Dextrocardia

Why Significant Left-Axis Deviation?

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ECG CHALLENGE

A 29-year-old male presented to the cardiology department with a 2-day history of aggravating choking sensation in the chest and symptoms of heart failure. He had a history of congenital heart disease diagnosed at 2 years of age. Physical examination revealed orthopnea, cyanosis, apical impulse located on the right side of his chest, and hepatic dullness located in the left subcostal region. A 12-lead ECG is shown in Figure 1. The ECG was inconsistent with typical ECG characteristics of mirror-image dextrocardia because R wave progression occurred in leads V_1 through V_6, although the R wave amplitude decreased progressively. How should we analyze ECG combined with clinical findings to confirm our diagnosis?

Please turn the page to read the diagnosis.

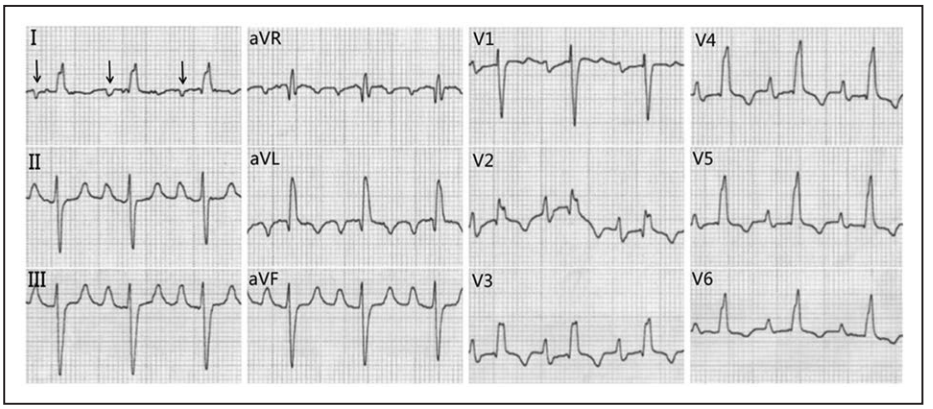

Figure 1. Standard 12-lead ECG on admission.
The 12-lead ECG on admission showed an inverted P wave in leads I and aVL (downward arrows), and the electric axis of the heart was −75°. The QRS complexes in lead V_1 has an rS morphology, and V_2 through V_6 have a qR morphology.

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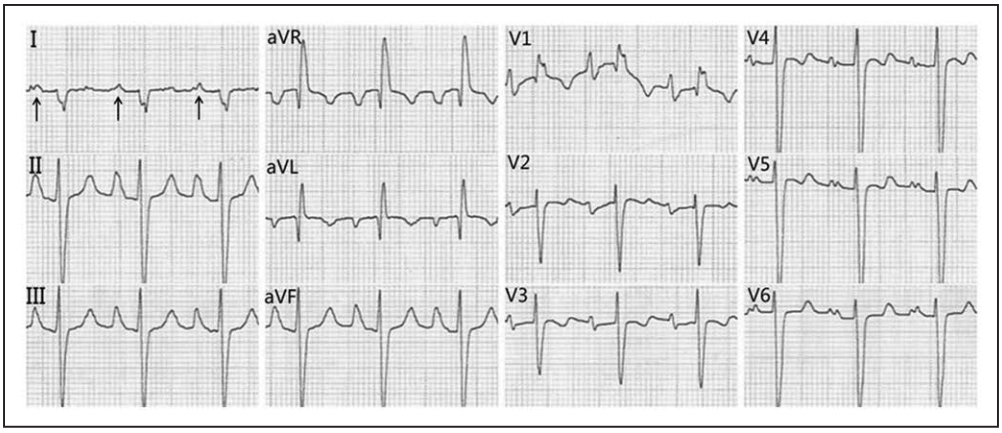

Figure 2. Corrected lead placement according to mirror position.
A 12-lead ECG was obtained.

