

Emergent percutaneous coronary intervention for acute myocardial infarction in patients with mirror dextrocardia: case reports and brief review

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Abstract: Mirror-image dextrocardia is a rare congenital abnormality with a life expectancy and risk of myocardial infarction similar to the normal population. Although there have been few case reports of emergent percutaneous coronary intervention (PCI) for acute myocardial infarction (AMI) in mirror-image dextrocardia, physicians, especially general and interventional cardiologists encounter problems in the diagnosis and treatment of AMI in these patients. In this paper, we report our experience with two cases of emergent transradial PCI for AMI in patients with the mirror-image dextrocardia. Subsequently, we summarize clinical features, electrocardiograph characteristic, approach to emergent PCI based on a review of the literature.

Keywords: Dextrocardia; acute myocardial infarction (AMI); emergent percutaneous coronary intervention (PCI); thrombus aspiration; radial artery access

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Introduction

Dextrocardia is a rare transposition of heart caused by congenital dysplasia or acquired diseases, which is characterized by abnormal position of the heart in the right thoracic cavity and the cardiac apex pointing to the right side. On the basis of its anatomical relationship within the thoracic cavity, dextrocardia is divided into three types: mirror-image dextrocardia, cardiac dextroversion and cardiac dextroposition. It is reported that dextrocardia occurs with a frequency of 1/10,000 in the general population (1), with a risk of coronary atherosclerosis and acute myocardial infarction (AMI) similar to those of normal persons (2). Although there have been sporadic case reports describing the occurrence of AMI in patients with mirror-image dextrocardia, several features increase the risk of misdiagnosis of AMI in patients with the mirror-image dextrocardia. Furthermore, there is a lack of detailed descriptions of the clinical features, electrocardiographic

(ECG) characteristics and approaches to emergent percutaneous coronary intervention (PCI) in this patient population. In this manuscript, we therefore describe our experience with two cases of emergent transradial PCI in patients with the mirror-image dextrocardia and AMI. In addition, we summarize the literature on AMI in patients with the mirror-image dextrocardia, reviewing clinic and ECG characteristics, as well as approaches to emergent PCI.

Case presentation

Case 1: a 57-year-old man was urgently admitted to our hospital with a one-day history of intermittent retrosternal pain, deteriorating over the last 8 hours. The retrosternal pain episodes and radiation into the neck started the day before the admission without obvious precipitating factors, lasted for about 5 minutes, and were spontaneously relieved. He sought medical attention when the pain became

