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CASE REPORT

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# Dynamic evolvement of the de Winter ECG pattern

Jian Wang MD | ShuLing Diao MD | Baoxin Ma PhD

Department of Cardiology, Binzhou Medical University Hospital, Binzhou, China

**Correspondence**
Jian Wang, Department of Cardiology, Binzhou Medical University Hospital, 661 Huanghe 2nd Road, Binzhou City, Shandong 256603, China.
Email: Jian19880907@126.com

## Abstract

The de Winter electrocardiograph (ECG) pattern in patients with chest pain is associated with occlusion of the proximal left anterior descending (LAD) artery. These patterns were once considered stable conditions, without dynamic evolution of ECG. Recently, several case reports have indicated that this ECG pattern may evolve into ST-elevation myocardial infarction (STEMI) or may follow the ECG manifestations of STEMI. However, our case report reveals a dynamic evolution from the de Winter pattern to STEMI and then to a normal ECG pattern.

**KEYWORDS**
De Winter ECG pattern, left anterior descending artery (LAD), ST-elevation myocardial infarction (STEMI)

## 1 | BACKGROUND

(Winter et al., 2008) described an ECG pattern without ST-segment elevation in ECG leads, which consisted of a 1–3 mm upsloping ST-segment depression at the J-point in precordial leads (V1-V6), followed by tall, positive, symmetrical T-waves, and ST elevation of 1–2 mm in lead aVR. The de Winter ECG pattern, known as a STEMI equivalent, has a high predictive value for acute occlusion of the LAD artery (95.2%–100%) (Karna et al., 2019), and the patient needs to be subjected to emergency coronary angiography (CAG) with the possibility of intervention. These patterns were once considered static and persistent, from the initial ECG until revascularization of the occluded vessel occurs. Recently, some reports have revealed a dynamic evolution of the de Winter ECG pattern (Montero Cabezas et al., 2016; Xu et al., 2019). However, to the best of our knowledge, this case is the first presentation in which the de Winter ECG pattern could progress to STEMI and then STEMI transformed into a normal ECG pattern.

## 2 | CASE PRESENTATION

A 56-year-old man presented to the local emergency department with persistent chest pain for 2 h. The patient had a previous history of anterior myocardial infarction and had received thrombolytic therapy; a coronary arteriogram confirmed 30% occlusion of the LAD artery 13 years ago. After having been discharged from the hospital 13 years ago, the patient did not experience chest pain. During the past year, while he was working, chest pain recurred, then persisted for 3–5 min, and could be relieved after rest. Unfortunately, no diagnosis or treatment was performed. Coronary artery disease risk factors included smoking and hypertension. His blood pressure was 127/67 mmHg, and his heart rate was 52 bpm. The heart sounds were normal, without murmurs or a friction rub, and lung auscultation revealed no rales. Initial ECG in the local hospital revealed a downsloping ST-segment at the J-point with tall, symmetrical T-waves in leads V1 to V4, together with a slight J-point elevation in the lead aVR and a depression in

