


CASE REPORT

The de Winter electrocardiographic pattern evolves to ST elevation in acute total left main occlusion: A case series

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Abstract

The de Winter electrocardiographic (ECG) pattern was characterized by upsloping ST-segment depressions, tall and positive symmetrical T waves in precordial leads. This rare ECG pattern was recognized as an indication of proximal left anterior descending artery occlusion. Less commonly, this ECG pattern was reported in association with occlusion of other coronary artery segments. We present three cases of the de Winter pattern associated with acute total left main occlusion. This pattern may evolve to ST elevation within hours of presentation. Widespread upsloping ST-segment depressions from V_2 - V_6 , centered on V_5 were observed in these patients.

KEYWORDS

De Winter, LM occlusion, STEMI

1 | INTRODUCTION

Acute total occlusion of left main artery (LM) is an uncommon but usually catastrophic cardiovascular emergency. The electrocardiographic (ECG) presentation is variable in these patients for various reasons, such as collateral flow, coronary anatomy, and timing of the ECG recording. Several ECG patterns have been reported to be associated with LM occlusion (Fiol et al., 2012): ST-segment elevation (STE) starting in precordial lead V_2 - V_4 and continuing through lead V_6 and in lateral extremity leads I and aVL, as well as STE in leads aVR / aVR and aVL with widespread ST-segment depressions (STD). The de Winter ECG pattern was first reported in 2008 in patients with left anterior descending coronary artery (LAD) occlusion; it consists of an upsloping STD at the J point in leads V_1 through V_6 that continues into tall, positive symmetrical T waves and is often concomitant with STE in lead aVR (de Winter et al., 2008). Here we present three cases of the de Winter ECG pattern associated with acute total LM occlusion.

2 | CASE REPORT

2.1 | Case 1

A 47-year-old man with a history of hypertension was admitted to our hospital for recurrent chest pain for 1 week that had exacerbated in the previous 5 h. ECG (Figure 1A) on admission revealed an upsloping STD in leads V_2 - V_6 (0.5-0.8 mV, max STD in V_4) and inferior leads (0.1-0.3 mV) that continued into tall, positive symmetrical T waves, combined with STE in aVR and V_1 (aVR > V_1). The patient was hemodynamically stable, with blood pressure 124/84 mm Hg, respiration of 18 breaths per minute and oxygen saturation of 96% on ambient air. Aspirin, clopidogrel, and GP IIb/IIIa inhibitor were administered, which alleviated the chest pain. However, severe substernal pain, dyspnea, and diaphoresis reappeared 1.5 h later, and the patient rapidly deteriorated into cardiogenic shock with blood pressure 92/54 mm Hg on dopamine infusion. Repeat ECG (Figure 1B) indicated evolution into extensive

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anterior and lateral myocardial infarction, consisting of STE in precordial leads V_2 through V_6 and in lateral extremity leads I and aVL. Emergent coronary angiography showed total occlusion of the proximal LAD and the middle left circumflex artery (LCX) with ambiguous thrombosis in the LM bifurcation (Figure 1C). This dislodgement of thrombi with distal embolization may be caused by injection of contrast medium and blood flow. There was no collateral flow from the right coronary artery (RCA). A crossover stent from the LM to the LAD was implanted, and the final flow was TIMI 2 (Figure 1D). Unfortunately, the patient died 3 h after the procedure due to refractory cardiac arrest.

2.2 | Case 2

A 76-year-old man with a history of hypertension and diabetes was admitted to our emergency department with acute typical chest pain for 3 h. ECG taken on arrival demonstrated an upsloping

Highlight

The de Winter ECG pattern with a widespread upsloping ST depression in V_2 to V_6 centered around V_5 may indicate total LM occlusion.