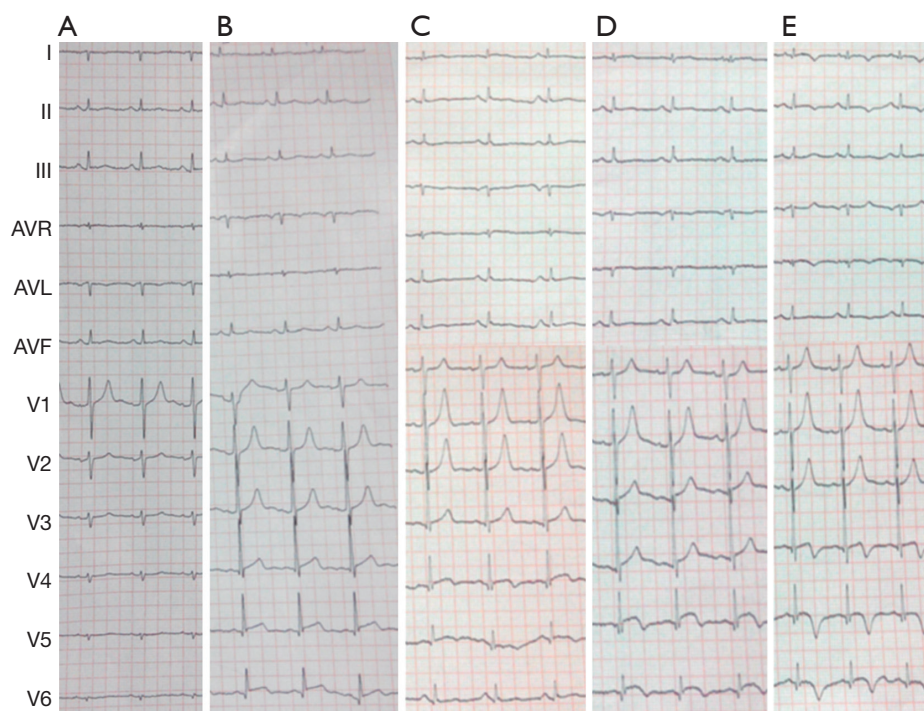


Figure 1 Electrocardiographic (ECG) manifestation of an acute lateral wall myocardial infarction in a patient with a mirror-image dextrocardia on admission with conventional lead placement (A); and corrected lead placement, prior to percutaneous coronary intervention (PCI) (B) and on three consecutive days after PCI (C-E).

persistent and squeezing. His coronary risk factors included hypertension, 80 pack-year history of smoking and moderate alcohol consumption. Blood pressure was 126/68 mmHg, pulse was 89/min. Auscultation of the heart and lungs was unremarkable. The point of maximum cardiac impulse was located in the 5th right intercostal space close to the right midclavicular line. Most of the heart lay in right thoracic cavity and cardiac apex pointed to the right side. There was no lower extremity edema. The ECG on admission showed a gradual decrease in R wave of V1-6 and abnormal limb leads I, AVL and AVR, which was simply mistaken for switched limb lead placement (Figure 1A). Because of the persistent chest pain, aortic computed tomography (CT) angiography was performed to rule out aortic dissection.

The CT scan demonstrated mirror-image dextrocardia. Based on subsequent additional inquiry, the patient had a history of mirror-image dextrocardia and situs inversus which was confirmed by echocardiography and abdominal ultrasonography. Repeated ECG with limb and chest leads placed in mirror location, named as the 'corrected ECG', was performed (Figure 1B-E). The results showed increased size of P waves and QRS waves of I and AVL leads, gradual

increase of R waves in V1-6 and elevated ST segments in V5-6, suggesting acute lateral wall myocardial infarction (Figure 1B). The diagnosis of lateral wall STEMI was further confirmed by elevated myocardial enzymes (CK 1310.00 U/L, CKMB 213.00 U/L, ALT 59.90 U/L, AST 308.10 U/L and Ultra-Sensitive Troponin I 69.500 ng/mL). Therefore, urgent coronary angiography was performed via the right radial artery. A wire was advanced to the bottom of the aortic sinus (Figure 2A). A 5-F Tig catheter could not be inserted into the coronary artery ostia. After switching to 5 F Judkins Left 4.0 catheter and 5 F Judkins Right 4.0 catheter, coronary angiography was completed and showed total occlusion in the proximal left circumflex artery (LCX) (Figure 2B,C). The left coronary ostium was cannulated with a 6-F BL 3.0 guide catheter, and the lesion was passed with a Runthrough NS wire to the distal of LCX. The lesion was then predilated with a 2.0×20 mm² balloon to 10 atm to prepare passage of a Diver CE suction catheter (Figure 2D,E). After evacuation of blood clots with a Diver CE suction catheter, a 2.75×33 mm² stent was placed, using an inflation pressure of 12 atm (Figure 2F,G), followed by a 3.0×10 mm² high pressure balloon with the post-dilatation in the proximal stent (Figure 2H). The emergent PCI was

