

## High-Grade Atrioventricular Block and Takotsubo Cardiomyopathy: Case Report and Review of the Literature

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### ARTICLE INFO

Article Type :  
Case Report

#### Article History:

Received: 21 Aug 2014

Revised: 18 Oct 2014

Accepted: 29 Nov 2014

#### Keywords:

Heart Block

Bradycardia

Takotsubo Cardiomyopathy

### ABSTRACT

In this report, we presented a 71-year-old woman who suffered a syncopal episode in the context of advanced atrioventricular block associated with takotsubo cardiomyopathy. The heart block did not resolve and a permanent pacemaker was implanted while there was a gradual improvement of the left ventricular systolic function. We also provided a detailed review of the literature regarding the association between atrioventricular block and takotsubo cardiomyopathy. Moreover, we critically discussed other cases reporting development of takotsubo cardiomyopathy after pacemaker implantation, possibly related to the perioperative stress.

#### ► Implication for health policy/practice/research/medical education:

High-grade AV block may induce TCM in susceptible individuals, while the same is true in some patients undergoing pacemaker implantation due to the stressful operation. Clinicians should be aware of these associations and promptly implement appropriate diagnostic and therapeutic procedures in affected individuals.

### 1. Introduction

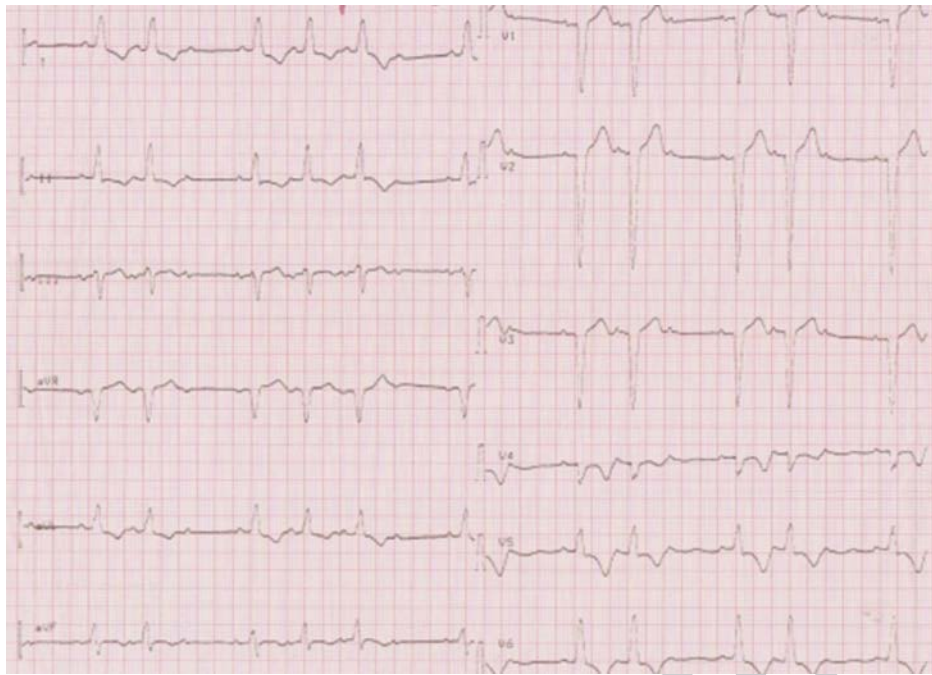
Tako-Tsubo Cardiomyopathy (TCM) or apical ballooning syndrome or stress cardiomyopathy represents a distinct form of cardiac dysfunction that mimics Acute Coronary Syndromes (ACS), often associated with physical or emotional stress (1-3). An increasing number of case reports have indicated a potential association between high-grade atrioventricular (AV) block and TCM (4-15). Additionally, in some other cases, TCM developed after implantation of a pacemaker, implying that possibly the perioperative stress was the provocative factor (16-22). In this report, we briefly describe a case of AV block-induced TCM and we provide a concise and critical overview of all the similar cases reported in the literature.

