

Transient Left Ventricular Apical Ballooning Developing After the Central Niigata Prefecture Earthquake: Two Case Reports

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Abstract

Two patients presented with transient left ventricular apical ballooning (takotsubo cardiomyopathy) induced by emotional stress caused by the Central Niigata Prefecture Earthquake in 2004. These patients complained of chest pain immediately after the earthquake. In patient 1, electrocardiography (ECG) showed slight ST elevation in leads V₅ to V₆ and 1 mm ST depression in lead I. Serial ECG revealed inverted giant T waves in leads V₃ to V₆ and inverted T waves in leads I, II, aVL and aVF 13 days after the earthquake occurred. Patient 2 also complained of chest pain right after the earthquake, but consulted a doctor 15 days after the earthquake occurred. ECG showed inverted giant T wave in leads V₁ to V₆ and inverted T waves in leads I, II, and aVL. Transthoracic echocardiography showed hypokinesis of the apical area of the left ventricle with normokinesis in the basal area in both patients. Coronary angiography showed no stenotic segments and coronary spasms were not induced by provocative testing. Serial cardiac radionuclide single photon emission computed tomography of myocardial functional sympathetic innervation using iodine-123-metaiodobenzyl-guanidine (MIBG) and thallium-201 (²⁰¹Tl) showed an MIBG uptake defect and increased wash-out in the apical area, but only mild decrease of apical ²⁰¹Tl uptake. Due to strong emotional stress, earthquakes may induce transient left ventricular apical ballooning (takotsubo cardiomyopathy).

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Key Words

- Cardiomyopathies, other (takotsubo, transient left ventricular apical ballooning)
- Stress (earthquakes, emotional)
- Electrocardiography

INTRODUCTION

Acute chest pain and transient apical hypokinesis with hyperkinesis in the basal area, without detectable coronary lesions, was originally called "transient left ventricular apical ballooning" (takotsubo cardiomyopathy).^{1,2)} Patients with this

syndrome demonstrate electrocardiography (ECG) changes similar to those seen in acute myocardial infarction with increased levels of serum cardiac enzymes. However, ventricular function normalizes within several weeks. A number of patients have presented with this syndrome in Japan.^{3,4)} Both emotional and somatic stress are considered to be

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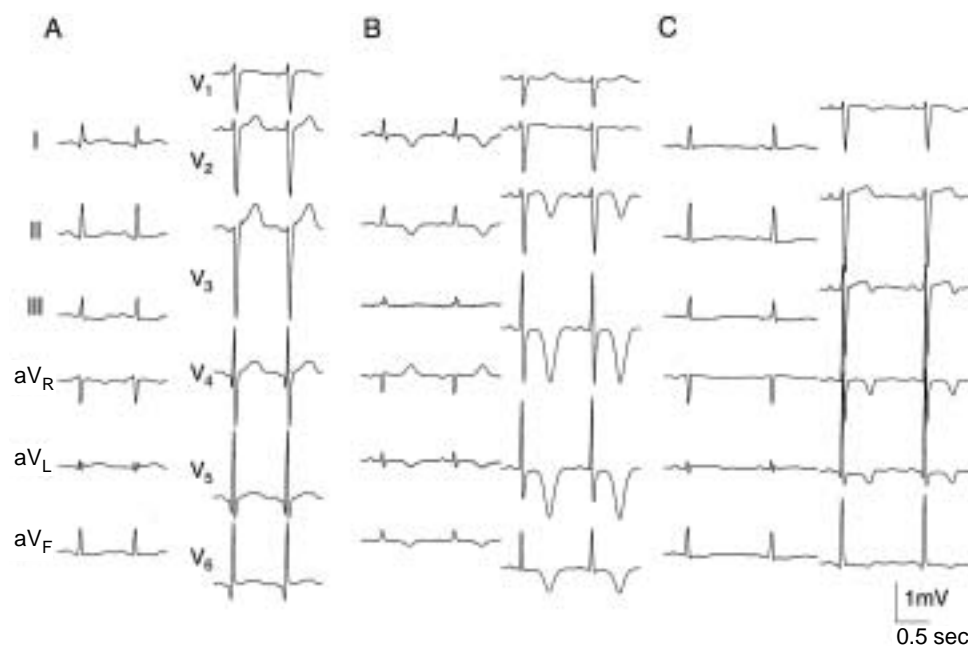


Fig. 1 Patient 1. Electrocardiographic findings showing the time course of T wave changes

A: Electrocardiography shows slight ST elevation in leads V_5 to V_6 and ST-depression in lead I immediately upon admission after the main shock of the earthquake.