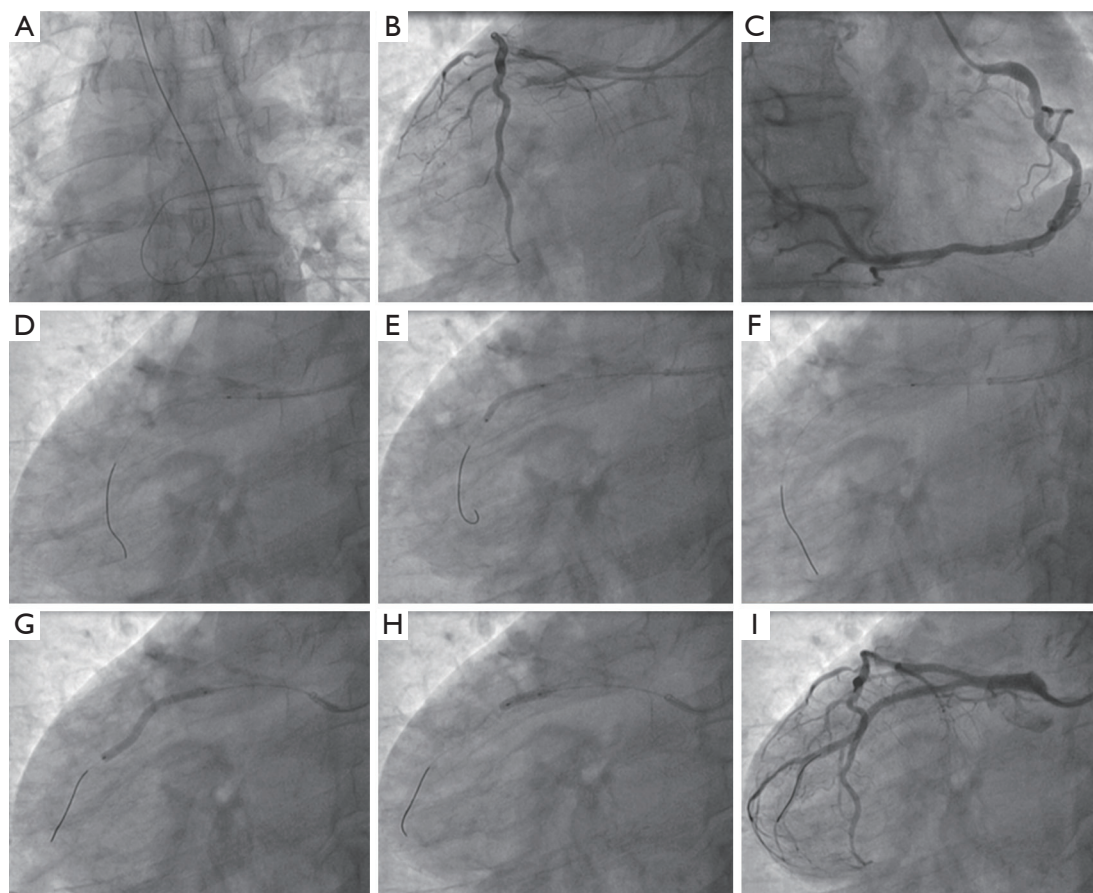


Figure 2 Emergent percutaneous coronary intervention (PCI) in a patient with a mirror-image dextrocardia and acute lateral wall myocardial infarction. Anteroposterior view from the angiogram showed mirror-image dextrocardia and right aortic arch in A. The angiogram showed proximal left circumflex artery (LCX) occlusion with acute thrombosis in a caudal 30 view (B) and mid RCA atherosclerosis in and RAO 45 view (C); TIMI grade 3 flow in LCX after coronary artery thrombus suction, balloon dilatation, and stent placement (D-I).

successful and resulted in TIMI-3 flow without residual stenosis (*Figure 2I*). The patient was monitored with daily ECG for three consecutive days, showing the AMI evolution (*Figure 1C,D,E*). He was discharged from the hospital on the seventh days after PCI in stable condition.

Case 2: a 51-year-old male patient was referred to our hospital with the chief complaint of persistent chest pain for one hour. One hour before admission, he felt persistent pain in the right side chest without a radiating pain, and simultaneously suffered from weakness, palpitation, nausea and emesis while taking a shower. Moreover, the pain was not relieved by taking sublingual nitroglycerin. His past history included chronic atrophic gastritis and mirror-image dextrocardia with situs inversus. Blood pressure was 120/70 mmHg, and heart rate was 104/min. Physical signs of mirror-image dextrocardia were discovered on

physical examination. Therefore, a ‘corrected ECG’ was performed according to the anatomical character of the mirror-image dextrocardia, indicating acute extensive anterior myocardial infarction (*Figure 3A*). Furthermore, the mirror-image dextrocardia with situs inversus were confirmed by the echocardiography, abdominal ultrasound and chest CT (*Figure 3B-E*). He was diagnosed with acute anterior STEMI in the setting of mirror-image dextrocardia with situs inversus. After administration of dual antiplatelet therapy, emergency coronary angiography was accomplished via the right radial artery approach. A 5-F Tig angiography catheter was successfully inserted into the ostia of left and right coronary artery, showing that the culprit vessel was proximal left anterior descending artery (LAD) occlusion (*Figure 4A,B*). A 6-F BL 3.0 guiding catheter was positioned into the anatomical left coronary