STD followed by upright, symmetrical T waves in leads V_2 - V_6 (0.3–0.5 mV, max STD in V_5) concomitant with STE in lead aVR (Figure 2A). The patient was hemodynamically stable (blood pressure 115/70 mm Hg, respiration of 18 breaths per minute and oxygen saturation of 98% on ambient air). The patient received dual loading antiplatelet and statin therapy, but he was hesitant about the recommended primary percutaneous coronary intervention (PCI). Twenty-five minutes later, repeat ECG (Figure 2C) showed a pattern dynamically changing into modest STE in V_2 - V_4 , more weakly upsloping STD in V_5 - V_6 , overt upsloping STD in inferior leads and prolonged QRS complex duration. These ECG changes

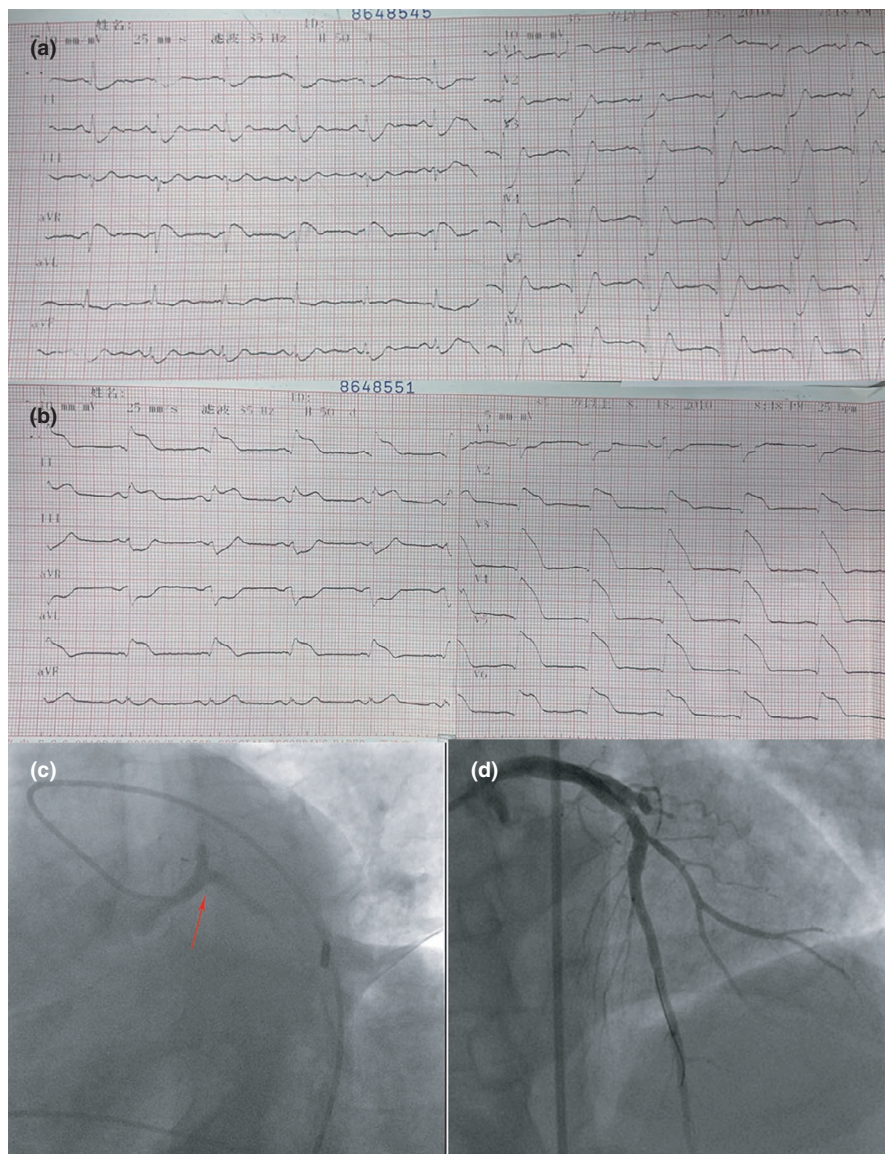
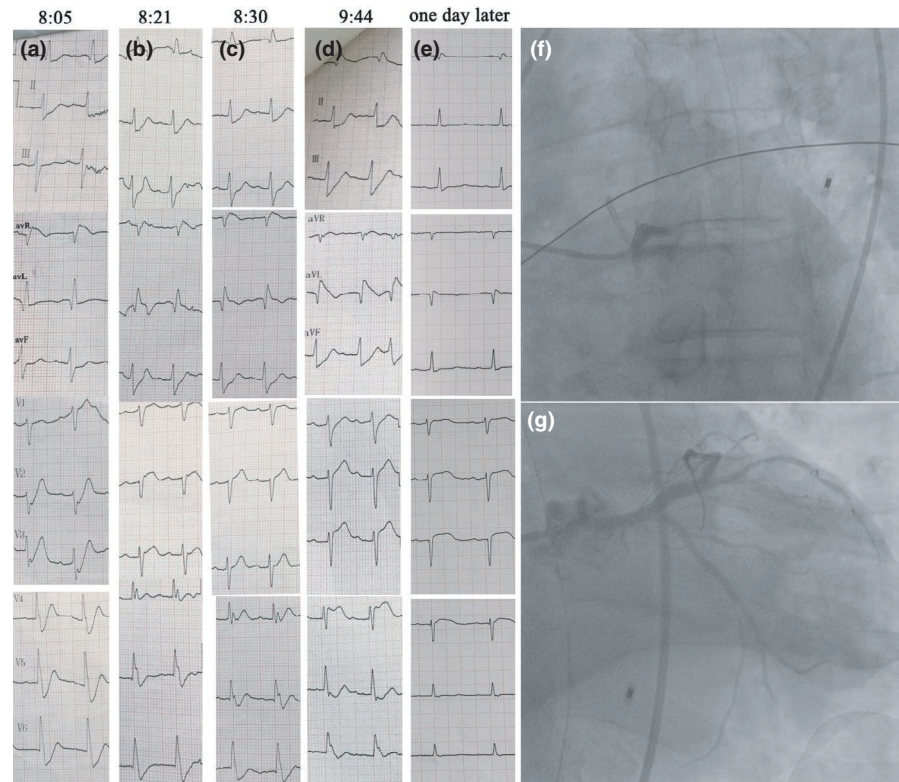