### 2. Case Presentation

A 71-year-old woman was transferred to the hospital

due to a typical syncopal episode of unknown duration associated with facial trauma. Her past medical history was significant only for arterial hypertension under treatment with irbesartan and hydrochlorothiazide. The patient did not report any significant chest pain or discomfort before the event, but she noticed a progressively worsening exertional dyspnea and fatigue during the past few days. A 12-lead ECG on admission showed intermittent 2:1 AV block with a left bundle branch block (not previously known) (Figure 1). Besides, an echocardiogram performed at the bedside demonstrated akinesis of the apical segments of the Left Ventricle (LV) with an estimated ejection fraction of 40%. Moreover, serial measurement of cardiac enzymes showed evidence of myocardial necrosis (positive troponin 6 hours after admission, and further increase at 12 hours) and, consequently, the patient managed as having ACS. Specifically, the patient was transferred promptly to the cath lab. After placement of a temporary pacemaker via the right femoral vein, coronary angiogram showed no

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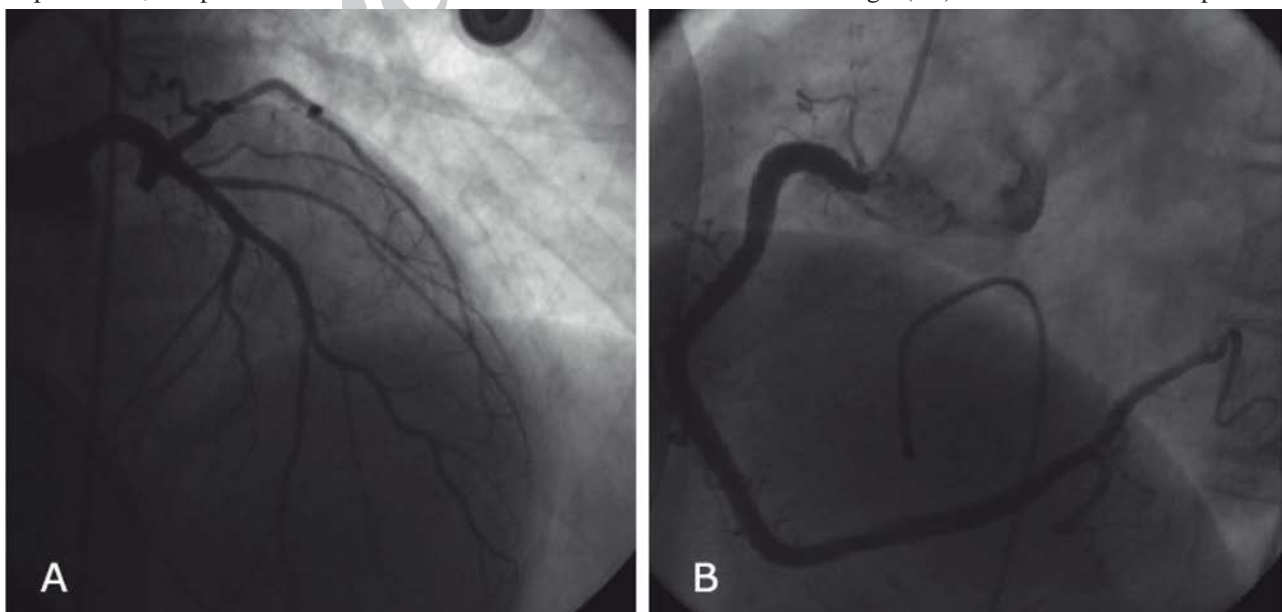
**Figure 1.** Electrocardiogram on Admission Showing Intermittent Atrioventricular Block and Left Bundle Branch Block