B, C: T waves were inverted in leads V_3 , V_4 , aVL, aVF, and V_3 to V_6 at the time of hospitalization (B) and T wave inversions persisted in leads V_3 to V_5 for more than 6 months (C).

triggering factors in this cardiac syndrome.⁵⁾ We treated two patients with this syndrome induced by emotional stress due to the Central Niigata Prefecture Earthquake in October 2004.

CASES

Patient 1

A 67-year-old woman had been well until she was admitted to the emergency room of our hospital with chest pain immediately after the main shock of the Central Niigata Prefecture Earthquake in October 2004. ECG showed slight ST-T segment elevation in leads V_5 to V_6 and 1-mm ST depression in lead I (Fig. 1 - A). However, extensive evaluation was difficult because of damage to the medical facilities caused by the earthquake. There were no symptoms after that time. She visited our hospital 4 days after the main shock of the first earthquake, but was unable to see a doctor because of the large aftershock. She was re-evaluated 13 days after the main shock of the earthquake. The ECG revealed inverted giant T waves in leads V_3 to V_6 and inverted T waves in leads I, aVL and aVF (Fig. 1 - B). Transthoracic echocardiography (TTE) demonstrated hypokinesia in the apical area of the left ventricle with normokinesia in the basal area (Fig.

2). Mild pericardial effusion was also noted and she was admitted to our hospital. Routine laboratory examinations were normal. Coronary angiography performed the next day showed no stenotic segments and provocation testing did not induce coronary spasm. Left ventriculography revealed slight hypokinesia of the apical area with normokinesia in the basal area. Iodine-123-metaiodobenzylguanidine (MIBG) imaging showed decreased uptake and increased wash-out on the late image in the apical lesion, whereas thallium-201 (^{201}Tl) uptake was only mildly decreased (Fig. 3 - A - a). Left ventricular contractions on TTE normalized within 1 week after admission. In contrast, the inverted T waves in leads V_3 to V_5 and the uptake defect in the apical lesion on the late imaging in MIBG imaging persisted for more than 6 months (Figs. 1 - C and 3 - A - b).

Patient 2

A 78-year-old woman with hypertension complained of chest pain immediately after the earthquake. However, she was only hospitalized 15 days after the earthquake because her house was severely damaged and she evacuated to her daughter's house. Previous ECG had found no abnormalities.

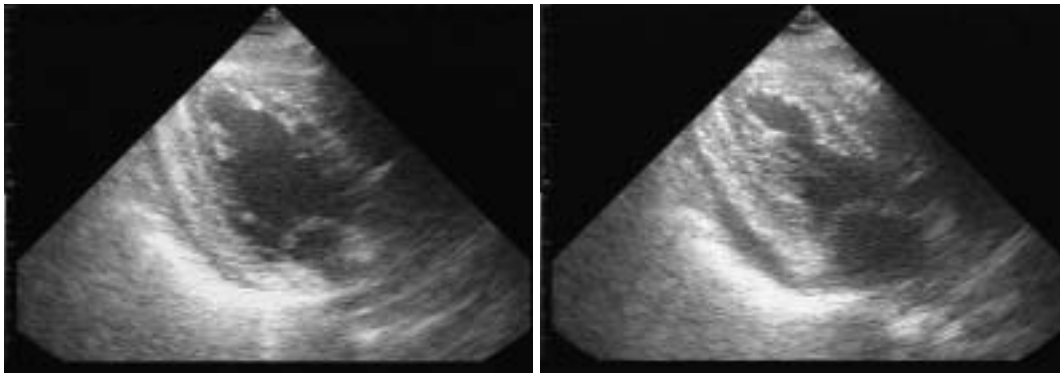


Fig. 2 Patient 1. Cardiac ultrasound scans demonstrating a hypokinetic area around the apex and normal contraction in the basal segment at the time of hospitalization
Parasternal long-axis views of the left ventricle in diastole (left) and systole (right)

