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Implantation of a dual-chamber pacemaker in a patient with dextrocardia and sick sinus syndrome: a case report

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Abstract

Dextrocardia is a congenital abnormal position of the heart in which the main part of the heart is in the right chest, and the long axis of the heart points to the lower right. Cases of a combination of dextrocardia and sick sinus syndrome are rare. A 65-year-old female patient was admitted to hospital with palpitations and dizziness for 1 week. Mirror-image dextrocardia and sick sinus syndrome were diagnosed by an electrocardiogram, echocardiography, Holter monitoring, and X-rays. Finally, we successfully implanted a dual-chamber pacemaker into the patient. The patient had an uneventful recovery and was discharged when her symptoms had greatly improved 1 week later. When dextrocardia is present, using active fixation leads in the atrial and ventricular leads is easier for finding the pacing position with optimal sensing and pacing thresholds, and they reduce the incidence of falling off.

Keywords

Dextrocardia, sick sinus syndrome, pacemaker implantation, active fixation lead, dual-chamber pacemaker, pacing threshold

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Background

Dextrocardia refers to the congenital abnormal position of the heart in which the main part of the heart is in the right chest, and the long axis of the heart points to the lower right.[1–2] Dextrocardia is a rare cardiac malformation in which an abnormal position and connection can occur in all parts of the heart and great vessels. Dextrocardia can be divided into the three types of mirror-image dextrocardia, dextroposition and dextroversion. In mirror-image dextrocardia, the relationship between the structures of the heart is normal, but cardiac structures are in the opposite direction, and this is usually accompanied by abdominal situs inversus. There are few cardiovascular malformations in mirror-image dextrocardia, and it is the most common form of dextrocardia in the general population.[2–4] The incidence of dextrocardia is approximately 1/10,000, of which mirror-image dextrocardia accounts for about 40%,[5] and the rate of dextrocardia with intracardiac malformation is approximately 40% to 50%.[6] Because of the low incidence of dextrocardia, patients with dextrocardia and arrhythmias are not common in the clinic, and cases of pacemaker implantation in these patients are even rarer. However, there are also successful cases of pacemaker implantation, among which dextrocardia with sick sinus syndrome and complete atrioventricular block are the main cases reported.[7–11]

We report the case of a patient with dextrocardia and sick sinus syndrome. Because of the rarity and anatomical specificity of this case, we experienced great difficulties and challenges to our dual-chamber (DDD) pacemaker implantation operation. Finally, we successfully completed the operation, improved the patient's symptoms remarkably and her quality of life was also improved.

Case presentation

A 65-year-old female patient was admitted to hospital because of palpitations and dizziness for 1 week. The palpitations and dizziness were aggravated after activity, and she had other symptoms, such as amaurosis and syncope. In addition, she had had hypertension for many years and was taking nifedipine for treatment. There were no episodes of syncope before these symptoms and no similar family history. At admission, a physical examination showed a blood pressure of 156/73 mmHg and heart rate of 56 beats/minute. The point of maximal impulse was found in the right fifth intercostal space approximately 0.6 cm from the midclavicular line. Premature beats were heard, but no cardiac murmurs were auscultated. An electrocardiographic (ECG) examination showed that the morphology of waves in leads avR and avL were opposite to normal. Additionally, there were inverted P and T waves in lead I, and the R wave in leads V1 to V6 gradually decreased (RV3>RV4) (Figure 1). An ECG with right-sided precordial leads and reversed limb leads showed sinus arrest, junctional escape, ventricular premature beats and clockwise transposition (Figure 2). Echocardiography showed mirror-image dextrocardia, and the size of the cardiac cavities and their connection with blood vessels were normal. A chest anteroposterior X-ray showed a heart shadow on the right (Figure 3). Holter monitoring showed an average heart rate of 53 beats/minute, sinus block or sinus arrest (the longest RR interval was 2.20 s) (Figure 4), frequent ventricular premature beats (4607 times/24 hours, 2 times in pairs), frequent atrial premature beats (3783 times/24 hours), junctional escape beats, ventricular escape beats and dextrocardia.