significant stenoses (Figures 2A, 2B). Interestingly, the left ventriculography revealed a typical pattern of TCM with an akinetic apex and hypercontractile base (Figures 3A, 3B). Bearing in mind that TCM in most instances is a reversible cardiomyopathy while the cause-effect relationship in cases with concomitant AV block is not very clear, we decided not to proceed directly to pacemaker implantation. Indeed, on the 6th day of hospitalization, normal 1:1 conduction was restored with no improvement in LV systolic function. On the 10th day, however, the patient suffered a dizzy spell and the telemetry recorded an episode of complete AV block with prolonged ventricular asystole (Figure 4). Thereafter, the patient reverted back to 2:1 AV block and, thus, a dual-chamber pacemaker was implanted. Six months after the implantation, the patient remains on 2:1 AV block while

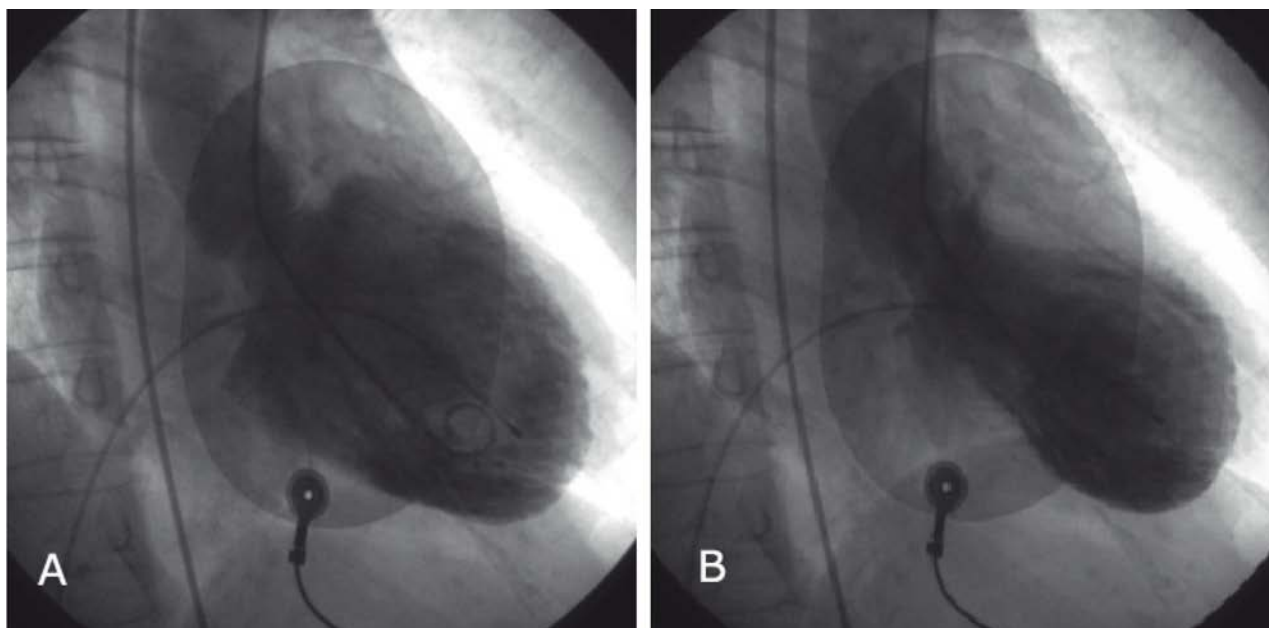
the LV systolic function has been completely normalized.