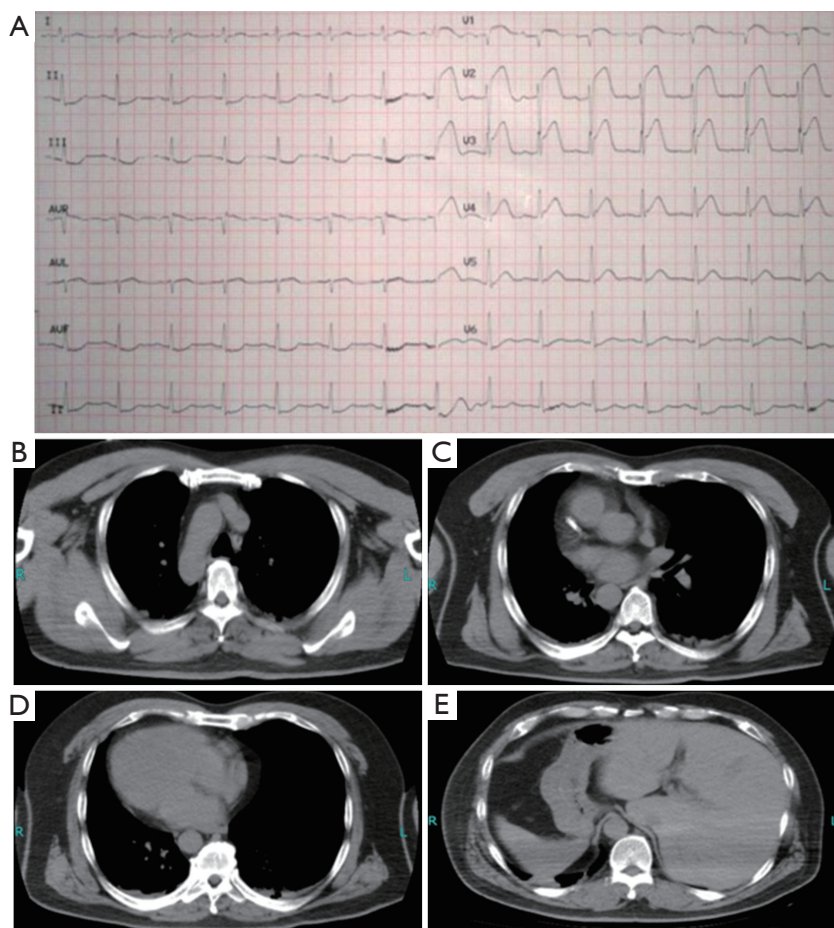


Figure 3 Corrected electrocardiogram (A) and chest computed tomography (CT) (B-E) of acute extensive anterior myocardial infarction in a patient with a mirror-image dextrocardia and situs inversus totalis.

ostium, and a Runthrough NS guide wire was advanced through the occlusion to the distal LAD. After thrombus aspiration with an Export aspiration catheter, the lesion site was predilated at 10 atm with a $2.5 \times 15 \text{ mm}^2$ balloon (Figure 4C,D). Subsequently, a $3.0 \times 16 \text{ mm}^2$ stent was implanted with 12 atm pressure (Figure 4E), followed by post-dilatation with a $3.25 \times 10 \text{ mm}^2$ high pressure balloon at 20–22 atm pressure (Figure 4F). The final result of coronary angiography showed that there was no residual stenosis in the stent of LAD with the TIMI 3 degree flow (Figure 4G,H). On the seventh day after PCI, the patient was discharged in stable condition.