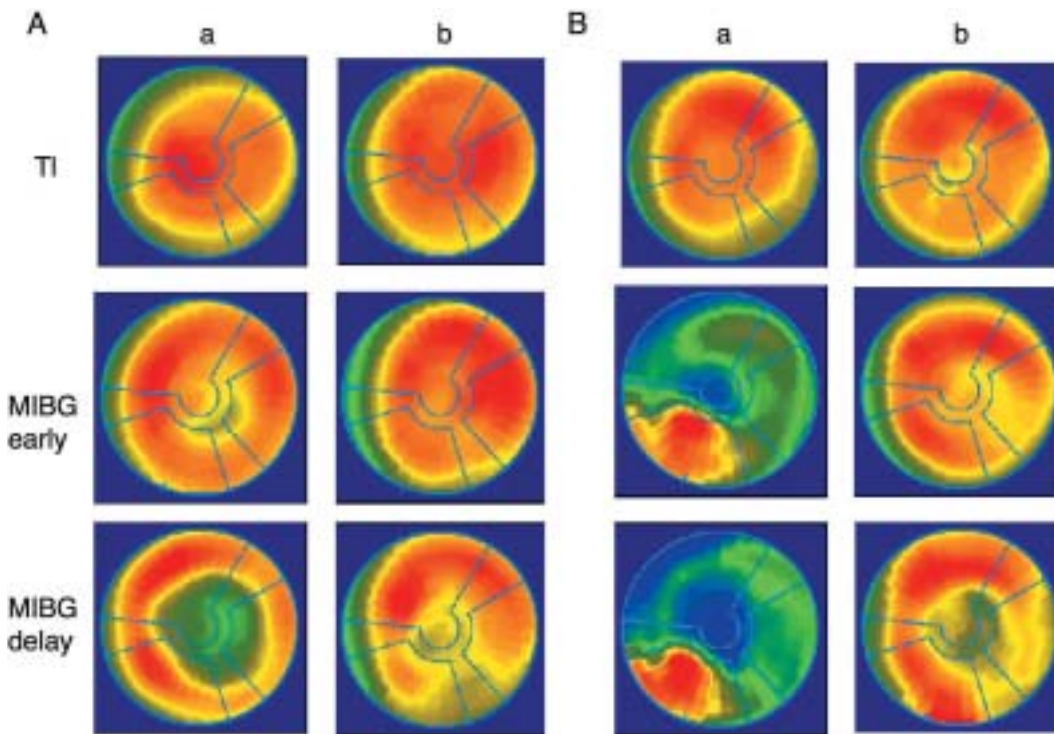


Fig. 3 Serial cardiac SPECT images using ²⁰¹Tl and MIBG in patient 1 (A) and patient 2 (B)
The SPECT images were obtained during hospitalization (a) and more than 6 months after the main earthquake (b). The SPECT images using ²⁰¹Tl show mildly decreased uptake in both patients. In contrast, the SPECT images using MIBG show uptake defects in the apex in patient 1 (A - a) and in the apex, septum, anterior, and lateral wall in patient 2 (B - a). The delayed images show increased MIBG wash-out which persisted for several months in both patients (A - b and B - b).
SPECT = single photon emission computed tomography; MIBG = metaiodobenzyl-guanidine.

However, the first ECG obtained at our hospital showed inverted giant T waves in leads V_1 to V_6 and inverted T waves in leads I , aVL , and aVF (Fig. 4 - A). Routine laboratory studies were normal but TTE demonstrated hypokinesia in the apical area of the left ventricle with normokinesia in the basal

area. She was admitted to our hospital. Coronary angiography undertaken the next day showed no stenotic segments and provocation testing did not induce coronary spasm. Left ventriculography revealed slight hypokinesis in the apical area. MIBG imaging showed significant uptake defects

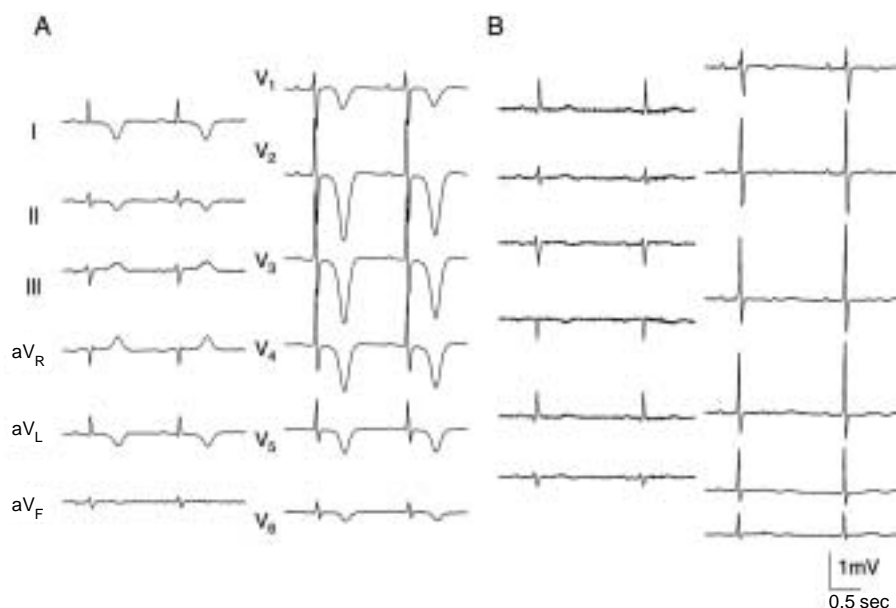


Fig. 4 Patient 2. Electrocardiographic findings on admission (A) and more than 6 months after the earthquake and aftershocks (B)

A: Electrocardiography revealing T wave inversions in leads I, aVL, and V1 to V6.