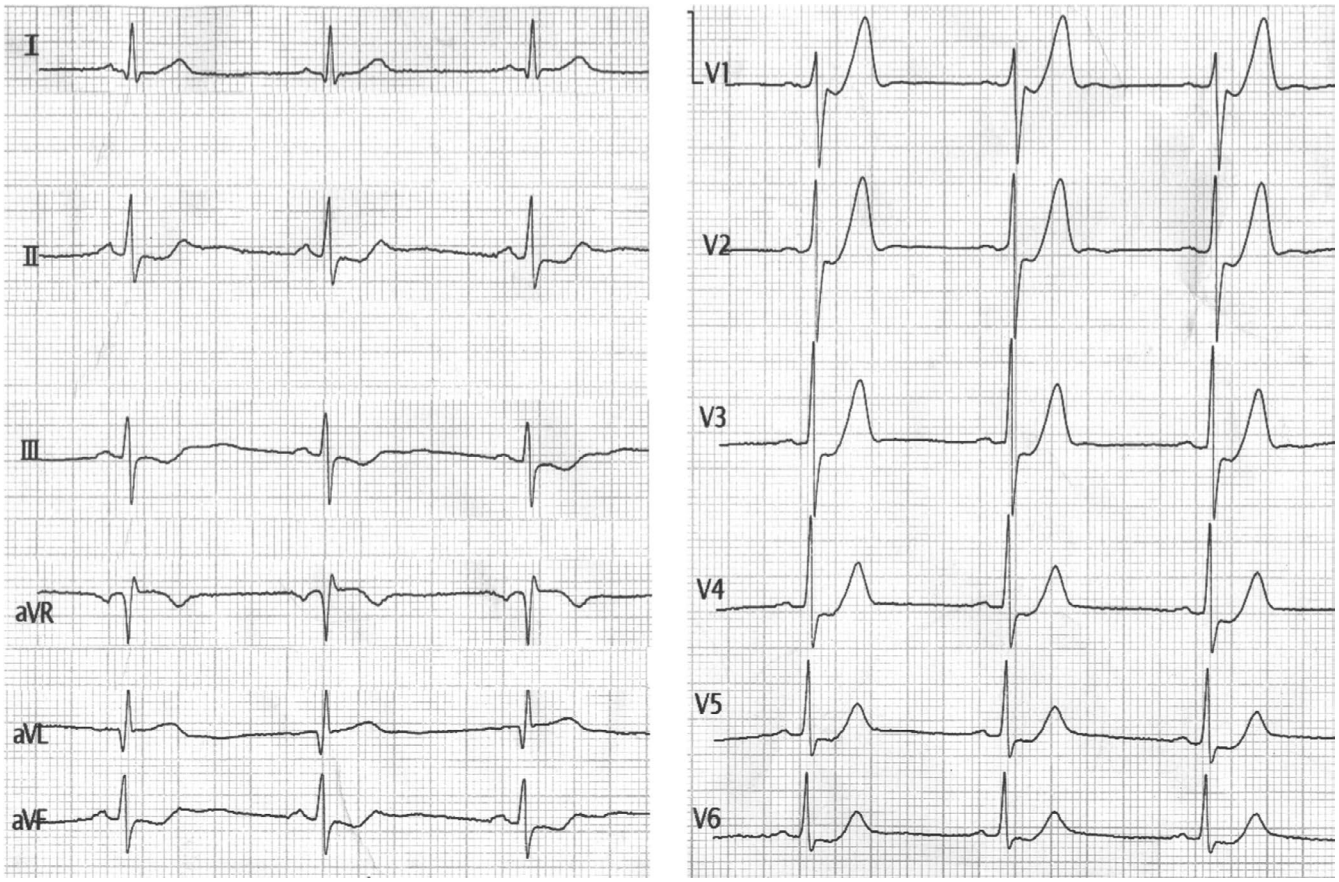


**FIGURE 1** Twelve-lead ECG of the patient. The initial ECG showed a downsloping ST-segment at the J-point, with tall, symmetrical T-waves in leads V1 to V4, together with a slight J-point elevation in the lead aVR and a depression in inferior leads

inferior leads, suggesting the de Winter ECG pattern (Figure 1). However, the patient was not willing to undergo hospitalization and coronary angiography. 4 h later, he was admitted to the Binzhou Medical University Hospital, and a second ECG was performed and revealed ST-segment elevation and R-wave loss in leads V1 to V3 (Figure 2). Doctors urgently started coronary angiography. Before CAG, a third ECG (30 min after the second ECG) indicated ST-segment and T-wave resolution in leads V1 to V3 (Figure 3). Emergency CAG revealed a complete occlusion of the proximal left anterior descending artery (Figure 4A) with collateral flows (Rentrop class 3) from posterior descending branches of the RCA (Figure 4C), followed by the insertion of a drug-eluting stent (Figure 4B). Laboratory tests showed elevated troponin I and creatine kinase-MB (CK-MB) levels, with values of 1.03 ng/ml (normal 0–0.09 ng/ml) and 37.5 ng/ml (normal 0–3.7 ng/ml), respectively, 6 h after the onset of persistent chest pain. A few days later, the patient was discharged without any sign of complications.

## 3 | DISCUSSION

The de Winter ECG pattern, known as a STEMI equivalent, accounts for 2% of patients with occlusion in the proximal LAD artery (Verouden et al., 2009). Recently, occlusions in the right coronary artery (RCA), a diagonal branch artery, and obtuse marginal artery, associated with this ECG pattern, have been reported (Karna et al., 2019; Montero Cabezas et al., 2016; Xu et al., 2019).