Discussion

Mirror-image dextrocardia, also known as genuine dextrocardia, which can be associated with situs inversus

or situs solitus, is characterized by a shift of the heart to the right side of the thoracic cavity during the embryonic development (3). Although the condition was already described in a case report by Geeslin *et al.* in 1944, the clinical diagnosis of AMI in mirror-image dextrocardia is often delayed or missed. With the deepening understanding of ECG and the progress of cardiac imaging technology, AMI in mirror-image dextrocardia has gradually become better known in the field of adult cardiology. Mirror-image dextrocardia has typical clinical and ECG characteristics, and with appropriate adjustment, PCI can be performed successfully.

Clinical features of AMI with mirror-image dextrocardia

Chest pain is a common symptom of AMI. It has been reported that some patients with mirror-image dextrocardia

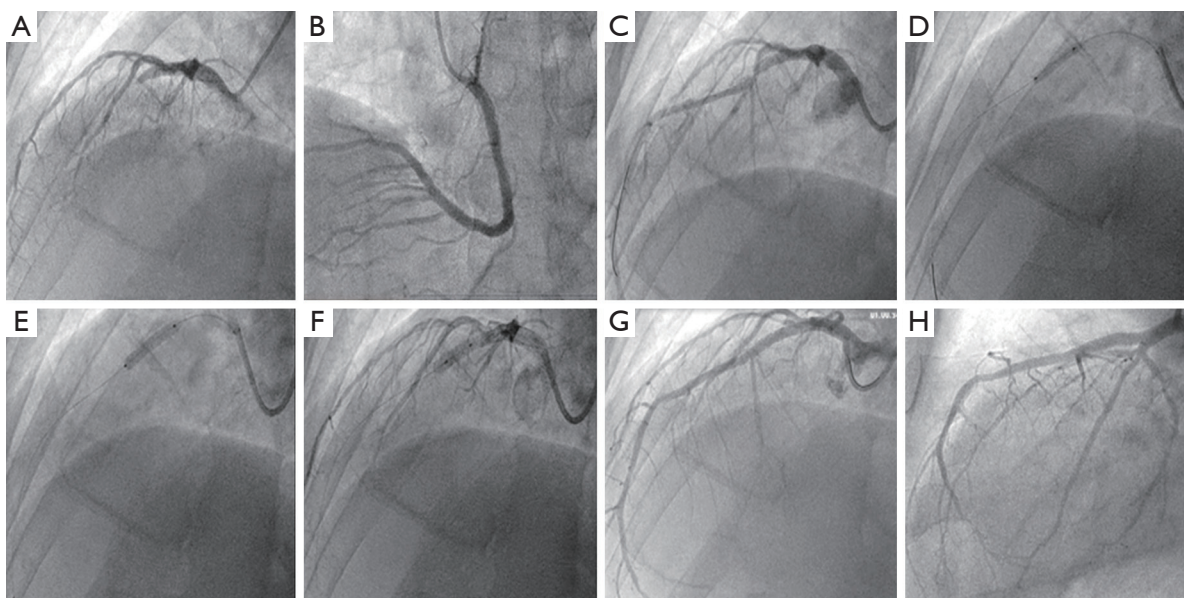


Figure 4 Emergent percutaneous coronary intervention (PCI) in a patient with a mirror-image dextrocardia and acute extensive anterior myocardial infarction. Coronary angiography showed proximal left anterior descending artery (LAD) occlusion with thrombosis and 50% stenosis of mid left circumflex artery (LCX) in left anterior oblique view (LAO) 30 cranial-30 view (A) and normal right coronary artery (RCA) in right anterior oblique view (RAO) 45 view (B); TIMI grade 3 flow in LAD after thrombus aspiration, balloon dilatation and stenting (C-H).

feel pain in the right chest with radiation to right shoulder and arm (4); another pattern is pain behind the sternum with the radiation to neck and left arm (5), or right arm (1,6), or right shoulder (7). In our two cases, chest pain was described as retrosternal, radiating to neck by the first patient, but right sided without radiation by the second patient. Right side chest pain is misinterpreted and attributed to diseases of pleura, lung, gall bladder, or aorta. The mechanism of right side chest pain may be related to shift of the sensory nerves of heart to the right side of the first 1–5 thoracic spinal cord segment during embryonic development (8).

A typical clinical sign of mirror-image dextrocardia is that the apex beat is situated at the intersection of the 5th right intercostal space with a line 5 mm medial to the right midclavicular line. The heart border is normal, but most of heart is in the right side chest (2). In addition, the value of a detailed history is to be emphasized, because patients reported a prior diagnosis of situs inversus with dextrocardia when asked.