B: T wave changes improved after 6 months.

and increased wash-out in the apex, septum, anterior, and lateral wall, whereas ^{201}Tl uptake was only mildly decreased (Fig. 3 - B - a). Left ventricular contraction normalized several days after admission. ECG findings after 6 months were almost normalized (Fig. 4 - B). In contrast, MIBG uptake defect in the apical region persisted for several months (Fig. 3 - B - b).

DISCUSSION

A severe earthquake of magnitude 6.8 occurred in the central area of Niigata Prefecture on October 23, 2004. Three main strong earthquakes of seismic intensity over 6 occurred on that day followed by multiple aftershocks. More than 4,500 people were injured and essential services were disrupted. In such a situation, the emotional stress experienced by inhabitants must have been very great. Cardiovascular events, such as myocardial infarction, could be triggered by the accumulated stress of an earthquake.⁶⁾ Our two patients with transient left ventricular apical ballooning (takotsubo cardiomyopathy) presented with symptoms at our hospital right after the earthquake.

Transient left ventricular apical ballooning (takotsubo cardiomyopathy) is a syndrome characterized by acute onset of ST-segment elevation and

subsequent T-wave inversion but with normal coronary angiography findings. TTE and/or left ventriculography reveals apical dilation and akinesis, and basal hypokinesis (or occasionally normokinesis), which gives the heart the characteristic shape (takotsubo in Japanese). Left ventricular function normalizes within several weeks.¹⁻³⁾

In our patients, ST-T segment changes and inverted giant T waves were present in leads V3 to V6. After admission, left ventriculography had already improved in both patients, but TTE on admission revealed hypokinesis of the apical region with normokinesis in the basal area without evidence of atherosclerosis of the coronary arteries. These findings support the diagnosis of transient left ventricular apical ballooning (takotsubo cardiomyopathy).

Although the mechanism responsible for transient left ventricular apical ballooning remains unclear, various systemic disorders including cerebrovascular accident,⁷⁾ epileptic attacks, exacerbation of bronchial asthma, hypoglycemia in the setting of anorexia nervosa,⁸⁾ pheochromocytoma,⁹⁾ and emotional/physical stress⁵⁾ have been reported to trigger development of transient left ventricular apical ballooning. Moreover, a case of "crush syndrome", with inverted giant T waves and reversible

left ventricular dysfunction, was reported in a patient who was rescued after being buried under his house for 20 hr during the earthquake in the Kansai area.¹⁰⁾ Our patients experienced great suffering and mental stress after the earthquakes of seismic intensity over 5. They also suffered transient left ventricular apical ballooning triggered by the earthquake.

In the present cases, MIBG images showed apical deficit and an increase in the MIBG wash-out in that region. This defect and increase in the wash-out of MIBG persisted for several months after the onset, indicating that emotional stress induced disturbance of both sympathetic innervation and sympathetic denervation. These results are compatible with the findings observed with transient left ventricular apical ballooning.^{5,10)}

Patients with transient left ventricular apical bal-

looning may complain of chest pain but usually it is relatively mild compared to that of acute myocardial infarction. Echocardiography and left ventriculography were not performed in the early stage in these patients. The typical "takotsubo" shape of the left ventricle was not confirmed but the typical changes of the ECG and nuclear imaging suggested the transient left ventricular apical ballooning was most likely triggered by the earthquake in these patients.

CONCLUSIONS

Determination in hospital functions is very likely immediately after an earthquake, but physicians must assess each patient's condition and identify the disease. Cases of transient left ventricular apical ballooning are likely after an earthquake.

要 約

新潟県中越地震後に発症したたこつぼ型心筋症の2例

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2004年の新潟県中越地震直後に発症したたこつぼ型心筋症の2例を経験したので報告する。症例1は67歳の女性。地震直後に胸痛で当科を受診。地震直後の心電図はⅤ₁-ⅥのSTの軽度上昇と誘導のST低下(1mm)であったが、地震発症13日目の心電図でⅢ-Ⅵで巨大陰性T波とⅠ,Ⅱ,Ⅴ₁,Ⅴ₄で陰性T波の出現が認められた。症例2は78歳、女性。地震直後より胸痛が認められたが、発症後15日目に当科を受診。心電図上Ⅰ-Ⅵで巨大陰性T波とⅠ,Ⅱ,Ⅴ₁で陰性T波が認められた。いずれの症例でも受診時の心エコー図検査で心尖部領域の壁運動低下と心基部の正常壁運動が認められた。冠動脈造影で優位狭窄は認められず、冠攣縮は誘発されなかった。MIBGシンチグラムで心尖部領域の取り込みの低下と洗い出しの亢進が認められた。一方、TIシンチグラムの取り込み低下は軽度であった。地震による著しいストレスがたこつぼ型心筋症を誘発した可能性が考えられたので報告する。

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