FIGURE 1 Electrocardiographic (ECG) (a) on admission showed an upsloping ST-segment depressions (STD) in leads V_2 - V_6 (max STD in V_4), and inferior leads continued into tall, positive symmetrical T waves concomitant with ST-segment elevation (STE) in aVR and V_1 (aVR > V_1). Repeat ECG (b) revealed an evolution into STEMI 1.5 h later. Coronary angiography showed total occlusion of the proximal left anterior descending coronary artery (LAD) and the middle left circumflex artery (LCX) with ambiguous thrombosis (red arrow) in the left main artery (LM) bifurcation (c). A video is supplied in supplemental materials Video S1 and S2. A crossover stent from LM to LAD was implanted (d)

FIGURE 2 Electrocardiographic (ECG) (a-e) illustrating the dynamic evolution from the de Winter pattern to STEMI within the first 2 h of presentation. Coronary angiography showed total occlusion of the left main artery LM) (f). A drug-eluting stent was implanted into the LM and proximal left anterior descending coronary artery (LAD) (g)



were more pronounced 90 min after arrival (Figure 2D). His hemodynamics deteriorated gradually, accompanied by ECG changes. Mechanical ventilation and intra-aortic balloon pumping were performed in the emergency department. Coronary angiography revealed total LM occlusion without collateral flow (Figure 2F). Successful PCI with drug-eluting stent implantations to the LM and proximal LAD was performed, and the final flow was TIMI III (Figure 2G). Extracorporeal membrane oxygenation was started after the procedure. The patient died 15 days after admission due to severe multiple-organ failure.