ECG in AMI with mirror-image dextrocardia

ECG is a widely used, economical and noninvasive method in the clinical evaluation of AMI. In the first case, initial

uncorrected lead placement did not reveal the ECG change and acute lateral myocardial infarction (*Figure 1A*). By reversing the left and right limb leads, interchanging chest leads V1 and V2, placing V3–6 leads in the mirror position (namely V3R–6R), i.e., corrected lead placement, which is called ‘corrected ECG’, the presence of an acute lateral myocardial infarction could be accurately identified (*Figure 1B–E*). In the second case, the corrected ECG identified an acute extensive anterior myocardial infarction (*Figure 3A*). An ECG with normal lead placement can correctly recognize acute inferior and anteroseptal myocardial infarction, as shown by the previous case reports (1,6,9). Different types of dextrocardia, including mirror-image dextrocardia, dextroversion and dextroposition have characteristic anatomical features, and different ECG expressions. Firstly, a gradual decrease instead of the typical increases of the R-wave amplitude in the precordial leads V1–6 is suggestive of mirror-image dextrocardia and cardiac dextroversion. Secondly, negative P waves and QRS waves in limb leads I and AVL of ECG, suggest of mirror image dextrocardia. In contrast, positive P wave and negative T wave in limb leads I and AVL of ECG, suggest cardiac dextroversion. A normal ECG waveform in limb leads I and aVL, but decreased amplitude is suggestive of cardiac dextroposition.

Approach to emergent PCI in AMI with mirror-image dextrocardia

Arterial access

PCI can be accomplished safely through a transfemoral, transradial, transbronchial and transulnar approach. Prior case reports of PCI for AMI in patients with mirror-image dextrocardia, typically described femoral artery access (3,6,7,10). The first reported case of transradial PCI for a patient with stable angina and mirror image dextrocardia was reported in 2004 by Macdonald *et al.* (11). In our two cases, we successfully performed emergent PCI via a right transradial access (Figures 2,4). To our knowledge, this is the first report of emergent PCI in AMI patients with mirror-image dextrocardia via the transradial approach. In our experience, the right transradial approach in mirror-image dextrocardia is as feasible and safe as in patient with normal heart position.

Percutaneous coronary intervention (PCI)

Compared to the normal heart position, selection and operation of interventional instruments, including angiographic catheter, guide catheter, guide wire, suction catheter and balloon and stent, should be adjusted to the expected anatomy in emergency PCI for AMI in patients with mirror-image dextrocardia. In the first case, it was difficult to reach the coronary ostia using the multifunctional Tig angiographic catheter, but a Judkins Left 4.0 and Judkins Right 4.0 catheter were used successfully. In the second case, the Tig angiographic catheter was successfully used. Both cases were completed using a BL 3.0 guiding catheter. In our experience, Judkins angiographic catheters are more suitable than multifunctional catheters for interventional procedures for mirror-image dextrocardia (3). Furthermore, the angle of brachiocephalic trunk originating from the aorta artery is a key feature in selecting angiographic catheter and guiding catheter (8). Based on the previous case reports, guiding catheters such as Judkins Left 5.0 (10,12), XB 3.0 (13) and Extra Backup 3.5 (8) are suitable for left coronary artery ostium. Judkins Right 4.0 (7,8,12), multifunctional guiding catheter (14) and extra support guiding catheter (ECR 3.5) (9) are used as the guiding catheter for right coronary artery ostium.

Conclusions

In clinical practice, attention should be paid to past history

of mirror-image dextrocardia, right side chest pain, and clinical features of dextrocardia. It is also important to carefully analyze negative P waves and QRS waves in limb lead I, positive P waves and QRS waves in limb lead AVR, and a gradual decrease of R waves in precordial leads V1-6. Myocardial necrosis markers, echocardiography, chest radiography and chest CT contribute to the diagnosis of AMI in mirror-image dextrocardia. Knowledge about this infrequent condition will reduce misdiagnosis of AMI patients with mirror-image dextrocardia, and appropriate technique allows effective treatment.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this Case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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