Initially, the de Winter ECG pattern was considered a stable condition until reperfusion (Winter et al., 2008). However, several studies have demonstrated that this ECG pattern may be a transient ECG phenomenon (Zhan et al., 2020). In our case, we observed a dynamic evolution from the de Winter ECG pattern to STEMI within four hours, which was associated with an occlusion proximal to the LAD artery, as (Wei-Wei et al., 2019) reported. In addition, (Lam et al., 2019). reported a case in which STEMI transformed to a de

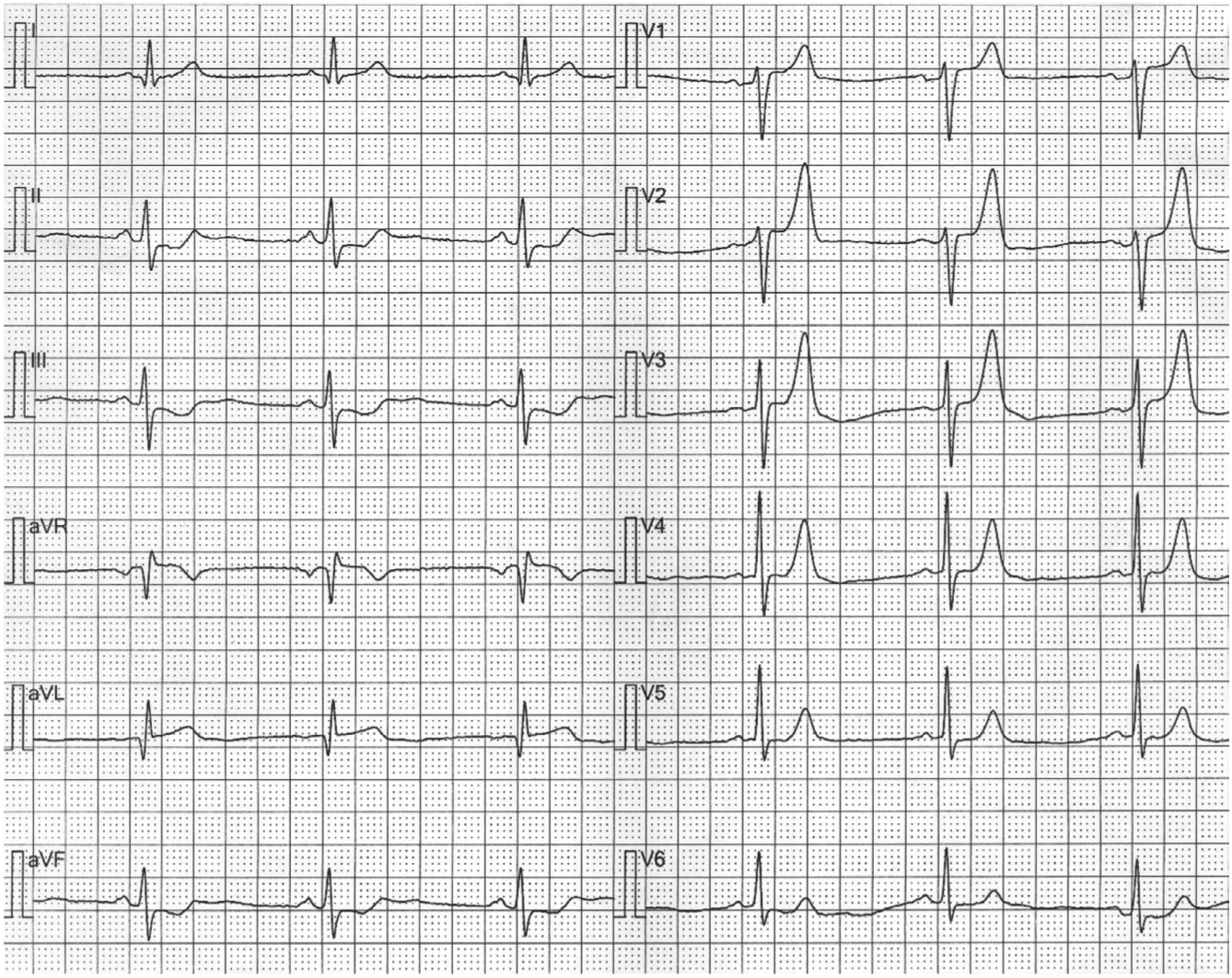


**FIGURE 2** Twelve-lead ECG of the patient. The second ECG, performed approximately 4 h after the first ECG, revealed ST-segment elevation and R-wave loss in leads V1 to V3