2.3 | Case 3

A 49-year-old man with no medical history presented to our emergency department with persistent chest pain for 3 h. ECG on admission (Figure 3A) revealed an upsloping STD in leads V_2 - V_6 (0.1-0.3 mV, max STD in V_5) and inferior leads (0.2-0.3 mV) with tall, positive symmetrical T waves concomitant with STE in aVR and V_1 (aVR > V_1). The patient was hemodynamically stable without signs of cardiogenic shock. He was directly transferred to the catheterization laboratory, and coronary angiography revealed total LM occlusion with collateral flow from the RCA (Figure 3B). Stent implantation in the LM and proximal LAD was performed successfully (Figure 3C). After struggling against cardiac failure and pulmonary edema for 2 weeks, the patient was discharged on guideline-directed medical therapy with dual antiplatelet, statin, beta-blocker, and sacubitril/valsartan therapy with an LVEF of 35%.

3 | DISCUSSION

The de Winter ECG pattern was initially described as a static ECG persisting from the time of the first ECG until the preprocedural ECG and was exclusively associated with LAD occlusion. In recent years, several reports have observed this ECG pattern in occlusions of arteries other than the LAD, such as the RCA (Tsutsumi & Tsukahara, 2018), the first diagonal branch (Montero Cabezas et al., 2016), the obtuse marginal artery (Xu et al., 2019), and the LM (Kashou et al., 2020; Liu & Wang, 2020; Sunbul et al., 2015). The location of the upsloping STD in the precordial leads seemed to be associated with the culprit artery. A systematic review of 70 cases of the de Winter ECG pattern reported that upsloping STD from V_2 to V_4 centered on V_3 had a high positive predictive value for LAD occlusion (Zhan, Li, Han, et al., 2020). Tsutsumi K (Tsutsumi & Tsukahara, 2018) reported a case of a de Winter pattern in leads II, III, aVF, and V_4 - V_6 associated with a predominantly large RCA culprit in an inferoposterior myocardial infarction. Zhong-Qun Zhan reported that the de Winter ECG pattern in leads V_2 - V_4 with concomitant STD and inverted T waves in leads V_5 - V_6 was associated with acute LM occlusion (Zhan et al., 2020). Our cases indicated that a widespread upsloping STD in V_2 - V_6 and inferior leads, with the strongest STD centered around V_5 , may indicate global subendocardial ischemia, suggesting total LM occlusion. Recent reports have argued that this ECG pattern is not a static but a transient phenomenon that evolves to an ST-segment elevation myocardial infarction (STEMI) ECG pattern within hours of presentation (Goebel et al., 2014), this dynamic change also occurs after STE spontaneously in a typical STEMI before any coronary intervention (Lam et al., 2019; Xu et al., 2019) or

