Acute total occlusion of left circumflex artery in a patient with dextrocardia and situs inversus

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Abstract
We herein present a case of acute left circumflex artery (LCx) occlusion associated with dextrocardia and situs inversus that was successfully treated with drug-eluting stent implantation. The patient was initially diagnosed with non-ST-segment elevation myocardial infarction (NSTEMI) based on an early electrocardiogram. However, coronary angiography demonstrated total occlusion of the LCx. A drug-eluting stent was implanted to cover the culprit lesion, and the coronary flow was completely restored. After the angioplasty, we recorded an electrocardiogram with the lateral leads placed on the right posterior thoracic wall (V7, V8, V9), and subtle ST-segment elevation was revealed in these leads. ST-segment elevation myocardial infarction (STEMI) was subsequently confirmed, and the patient recovered uneventfully. Our case emphasizes the importance of a comprehensive understanding of the electrocardiogram to detect LCx-related acute myocardial infarction in select patients such as those with dextrocardia, in whom the entire clinical situation may look much more complicated. Our experience also demonstrates that treatment with percutaneous coronary intervention is an effective therapeutic option to improve the prognosis of LCx-related acute myocardial infarction in patients with dextrocardia.

Keywords
Myocardial infarction, dextrocardia, situs inversus, coronary occlusion, left circumflex artery, electrocardiogram

Date received: 19 January 2019; accepted: 11 November 2019

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Introduction

Dextrocardia with situs inversus is a rare cardiac anomaly in which the heart is located in the right hemithorax with the axis directed to the right and caudally. Patients with dextrocardia present a diagnostic challenge, especially in the setting of acute coronary syndrome. The left circumflex artery (LCx) is the least frequent culprit artery for acute myocardial infarction (AMI) in the general population. An electrocardiogram (ECG) has very low sensitivity for detecting ST-segment elevation myocardial infarction (STEMI) if the culprit lesion is in the LCx. The coexistence of dextrocardia and LCx occlusion increases the difficulty of diagnosis via ECG. We herein present a case of dextrocardia and LCx-related STEMI in a patient who was initially diagnosed with non-ST-segment elevation myocardial infarction (NSTEMI) by our inexperienced physician.

Case report

A 60-year-old man with known dextrocardia and situs inversus presented to Sichuan Provincial People’s Hospital because of a 2-hour history of chest tightness. His symptoms had worsened by the time of admission, and he was transported to the emergency department with severe dyspnea. He had a smoking history of one to two packs per day for 30 years. On admission, his heart rate was 44 beats/minute, blood pressure was 90/60 mmHg, and oxygen saturation was 90% on room air. The heart sounds could be auscultated on the right side of his chest without any murmurs, and his breath sounds were clear in both lung fields. His troponin I concentration was 59 ng/L (reference range, 0–40 ng/L). The remaining systemic evaluation findings were unremarkable. The initial ECG indicated a junctional rhythm, right axis deviation, a positive R wave in aVR, and a prominent S wave and absent R-wave progression in the left-side chest leads; these findings were suggestive of dextrocardia (Figure 1(a)). The patient was given 0.5 mg of intravenous atropine and normal saline solution, which yielded improvement in his heart rate and blood pressure over the next few minutes. After hemodynamic recovery, another ECG was recorded with reversal of the left and right arm leads and placement of the precordial leads in a mirror-image position on the right side of the chest. This ECG revealed an accelerated junctional escape rhythm with prominent ST depression in the precordial leads (Figure 1(b)). Therefore, the patient was diagnosed with NSTEMI.

Because of the hemodynamic instability caused by the AMI, emergency coronary angiography was performed with right radial access. Coronary angiography demonstrated total occlusion of the LCx. The totally occluded LCx was the culprit lesion responsible for the AMI (Figure 2(b)). A drug-eluting stent (DES) was implanted to cover the culprit lesion, and the coronary flow was restored completely (TIMI 3 flow) (Figure 2(c)). The patient was then transferred to the intensive cardiac care unit.

Considering that the total occlusion of the LCx shown on the diagnostic angiogram did not correspond to the early ECG findings, which should have been consistent with STEMI, we added right lateral ECG leads including V7 (at the posterior axillary line), V8 (below the scapula), and V9 (at the paravertebral border), each in the same horizontal plane as V6, considering that these leads can distinguish between anterior wall ischemia and lateral wall AMI. These additional ECG leads revealed subtle ST-segment elevation in leads V7 to V9, consistent with lateral wall AMI (Figure 1(c)). Finally, STEMI of the lateral wall was confirmed. The patient recovered
uneventfully and was discharged 5 days later on dual antiplatelet therapy for 12 months. He remained symptom-free at the 3-month follow-up.

The institutional review board granted permission to report this case. Written informed consent was obtained from the patient.