Winter ECG pattern, which was exactly the opposite of our finding. Some studies have hypothesized that the dynamic evolution, as in our case, may be attributed to the gradual occlusion of the LAD artery (He et al., 2020). However, a de Winter ECG pattern associated with complete LAD occlusion has also been reported. Other authors have speculated that the de Winter pattern may be associated with variations in coronary anatomy or collateral recruitment (Donato et al., 2017; Sunbul et al., 2015).

The exact mechanism for this ECG pattern is unknown. Such ECG changes may be due to the lack of activation of sarcolemmal ATP-sensitive potassium (KATP) channels because of ischemic ATP depletion.

In the present case, it is worth noting that during progression from the de Winter ECG pattern, STEMI transformed to a normal ECG pattern, which has never been reported before. We speculate that this dynamic evolution may have been due to collateral flows from the RCA. What would you do if you attended to a patient with persistent chest pain whose admission ECG was the same as in Figure 3? According to the fourth universal definition of myocardial infarction, we considered the diagnosis of acute myocardial infarction to be clear on the basis of his elevated troponin I values and symptoms of myocardial ischemia. If his chest pain persisted, emergency angiography would be performed.

In conclusion, this case indicates that during progression from a de Winter ECG pattern, STEMI can transform to a normal ECG

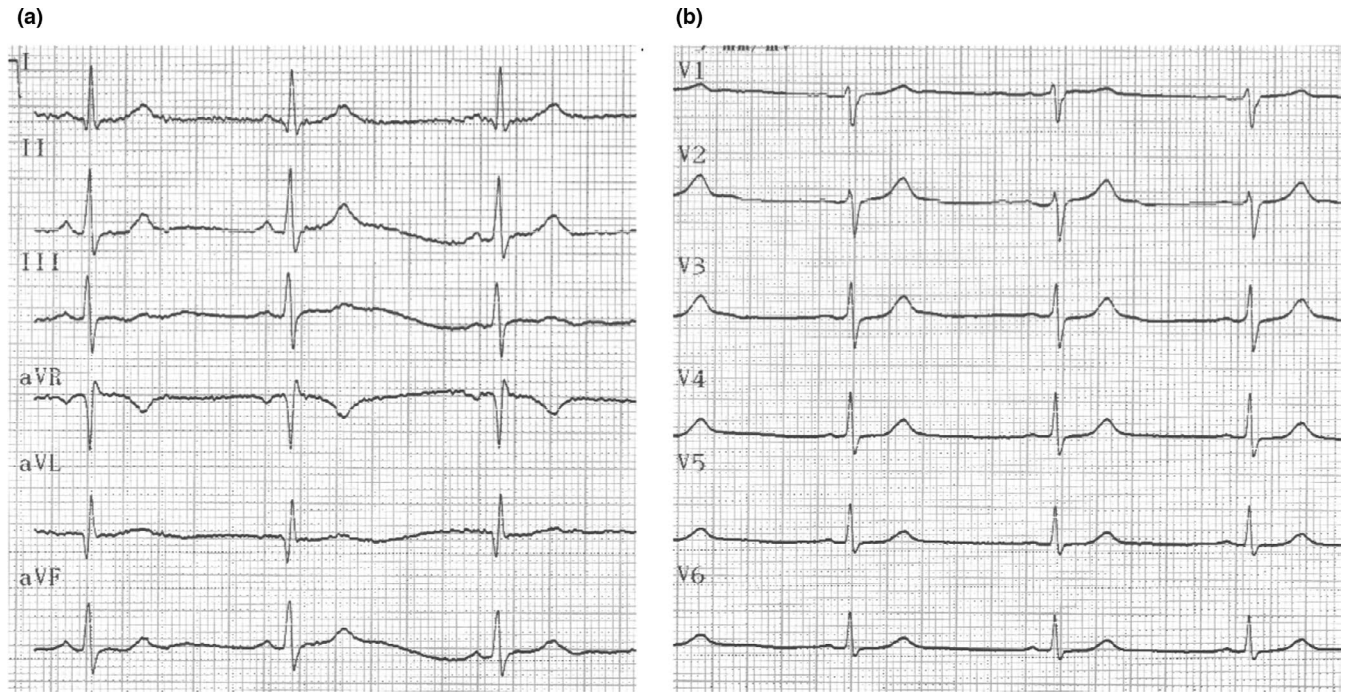


