Abnormal His-Purkinje System Conduction Leading to Complete Atrioventricular Block in Patients With Hypertrophic Cardiomyopathy

A Report of 3 Cases

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SUMMARY

This case report describes three hypertrophic cardiomyopathy patients with abnormal His-Purkinje conduction and complete atrioventricular block with attacks of syncope and cardiopulmonary arrest. Although arrhythmias are common in hypertrophic cardiomyopathy, complete atrioventricular block is very rare. Prolonged QRS duration and abnormal His-Purkinje system conduction may result in complete atrioventricular block. (Jpn Heart J 2004; 45: 347-352)

Key words: Hypertrophic cardiomyopathy, Atrioventricular block, Intracardiac ECG

HYPERTROPHIC cardiomyopathy (HCM) is a genetic cardiac disease with an autosomal-dominant pattern of inheritance in some cases.¹⁾ It is characterized by left ventricular hypertrophy in the absence of another cause for the increased cardiac mass, and it is the most common cause of sudden death in otherwise healthy young individuals.²⁾ The identification of patients who are at a high risk for sudden death remains an important challenge. Sudden death is thought to be caused by ventricular arrhythmia in most patients.³⁾ Although arrhythmias are common in HCM, complete atrioventricular (AV) block is very rare.⁴⁻⁸⁾ In this study, we describe three HCM patients with abnormal His-Purkinje conduction and complete AV block with attacks of syncope or cardiopulmonary arrest.

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CASE REPORTS

Case 1: A 27-year-old Turkish male patient was admitted to our emergency department with a recent history of syncope. On further questioning, the patient mentioned dyspnea with exercise for two weeks and only one syncope attack. On physical examination, his heart rate was 30 beat/min and his blood pressure was 80/50 mmHg. There was a grade 1-2/6 systolic ejection murmur heard best at the left sternal border. Electrocardiography demonstrated complete AV block at a ventricular rate of 31 beats/min (Figure 1A). Heart rate did not respond to IV atropine. A temporary transvenous ventricular pacemaker was inserted urgently. In a two-dimensional echocardiographic examination, the end-diastolic thickness of the septum was 1.9 cm, the posterior wall 1.5 cm, the apex 1.6 cm, and the lateral wall was 1.5 cm (Figure 1B). There was no systolic anterior motion of the mitral valve and a left ventricular outflow tract gradient was not detected in a Doppler study from the apex. The Valsalva maneuver did not change the velocity in the left ventricular outflow tract. Mild mitral regurgitation was observed in color flow imaging. As a result of this echocardiographic examination, the patient was diagnosed as having nonobstructive HCM. Routine laboratory tests were within normal limits. Subsequently, a permanent, transvenous DDD pacemaker was implanted in the patient. Before permanent pacemaker implantation, an in-

Figure 1. A: The 12-lead ECG of case 1 showing complete atrioventricular block. B: The parasternal long-axis two-dimensional echocardiogram of case 1. C: Intracardiac ECG of case 1 revealed that total QRS duration was 140 msec with a nonspecific conduction pattern, the A-H interval was 65 msec, and the H-V interval was 130 msec. (RV = right ventricle; LV = left ventricle; LA = left atrium; His bundle activation is indicated by H, atrial activation is indicated by A, and ventricular activation is indicated by V.)

tracardiac ECG revealed that the total QRS duration was 140 msec with a nonspecific conduction pattern, the A-H interval was 65 msec, and the H-V interval was 130 msec (His bundle activation is indicated by H, atrial activation is indicated by A, and ventricular activation is indicated by V) (Figure 1C).

We have also interviewed other family members of the patient. In the family history, one sister died suddenly at age 12 without any determined reason and the father died at age 65 after a cerebrovascular accident. The patient had a mother aged 68, two brothers aged 33 and 43, an aunt (maternal) aged 58, and an uncle (maternal) aged 50 who were all still alive. We detected nonobstructive HCM in the mother, aunt, and elder brother of the patient, but they did not have AV block on their electrocardiograms or 24-hour ECG Holter examinations.

Case 2: A 19-year-old male Turkish patient was referred to our hospital with three attacks of syncope associated with documented intermittent complete AV block for 1 month (Figure 2A). He also reported intermittent attacks of dizziness. His pulse rate was 70 beats/min and his blood pressure was 120/70 mmHg at the time of presentation to our hospital. There was a grade 2-3/6 midsystolic murmur at the mesocardiac region. There was no change in the intensity of the murmur with the Valsalva maneuver, exercise, or sublingual nitroglycerin. An ECG showed a heart rate of 70 beats/min with a left bundle branch block pattern. Echocardiographic examination showed normal cardiac chamber sizes except for

Figure 2. A: 12-lead ECG of case 2. B: Parasternal long-axis view of case 2. C: Intracardiac ECG of case 2 revealed that the total QRS duration was 166 msec with a left bundle branch block pattern, the A-H interval was 56 msec, and the H-V interval was 74 msec. (RV = right ventricle; LV = left ventricle; LA = left atrium; AO = aorta; His bundle activation is indicated by H, atrial activation is indicated by A, and ventricular activation is indicated by V.)

left atrium enlargement (4.2 cm). There was diffuse thickening of the left ventricular myocardium with the interventricular septum (1.4 cm), the left ventricular apex (1.5 cm), and the left ventricular posterior wall (1.7 cm) (Figure 2B). There was no Doppler evidence of left ventricular outflow obstruction. Intracardiac ECG revealed that total QRS duration was 166 msec with a left bundle branch block pattern, the A-H interval was 56 msec, and the H-V interval was 74 msec (Figure 2 C). A permanent, transvenous DDD pacemaker was implanted in the patient to prevent syncope attacks due to the complete AV block. Screening of the family members by physical examinations, ECG, and echocardiography revealed there was no other familial occurrence of HCM.