RESPONSE TO ECG CHALLENGE

The apex of the heart located at the right side of the chest is a reliable sign of dextrocardia. It is commonly seen in mirror-image dextrocardia (mirror image change, mostly accompanied by situs inversus viscerum and a few accompanied by intracardiac anomaly), dextroversion cardis (dextroverted heart without situs inversus viscerum, mostly accompanied by intracardiac anomaly), and in conditions in which the heart shifted to the right (such as pulmonary, pleural, or diaphragmatic lesions). This patient was found to have the apex of the heart located at the right side of the chest accompanied by situs inversus viscerum at 2 years of age, which supports mirror-image dextrocardia. An inverted P wave in lead I is a reflection of atrial mirror reversal.

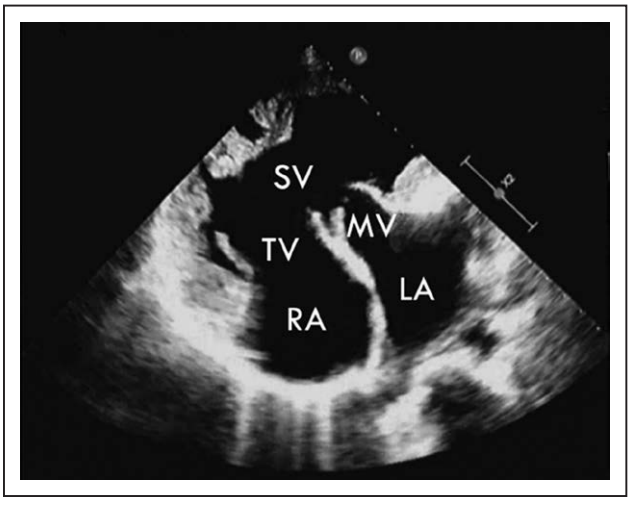

Figure 3. Transthoracic echocardiography.
Searched on the apex located in the right side of chest, the transthoracic echocardiography showed atrial situs inversus, single ventricle with no septal structure in apical 4-chamber view, which demonstrated mirror-image dextrocardia with single ventricle. LA indicates left atrium; MV, mitral valve; RA, right atrium; SV, single ventricle; and TV, tricuspid valve.

Leads placement can be corrected according to mirror position, wherein the left lead is placed on the right arm, the right arm lead is placed on the left arm, and the V_1 through V_6 leads are placed in the V_2, V_1, and V_{3R} through V_{6R} positions. The ECG (Figure 2) performed with the leads correction showed sinus rhythm with positive P wave in leads II and III, negative P wave in lead aVR, and right atrium hypertrophy. The electric axis of heart was −105°. QRS in limb leads in II, III, and aVF were characterized by rS complex, the chest lead in V_1 showed a qR, and in V_5 and V_6 were rS. These ECG findings were consistent with mirror-image dextrocardia accompanied by right ventricular hypertrophy and left anterior fascicular block. The patient had congenital cyanosis (suggestive of intracardiac anomaly); therefore, it was necessary to exclude the possibility of single ventricle because in this heart lesion the ECG can be show rS in leads II, III, aVF, and the axis pointing upward, as in our patient.[1,2]

Transthoracic echocardiography (Figure 3 and Movie I in the online-only Data Supplement) and chest computed tomography (CT) scan demonstrated that the patient had mirror-image dextrocardia with single ventricle. Only 3% to 10% dextrocardia has been reported to have concomitant intracardiac anomaly,[3] whereas single ventricle is even rarer. Therefore, a diagnosis of ventricular depolarization abnormality should not be made in this circumstance. In this case, the significant left-axis deviation can be explained by the underlying congenital abnormality, which leads to malposition of the conduction system. The His bundle and left bundle branch of a single ventricle are congenitally displaced toward the inferoposterior septum, and there is concomitant left anterior fascicular hypoplasia, leading to relative advanced depolarization of inferior myocardium and the axis pointing upward in ECG.

The important lesson learned from the diagnostic procedure of this case is that in a patient with mirror-image dextrocardia accompanied with cyanosis, the possibility of single-ventricle physiology should be considered in the face of conflicting ECG findings.

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DISCLOSURES

None.

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FOOTNOTES

The online-only Data Supplement is available with this article at http://circ.ahajournals.org/lookup/suppl/doi:10.1161/CIRCULATIONAHA.117.031095/-/DC1.

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