According to the examination results and clinical symptoms, we diagnosed this patient with mirror-image dextrocardia

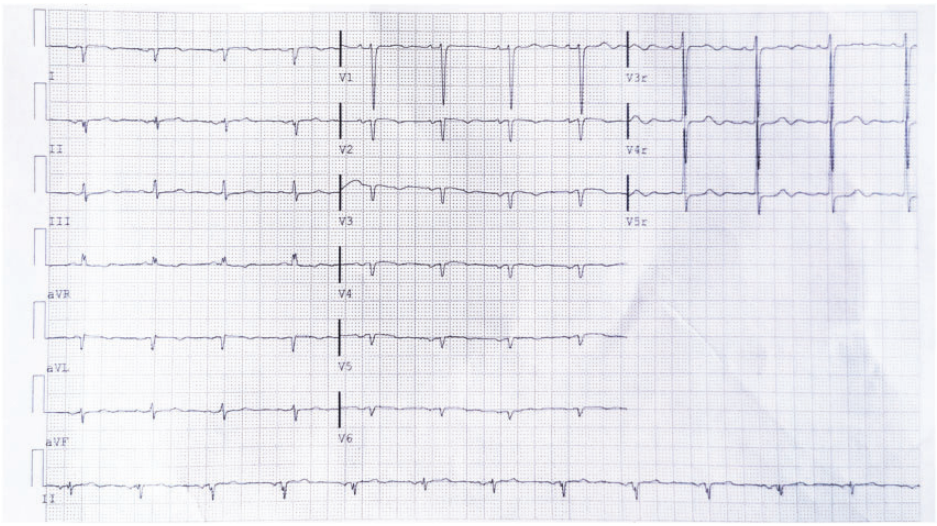

Figure 1. An electrocardiogram shows that the morphology of waves in leads avR and avL is opposite to normal, P and T waves are inverted in lead I and the R wave in leads V1 to V6 is gradually decreasing (RV3>RV4).

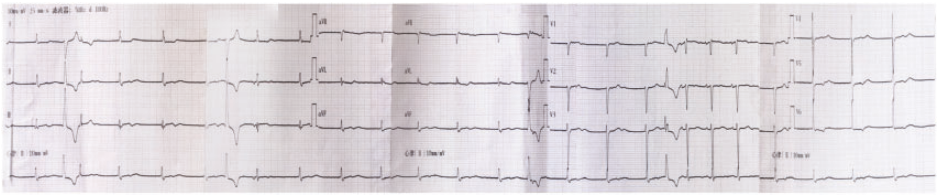

Figure 2. An electrocardiogram with right-sided precordial leads and reversed limb leads shows sinus arrest, junctional escape, ventricular premature beats and clockwise transposition.

and sick sinus syndrome, and prepared to implant a DDD pacemaker.

There may have been cardiac anatomical abnormalities and venous alterations, and we did not perform angiography before the operation. However, we repeatedly confirmed the position of the leads through positive, lateral and oblique positions under fluoroscopy during the operation. The patient was in the supine position, and a guide wire was successfully placed after the left subclavian vein was punctured under local anesthesia. Active fixation leads were used in the atrial and ventricular leads. The ventricular lead was positioned in the right ventricular apex, the pacing threshold was 0.6 V, the sensitivity was 11.0 mV and the impedance was 560 Ω. The atrial lead was fixed to the free wall of the right atrium, when the atrial lead was placed for the first time, and it was located in the posterior wall of the atrium. The patient developed hiccups while adjusting the parameters of the pacemaker, and phrenic nerve stimulation was considered. The hiccups disappeared with the combination of the left anterior oblique and right anterior oblique positions to adjust the lead to the appropriate position. The pacing threshold was 0.5 V, the sensitivity was 2.5 mV and the impedance was 620 Ω. We closely connected the ventricular and atrial leads to the pulse

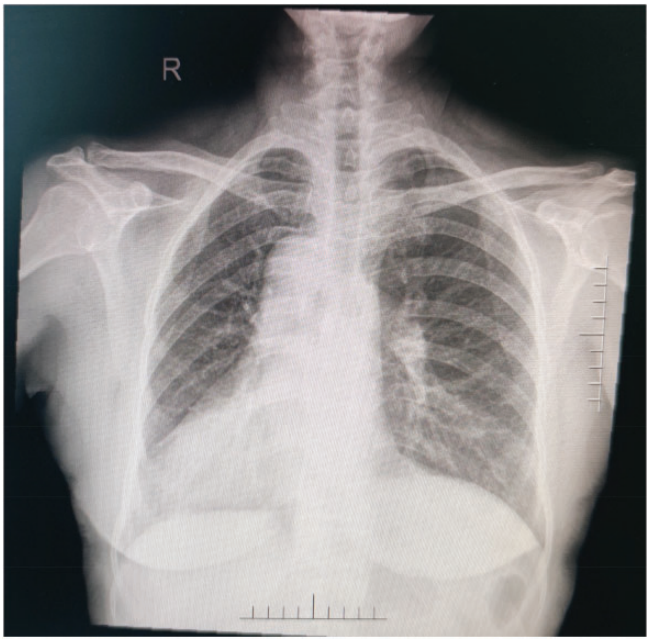

Figure 3. X-ray showing a heart shadow on the right.