**Figure 1.** Electrocardiogram manifestation on admission with (a) conventional lead placement and (b) modified lead placement prior to percutaneous coronary intervention, (c) right posterior lead placement (V1–V3 reflect V7–V9 as shown in this picture), and (d, e, f) modified lead placement on 3 consecutive days after percutaneous coronary intervention.

**Figure 2.** (a) Diagnostic angiogram with a 6-French Judkins right 4 catheter in the left anterior oblique 30° view revealing the cardiac silhouette in the right hemithorax, with the cardiac apex pointing rightward, and a diffusely diseased right coronary artery with non-significant stenosis. (b) Diagnostic angiogram with a 6-French Judkins left 3.5 catheter in the right anterior oblique 40° view showing total cutoff of the proximal left circumflex artery (white arrow). (c) Left circumflex artery in the right anterior oblique 40°, caudal 30° view following stenting showing TIMI 3 flow (black arrow).
Discussion

Dextrocardia with situs inversus has an incidence of 1 in 10,000 and is a rare cardiac anomaly in which the heart is located in the right hemithorax with the axis directed to the right and caudally. Coronary heart disease and AMI occur at the same frequency in patients with dextrocardia as in the general population. AMI with total occlusion of the coronary artery is a medical emergency that requires immediate reperfusion therapy. Previous studies have shown that the LCx is the least frequent culprit artery for AMI in the general population. Notably, given the rarity of dextrocardia, only a few reports to date have described the existence of AMI as a result of acute LCx occlusion in a patient with dextrocardia.

In the current treatment pathways, the presence of ST-segment elevation indicates acute occlusion of the coronary artery and is critical evidence that prompts performance of primary percutaneous coronary intervention (PCI). Generally, identification of the infarct-related artery based on the location of ST-segment elevation on the ECG is consistent with the angiographic findings of the left anterior descending artery or right coronary artery. However, a standard 12-lead ECG has very low sensitivity for detecting STEMI if the culprit lesion is in the LCx. Hence, the current guidelines recommend placement of three additional leads (V7–V9) on the lateral wall to increase the sensitivity of the ECG. In the present case, however, the coexistence of dextrocardia and LCx occlusion increased the difficulty of diagnosis via ECG. The initial ECG with traditional lead placement provided little information for the assessment of ST-segment changes in our case. Additionally, the indication of possible dextrocardia in the initial ECG was not recognized by our inexperienced physician; otherwise, he would have immediately obtained another ECG with modified lead replacement. Our second ECG was obtained by reversing the upper limb leads and placing V1 to V6 leads in the mirror position, which is called a “corrected ECG.” According to the guidelines, the presence of widespread ST-segment depression on the precordial leads indicate acute anterior myocardial ischemia or should be regarded as suspicious for STEMI-equivalent LCx occlusion. Unfortunately, in our case, no lateral ECG was recorded before PCI because of the physicians’ lack of experience and our carelessness. ST-segment elevation was not displayed on the 12-lead corrected ECG in our patient; therefore, he was triaged as having NSTEMI, not STEMI, and this might have led to an unwarranted delay of primary PCI if not complicated with hemodynamic instability. The diagnosis of STEMI was established retrospectively by the angiographic findings as well as the subsequent presence of ST-segment elevation in leads V7 to V9. Moreover, we again made the mistake of not reversing the limb leads while recording the ECG of the lateral wall. In this situation, the limb leads continue to remain not inverted, alerting clinicians to the abnormal heart location. Considering that the precordial leads are unipolar leads and the strips do not differ with the upper limb lead placement, STEMI of the lateral wall was definitively diagnosed. The demonstration of ST-segment depression in the precordial leads can be confirmed as a reciprocal change of the lateral wall infarction, and this can be further supported by restoration of the ST segment in precordial leads V1 to V5 on the post-procedural ECGs.

As previously reported, PCI can be safely performed through a transradial approach in patients with dextrocardia. The unusual anatomy can make the PCI procedure more challenging because the system guidance and steerability become more difficult. Fortunately, we did not...
face major difficulties in our case except during the right coronary ostium engagement. We and others have shown that patients with LCx-related STEMI and dextrocardia with situs inversus can be managed with PCI through transradial access with excellent outcomes.\(^6\)

**Conclusion**

As in the general population, the 12-lead standard ECG does not adequately diagnose LCx-related AMI in patients with dextrocardia. Therefore, in such patients, early echocardiographic evaluation with a corrected ECG and additional lateral leads should be mandatory to reduce the risk of misdiagnosis of AMI. Furthermore, our experience demonstrates that PCI is an effective therapeutic option to improve the prognosis of LCx-related AMI in patients with dextrocardia.

**Declaration of conflicting interest**

The authors declare that there is no conflict of interest.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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