### 3. Discussion

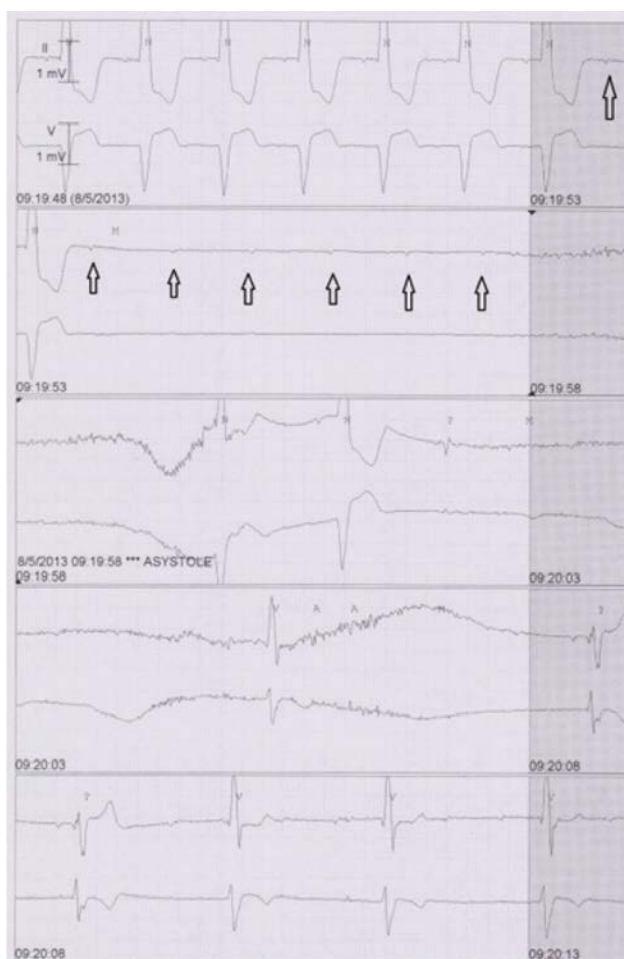
TCM represents an increasingly recognized entity in the setting of ACS, sometimes associated with serious complications (1-3). However, in most cases, the prognosis is excellent with full recovery of myocardial function and low recurrence rates. In particular, stressful events may trigger the development of this specific cardiomyopathy. Its exact pathophysiology remains unknown although microvascular dysfunction, diffuse coronary spasm, autonomic disturbances, and neurogenic injury/stunning have been implicated (1-3). TCM may be provoked by a variety of stimuli and conditions that can induce a catecholamine surge (1-3). Patients with TCM present



**Figure 2.** Coronary Angiogram Showing Normal Left (A) and Right (B) Coronary Artery System



**Figure 3.** Left Ventriculography Showing Akinesia of the Apical Segments and Hypercontraction of the Basal Segments: (A) Diastole, (B) Systole



**Figure 4.** Telemetry strip showing Complete Heart Block with Ventricular Asystole

with symptoms suggestive of ACS, transient and reversible changes of the ST-segment (mainly elevation) in the electrocardiogram, and a small increase in cardiac troponin levels (1-3). The characteristic imaging findings include the hypokinesia or akinesia of the apical segments of the LV

along with hypercontraction of the basal segments as well as the absence of obstructive coronary lesions. Variants, such as midventricular TCM and reversed TCM, have also been described. Moreover, other secondary causes, such as pheochromocytoma, myocarditis and cerebrovascular accidents, should be excluded (2).

It should be noted that an association between TCM and advanced conduction abnormalities has been recently recognized (Table 1). Nonetheless, the cause-effect relationship is not clear yet. However, in most of the published cases, the AV conduction abnormality persisted for a long time despite the improvement of segmental wall motion abnormalities and LV systolic dysfunction (Table 1). Only in 2 cases, the AV block was transient and no permanent pacemaker was implanted (9, 15). In other words, it seems that in most instances, the conduction abnormality was the primary independent event that triggered TCM and not vice-versa. In a very recent observational study from the Tokyo CCU Network database, advanced AV block was observed in 2/107 cases at the time of hospitalization, requiring permanent pacemaker implantation in 1 patient (23). However, no further details regarding these 2 patients were available (not included in Table 1).