Case 3: A 40 year-old Turkish woman presented to our emergency department with signs and symptoms of cardiopulmonary arrest. Her heart rate was found to be < 20 beats/min and an external cardiac massage was started immediately with administration of 1 mg intravenous epinephrine. Electrocardiography demonstrated complete AV block with a slow ventricular escape rate. The atrial rate was 84 beats/min (Figure 3A). An urgent external temporary pacemaker was implanted resulting in a recovery of consciousness and blood pressure.

Echocardiographic examination demonstrated an enlarged left atrial cavity (4.6 cm). Nonobstructive hypertrophy in the left ventricle with systolic cavity

Figure 3. A: 12-lead ECG of case 3. B: Parasternal long-axis view of case 3. C: Intracardiac ECG of case 3 under temporary pacemaker implantation showed blockage of the His potential as a cause of third degree AV block. A-H interval was normal (98 msec). (RV = right ventricle; LV = left ventricle; LA = left atrium; AO = aorta; His bundle activation is indicated by H, atrial activation is indicated by A, and ventricular activation is indicated by V.)

obliteration was observed. The thicknesses of the interventricular septum (2.3 cm), the left ventricular posterior wall (1.6 cm), and the left ventricular apex (1.6 cm) were increased with normal valvular functions (Figure 3 B). There was no history of hypertension or any other disease affecting the cardiovascular system.

An intracardiac ECG under a temporary pacemaker showed blockage of the His potential as a cause of third degree AV block (Figure 3C). The A-H interval was normal (98 msec). Screening of the family did not find any patient with HCM.

DISCUSSION

Hypertrophic cardiomyopathy is a heterogeneous disease presenting with a variety of clinical cardiac events. The majority of cases are caused by mutations in genes encoding cardiac sarcomeric proteins. These mutations are inherited in an autosomal dominant fashion with variable penetrance and age-related expression.⁹⁾

Cardiac arrhythmia is a common but manageable complication of HCM. Although supraventricular and ventricular tachycardias are common in HCM, they rarely cause complete AV block.⁴⁻⁸⁾ As in our group of patients, prolonged QRS duration and abnormal His-Purkinje system conduction may result in complete atrioventricular block. This presentation may be precipitated by antiarrhythmic drugs affecting the conduction system. Patients with HCM may also experience recurrent syncopal attacks due to torsades de pointes following AV block.¹⁰⁾ There was no history of drug usage that would affect the AV conduction system in any of the three patients.

To the best of our knowledge, we have described the largest series of complete AV block with HCM from different families. Two patients had paroxysmal complete AV block with syncope and one patient had persistent complete AV block with resuscitated cardiopulmonary arrest. All had undergone intracardiac ECG recordings and successful permanent DDD pacemaker implantation. We documented abnormal His-Purkinje system conduction of 130 msec in case 1 and 74 msec in case 2 and a blocked His potential in case 3.

Fananapazir, *et al* demonstrated abnormal His-Purkinje conduction in 23% of HCM patients who survived sudden cardiac death.³⁾ These data, in connection with our findings, suggest some patients with HCM may have syncope and sudden cardiac death related to complete AV block. From this point of view, we recommend intracardiac ECG in patients with HCM and a prolonged QRS complex for risk stratification in addition to Holter monitoring.

The pathophysiology of AV block in HCM is not known. Since AV block did not respond to atropine in these patients, an organic pathology in the cardiac con-

duction system may be possible rather than a neural pathology. Eleven genes and around 150 mutations have been identified in the etiology of HCM.⁹⁾ We did not perform genetic analysis in the patients due to financial constraints. In a study on the genetics of HCM, a specific mutation concerning AV block in HCM was not identified.⁹⁾ Therefore, this form of HCM may be caused by a new and unknown genetic mutation which causes dysfunction of the ion channels. Furthermore, myocardial ischemia, autonomic dysfunction, and an abnormal vascular response in HCM may be one of the underlying mechanisms for complete AV block.¹¹⁾

We have described particularly unusual presentations of HCM in this study. HCM is one of the unusual etiologies of AV block, such as Behcet's disease.¹²⁾ In clinical practice, complete heart block may also occur as a complication of septal myectomy or septal alcohol ablation in HCM.¹³⁾ Complete AV block should always be considered in the differential diagnosis of syncope and cardiopulmonary arrest, even in young patients with HCM.

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