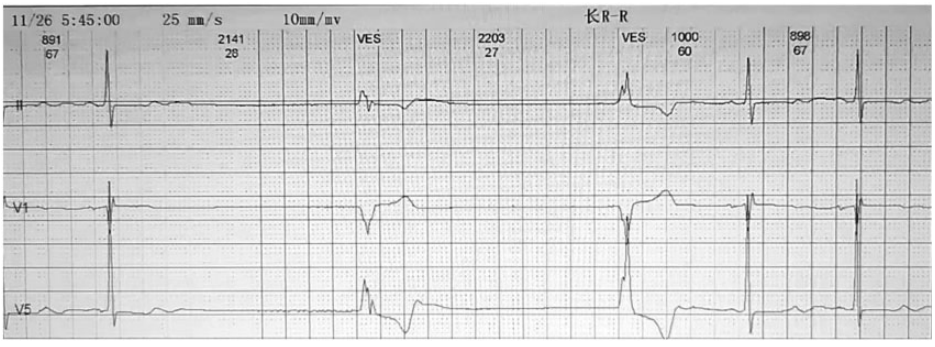

Figure 4. An electrocardiogram shows the longest RR interval of 2.20 s.

generator. The final position of the lead was confirmed using fluoroscopic projections (Figure 5).

The patient had an uneventful recovery and was discharged with improvement of her symptoms 1 week later. During 3 months of follow-up, the patient was not admitted to hospital again, and she did not have repeated palpitations within 3 months.

The reporting of this study conforms to the CARE guidelines.[12]

Discussion

In cardiac pacemaker implantation, the commonly used leads are the passive fixation lead and the active fixation lead. The passive fixation lead is widely used because of its easy operation and low