It would be reasonable to assume that excessive bradycardia and AV dissociation elicit an adrenergic response that drives the pathophysiological alterations of TCM. Moreover, patients with AV block-induced TCM seemed to have a favorable outcome without residual LV dysfunction (Table 1). Also, a female predominance was evident and most patients had advanced age (Table 1). In addition, a classical pattern of apical ballooning was noticed in all the cases, while the midventricular pattern was evident in 1 case (15) (Table 1). In general, temporary pacing and a few-day waiting period appear to be a reasonable strategy although, as mentioned before, most patients need permanent pacing. Interestingly, in several cases, a significant QT prolongation was evident, while associated episodes of Torsades de Pointes (TdP)

**Table 1.** The Reported Cases of Advanced Atrioventricular Block Associated with Takotsubo Cardiomyopathy

Authors (Year)	Case(s), Gender, Age	Type of AV Block	Clinical Presentation	LV Ejection Fraction in Acute Phase	Recovery of LV Systolic Function	Temporary Pacing	PPM Implantation	Persistence of AV Block after Remission of TCM
Saito M, et al. (2004)	1 female, 86 year-old	Complete AV block	Chest discomfort, dyspnea	N/A	Yes, delayed but complete	Yes	Yes	Yes – Persistent AV block
Lee WL, et al. (2006)	1 female, 72 year-old	Mobitz I evolved into complete AV block	Angina	42%	Yes, complete	Yes	No	No(Transient) – AV conduction recovery after 2 days
Nef HM, et al. (2006)	1 male, 58 year-old	Complete AV block	Syncope	32%	Yes, complete	Yes	Yes	No (Transient) – AV conduction recovery after 3 months
Nault MA, et al. (2007)	1 female, 62 year-old	Complete AV block	Syncope	24%	Yes, complete	Yes	Yes	Yes – Evidence of 2:1 AV block after 1 year but normal conduction at 2-year follow- up
Kurisu S, et al. (2008)	1 female, 87-year-old	2:1 AV block	Dyspnea	62%	Yes	Yes	Yes	Yes- Recurrence of AV block 10 days after admission
	1male, 78 year-old	Complete AV block	Syncope	38%	Yes, complete	Yes	Yes	Yes
Kodama S, et al. (2009)	1 female, 39 year-old	Complete AV block	Syncope	N/A	Yes, complete	Yes	Yes	Yes- Persistent AV block
	1 female, 57 year-old	2:1 AV block	Dizziness, chest pain, and syncope	N/A	Yes, complete	Yes	Yes	Yes-Persistent AV block
Inoue M, et al. (2009)	1 female, 82 year-old	Complete AV block	Syncope	45%	Yes	Yes	Yes	Yes- Persistent AV block
Siry M, et al. (2011)	1 female, 70 year-old	Complete AV block	Chest pain	N/A	Yes	Yes	Yes	Yes
Shanmugasundaram R, et al. (2012)	1 female, 72 year-old	Complete AV block	Chest pain	N/A	Yes, complete	Yes	Yes	Yes- Recurrence of AV block 10 days after admission
Benouda L, et al. (2012)	1 female, 69 year-old	2:1 block	Acute dyspnea	N/A	N/A	No	Yes	Yes – Persistent AV block
Chadha S, et al. (2013)	1 female, 61 year-old	Complete AV block	Chest pain, dyspnea	N/A	Yes, complete	No	No	No (transient) – AV block resolved spontaneously
Sugiura T, et al. (2013)	1 female, 63 year-old	Transient complete heart block	Syncope	N/A	Yes, complete	Yes	No	No (transient) – AV block resolved spontaneously
Present case	1 female, 71 year-old	2:1 AV block, and episode of complete heart block	Syncope, exertional dyspnea	40%	Yes, complete	Yes	Yes	Yes- Recurrence of AV block 10 days after admission and persisting after 6 months

Abbreviations: AV, atrioventricular; LV, left ventricular; N/A, not available; PPM, permanent pacemaker; TCM, takotsubo cardiomyopathy

occurred in some instances (4, 6-8). Of note, temporary pacing at relatively high rates decreased the QT interval and prevented the recurrence of TdP (6, 8). It seems that besides AV block, other forms of excessive bradycardia can be associated with TCM. In specific, 2 cases of sinoatrial block accompanied by TCM have been published in the

literature (4, 24).