**FIGURE 3** Twelve-lead ECG of the patient. (a): Each 1 mm on the vertical axis represents 0.1 mV. (b): Each 1 mm on the vertical axis represents 0.05 mV. The third ECG (30 min after the second ECG) before emergency coronary angiography indicated ST-segment and T-wave resolution in leads V1 to V3

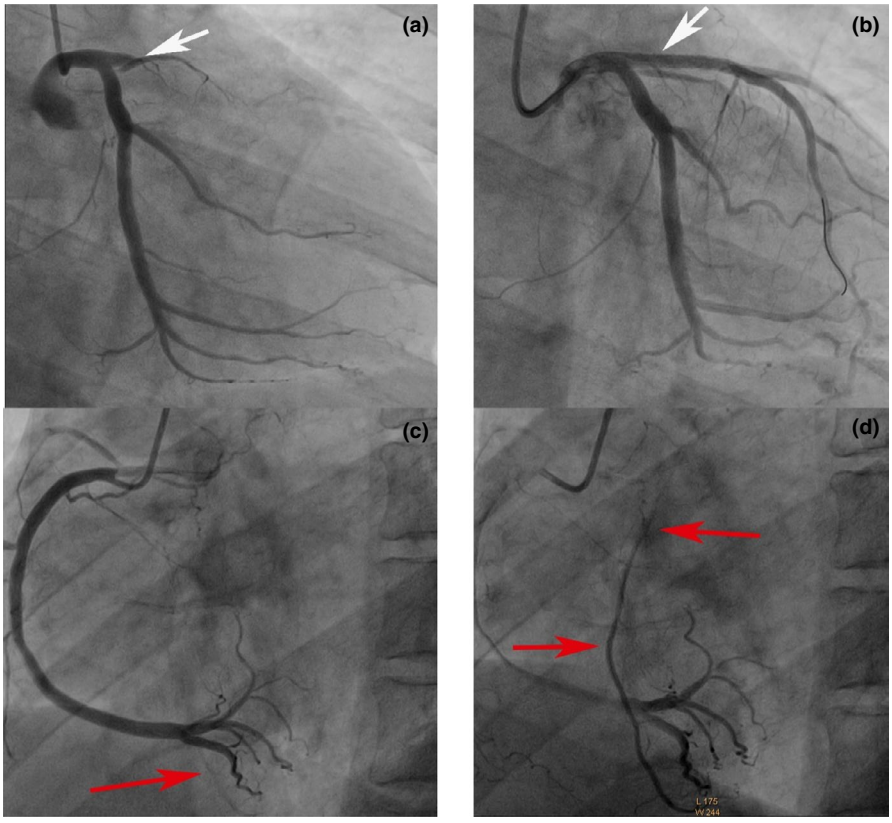


**FIGURE 4** Coronary angiography. The coronary angiogram showed that the proximal left anterior descending (LAD) artery was completely occluded (a, white arrow) and was successfully recanalized by the insertion of a drug-eluting stent (b, white arrow). Collateral flows from posterior descending branches of the RCA to the LAD artery were observed (c and d, red arrow)

pattern. Irrespective of whether the de Winter ECG pattern shows dynamic evolution or not, early identification is essential for optimal therapy.

## ACKNOWLEDGEMENTS

We thank the patient in this report.

## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest.

## AUTHOR CONTRIBUTION

JW performed the collection of data and wrote the manuscript. BX performed the literature search. SL guaranteed of the integrity of the entire study.

## ETHICAL APPROVAL

This case report has been conducted according to the standards of the Declaration of Helsinki.

## DATA AVAILABILITY STATEMENT

The datasets are available in this case report, if you have requests, please connect the corresponding author.

## ORCID

*Jian Wang* https://orcid.org/0000-0002-5974-2602

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