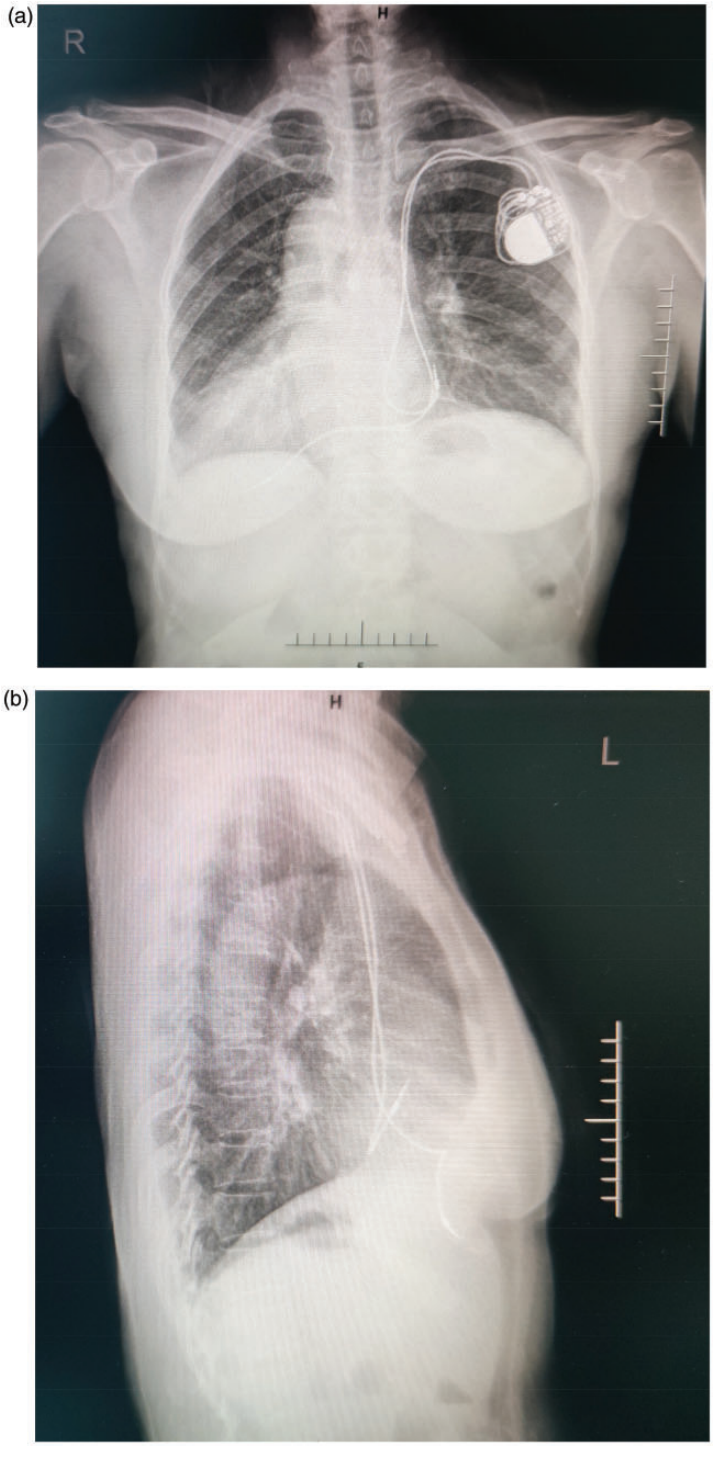

Figure 5. Chest X ray showing the correct placement of atrial and ventricular pacemaker leads.

price. This lead has "tines" at the end of the lead, which enable it to be embedded in the trabecular muscles acutely. After a period of time, the myocardium around this lead fibroses to secure it further.[13] With the continuous development of pacing technology, the utilization rate of the active fixation lead is increasing.[14] The tip of the active fixation lead is a screw, which rotates out of the spiral structure during implantation and rotates into the myocardium, and it can be placed anywhere in the cardiac cavity.

In this case, the atrial and ventricular leads were active fixation leads. With regard to the atrial leads, the passive fixation leads need to be fixed in the right atrial appendage, where the trabecular muscles are dense. However, because of the anatomical specificity of mirror-image dextrocardia, reaching an accurate position by using passive fixation leads is difficult. This difficulty increases the radiation exposure time of the patients, and the lead easily falls off.

The active fixation leads can be fixed anywhere in the atrium. Identifying the position to fix the active fixation leads to optimal sensing and pacing thresholds, and this reduces the operation time. Therefore, we fixed the atrial leads to the free wall of the right atrium. The incidence of pericardial effusion and pericardiocentesis with active fixation leads in the atrium is higher than that with passive fixation leads because of the thin free wall.[15] However, a good percepual and pacing function of the atrial lead are important for patients with sick sinus syndrome with an indication for pacemaker implantation. Considering the anatomical specificity of this patient, we decided to use active fixation leads in the right atrium to reduce the incidence of dislodgement.[16–17] In addition, the pacing threshold of the active atrial fixation lead is lower and more stable than that in the passive fixation lead, and it can also greatly reduce the time of bed rest and hospitalization of patients.[18]

Because of the anatomical specificity of mirror-image dextrocardia, the operation during implantation is opposite to that in a normal person. Therefore, surgeons need to be fully familiar with and knowledgeable about the anatomical characteristics and the course of blood vessels before the operation to help determine the path of lead implantation. While positioning the leads, a positive position, lateral position and oblique position can be combined under fluoroscopy. To determine the position of the leads from different angles, surgeons should not push blindly and cause surgical complications. During the operation, the fluoroscopic image needs to be inverted, and the operation should be performed under the posterior anterior view.[11] This approach is more in line with the usual operating procedure, can increase the success rate of the operation and can also reduce mistakes in operations, which can cause vascular and cardiac injuries.

Conclusions

The atrial leads can be fixed to the atrial free wall using the active fixation lead so that it is easier to find and can reach the required position with an optimal sensing and pacing threshold in patients with dextrocardia. During the operation, we can combine the different positions of the leads under fluoroscopy and determine the position of the leads from different angles. The fluoroscopic image can be inverted, and the operation can be performed under the posterior anterior view, which is more in line with the usual operating procedure, and this can increase the success rate of the operation.

Ethics statement

The study protocol was approved by Ethics Review Committee of the First Affiliated Hospital of Guangdong Pharmaceutical

University. Written informed consent was obtained from the patient to publish their case.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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Author contributions

JLuo collected the patient's medical history, discussed the advantages of active fixation leads, and was a major contributor in writing the manuscript. ZZhou analyzed and explained the types of dextrocardia. ZZeng contributed to the final review of the manuscript. KC stated the incidence of dextrocardia. JLin contributed to analysis and manuscript preparation. CC analyzed and explained the principle of the active fixation lead and the passive fixation lead. All authors read and approved the final manuscript.

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