in univariate analysis. Statistical analysis was performed using JMP Pro 13 (SAS Institute, Cary, NC, USA). A p-value of <0.05 was considered statistically significant.

Results

Myocardial bridging was observed in 33 patients (23%). There were no significant differences between the 2 groups in terms of baseline clinical characteristics except for lower body mass index in patients with myocardial bridging (Table 1). Systolic blood

Table 1
Baseline clinical characteristics.

	Overall ($n=144$)	Bridging (+) ($n=33$)	Bridging (−) ($n=111$)	p-value
Age (years)	70 ± 11	72 ± 11	70 ± 12	0.41
Female	123 (85%)	28 (85%)	95 (86%)	>0.99
BMI (kg/m^2)	21.3 ± 3.6	20.0 ± 2.9	21.7 ± 3.8	<0.01
Hypertension	73 (51%)	16 (48%)	57 (51%)	0.84
Dyslipidemia	54 (38%)	15 (45%)	39 (35%)	0.31
Diabetes mellitus	32 (22%)	4 (12%)	28 (25%)	0.15
Smoking	20 (14%)	4 (12%)	16 (14%)	>0.99
Symptoms				
Chest pain	70 (49%)	17 (52%)	53 (48%)	0.84
Dyspnea	32 (22%)	4 (12%)	28 (25%)	0.15
Triggers				
Emotional stress	23 (16%)	7 (21%)	16 (14%)	0.42
Physical stress	70 (49%)	17 (52%)	53 (48%)	0.84
No apparent trigger	52 (36%)	10 (30%)	42 (38%)	0.54
Medications before the onset				
β-blocker	6 (4%)	0 (0%)	6 (5%)	0.34
Ca-channel antagonist	35 (25%)	9 (29%)	26 (24%)	0.64
ACE-I/ARB	37 (26%)	6 (19%)	31 (28%)	0.37
ECG findings				
ST elevation	102 (71%)	28 (85%)	74 (67%)	0.05
T wave inversion	91 (64%)	20 (63%)	71 (64%)	>0.99
QTc (ms)	486 ± 61	480 ± 43	488 ± 65	0.42
Troponin elevation[a]	119 (87%)	30 (94%)	89 (85%)	0.24

BMI, body mass index; ECG, electrocardiography; ACE-I/ARB, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker.
[a] Troponin was measured in 137 patients.

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