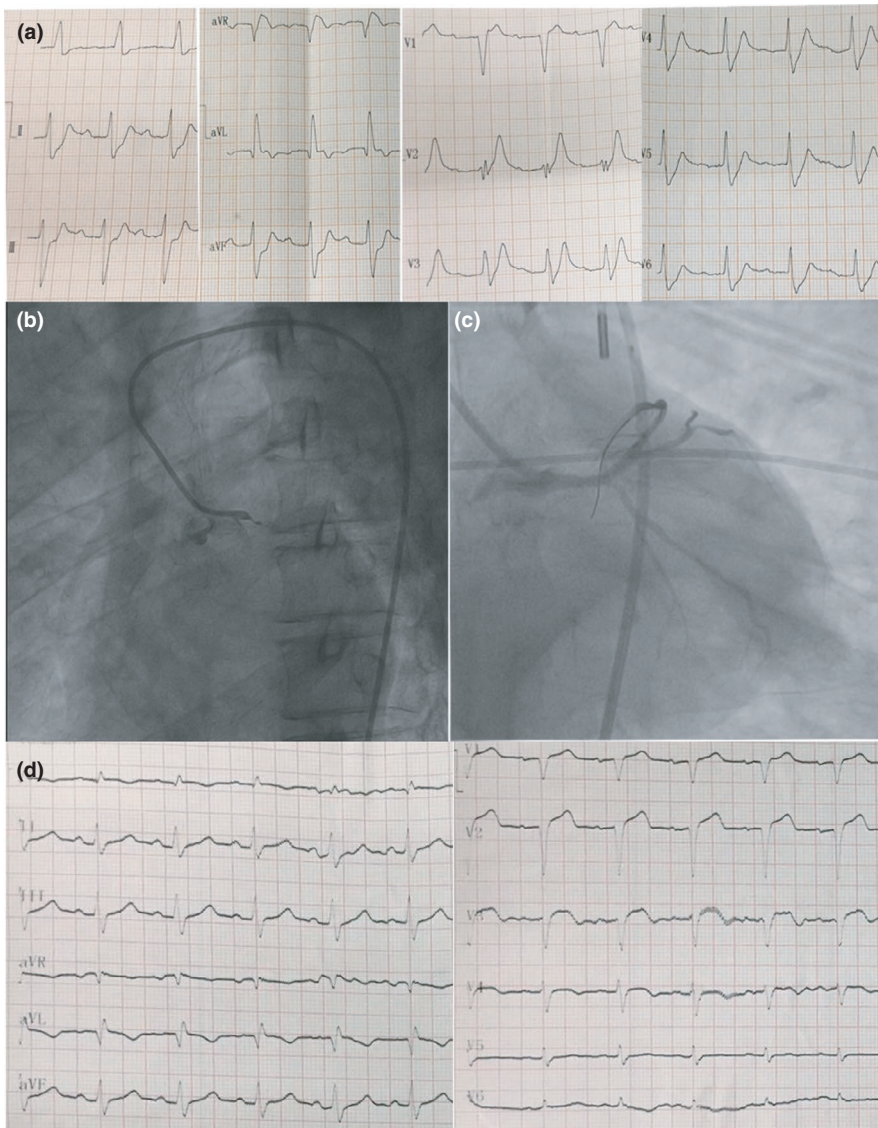


FIGURE 3 Electrocardiographic (ECG) (a) on admission revealed an upsloping ST-segment depressions (STD) in leads V_2 - V_6 (max STD in V_5) and inferior leads with tall, positive symmetrical T waves combined with ST-segment elevation (STE) in aVR and V_1 (aVR > V_1). Coronary angiography showed total occlusion of the left main artery (LM) (b). Stent implantation of the LM and proximal left anterior descending coronary artery (LAD) was performed (c). Repeat ECG on the second day showed a Q wave in precordial leads and lateral leads (d)

following thrombolytic therapy in anterior STEMI (Fiol Sala et al., 2015). Zhong-Qun Zhan reported that de Winter ECG pattern (in leads V_4 - V_6) may evolve to ST elevation accompanied by increased severity of myocardial ischemia in LM dissection (Zhan et al., 2020). So far, the electrophysiological mechanism of the de Winter pattern and its dynamic evolution remains elusive. The electrocardiographic-angiographic correlation (Zhong-qun et al., 2011), the distribution of ischemic myocardium (Gorgels, 2009), and the thrombosis progression may be responsible for this ECG pattern, yet it is difficult to draw a definite conclusion from current clinical data.

4 | CONCLUSION

Our cases demonstrate that de Winter ECG pattern may evolve to ST elevation in acute total LM occlusion. An emergency physician should be aware that a de Winter ECG pattern with a widespread upsloping STD in V_2 - V_6 centered around V_5 may indicate total LM occlusion which needs urgent angiography and reperfusion therapy.

CONFLICT OF INTEREST

There are no conflicts of interest.

AUTHOR CONTRIBUTIONS

C.-W.L. contributed to the conception and design of the work and drafted the manuscript. J.-X.Z., Y.-C.H., Y.-Y.Z. and L.W. revised it critically for important intellectual content. This study was directed by H.-L.C.

ETHICS STATEMENT

Ethics approval was not sought as this report contains case reports for which patient consent was obtained.

INFORMED CONSENT

A written informed consent for publication was obtained from the patient or the relatives.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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