On the other hand, 9 published cases indicated the development of TCM after permanent pacemaker implantation (Table 2) (16-22). Although this particular operation represents a minor surgical procedure, it may cause significant stress. Thus, this stressful condition may



**Table 2.** Reported Cases of Takotsubo Cardiomyopathy Following Pacemaker Implantation

Authors (Year)	Case(s), Gender, Age	Indication for PPM	Clinical Presentation	Time of TCM Occurrence after PPM Implantation	LV Ejection Fraction before PPM Implantation	LV Ejection Fraction When TCM Diagnosed	Recovery of LV Systolic Function
Kurisu S, et al. (2006)	1 female, 89 year-old	Complete AV block	Dizziness	The following day	62%	38%	No
	1 female, 77 year-old	Complete AV block	Exertional dyspnea	3 days later	75%	27%	No
Kimura K, et al. (2007)	1 female, 54 year-old	Complete AV block	Syncope	3 hours later	N/A	N/A	Yes, after 14 days
Chun, et al. (2007)	1 female, 77 year-old	First degree AV block evolved into Mobitz I block	Syncope	12 hours later	> 60%	20%	Yes, LV ejection fraction 50%
Abu Sham'a, et al. (2009)	1 female, 86 year-old	Complete AV block	Syncope	After 1 day	60%	20%	Yes, complete
Kohnen RF and Baur LHB. (2009)	1 female, 83 year-old	Sick sinus syndrome/ tachy-brady	Dyspnea, peripheral edema	Immediately after the implantation	55%	40%	Yes, complete
Brunetti ND, et al. (2011)	1 female, 65 year-old	Complete AV block	Worsening dyspnea	A few hours later (in the context of pneumothorax)	50%	25%	Yes, complete
Golzio PG, et al. (2011)	1 female, 67 year-old	Advanced AV block	Angina in the past	First postoperative day	N/A	N/A	Yes, complete
	1 female, 64 year-old	Sick sinus syndrome	Angina in the past	First postoperative day	N/A	40%	Yes, complete

Abbreviation: AV, atrioventricular; LV, left ventricular; N/A, not available; PPM, permanent pacemaker; TCM, takotsubo cardiomyopathy

trigger TCM in some susceptible individuals. It is evident that in these cases, the LV systolic function was normal before the implantation and dramatically worsened in the context of postoperative TCM (Table 2). Remarkably, in 2 instances, no recovery of LV systolic function was observed during follow-up (22). Also, there seems to be a more severe myocardial insult since the observed LV ejection fraction during the acute phase of TCM was moderately to severely depressed in most of the cases (Table 2).

In conclusion, high-grade AV block may induce TCM in susceptible individuals, while the same is true in some patients undergoing pacemaker implantation due the stressful operation. Clinicians should be aware of these associations and promptly implement appropriate diagnostic and therapeutic procedures in affected individuals.

#### Acknowledgements

There is no acknowledgement.

#### Authors' Contribution

Panagiotis Korantzopoulos, Dimitrios Nikas, Ioannis Gkirdis, Marios Kolios, and Ioannis Ntalas: Evaluation and management of the patient, literature search, and drafting of the manuscript. Panagiotis Korantzopoulos, Dimitrios Nikas, Konstantinos Letsas, John and Goudevenos: Critical revision of the manuscript for important intellectual content and supervision.

#### Financial disclosure

The authors declare that there is no conflict of interests regarding the publication of this paper.

#### Funding/Support

There is no funding/support.

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