

[EDITORIAL]

Exercise-induced Atrioventricular Block

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Atrioventricular (AV) block is defined as a conduction delay or interruption of the electrical signal from the atria to the ventricles. AV block occurs due to both transient or permanent, physiological or pathological conditions. An anatomical or functional impairment of the conduction system exists in pathological AV block. AV block is classified into first-degree AV block, second-degree AV block, high-degree (advanced) AV block, and third-degree (complete) AV block (1).

Physiological AV block is typically the result of increased parasympathetic nervous activity. An enhanced vagal tone is caused by rest, sleep, pain, or carotid sinus massage. Generally, invasive treatment is unnecessary for physiological AV block, and avoidance of the cause is applied in such patients.

Pathological AV block is a result of fibrosis and sclerosis of the conduction system. However, the etiology of the degeneration of the conduction system cannot be identified in half of patients with AV block and is referred to as “idiopathic”. The definitive etiology of AV block includes an older age, hypertension, ischemic heart disease, cardiomyopathies or myocarditis, valvular heart disease, especially aortic stenosis, congenital heart disease, and genetic disease. If there is a familial pattern of conduction disturbance, a progressive cardiac conduction disease is suspected, and *SCN5A* or *LMNA* is the candidate gene for the disease.

Cardiac sarcoidosis is one of the important differential diagnoses in patients with AV block. AV block is frequently observed as the first-onset symptom in patients with cardiac sarcoidosis. Furthermore, it is reported that 10-20% of patients implanted with pacemakers are diagnosed with cardiac sarcoidosis by a biopsy of cardiomyocytes (2). However, nonspecific, right bundle branch block is also frequently observed in patients with cardiac sarcoidosis (3).

Iatrogenic AV block can result from either drugs or invasive procedures. Drugs that can disturb the AV conduction include beta blockers, calcium channel blockers, digoxin, adenosine, and antiarrhythmic drugs. Cardiac procedures

that may cause AV block include open heart surgery, transcatheter aortic valve implantations (TAVIs), catheter ablation of arrhythmias, and percutaneous transluminal septal myocardial ablation (PTSDMA) in patients with hypertrophic cardiomyopathy.

During exercise, shortening of the PR interval as the sinus rate increases due to sympathetic nervous activity is a normal response in healthy individuals. However, if second-degree or advanced AV block develops during exercise, it may reflect an underlying severe conduction system disease.

In patients with AV block of an unknown level of block in the conduction system, exercise electrocardiographic testing is useful. Improvement in the AV block with exercise is usually attributable to a supranodal cause, which does not require treatment. However, worsening AV block with exercise is usually attributable to infranodal disease, which requires an intensive examination and intervention. Although it is rare, AV block elicited by exercise may be precipitated by myocardial ischemia or coronary vasospasms. An evaluation of coronary heart disease is necessary if suspected. The administration of atropine sulfate is an alternative method of unmasking physiological AV block. Pacemakers are recommended as a class IIa indication for asymptomatic patients with second- or high-degree AV block if AV block worsens with exercise or atropine sulfate administration, according to the 2018 Japan Circulation Society (JCS)/Japan Heart Rhythm Society (JHRS) Guidelines on Non-Pharmacotherapy of Cardiac Arrhythmias (4).

In *Internal Medicine*, Tasaki et al. reported a case of exercise-induced symptoms with 2:1 AV block (5). The patient did not have any underlying disease. A treadmill test reproduced her symptoms, and 2:1 AV block indicating a pathological conduction disturbance was diagnosed. A dual-chamber pacemaker was implanted in this patient, and the symptoms subsequently disappeared. Although pacemaker implantation is an established and efficient therapy for AV block, exploring the etiology or underlying disease is of critical importance in clinical practice.

The authors state that they have no Conflict of Interest (COI).

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