

Dobutamine stress echocardiography in a patient with Wolff-Parkinson-White syndrome

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Abstract

We describe the case of a patient with ventricular pre-excitation who underwent dobutamine stress echocardiography to evaluate atypical chest pain. The patient safely underwent the procedure with interesting electrocardiographic findings during pharmacological stress. The risks of dobutamine stress testing, along with possible explanations of this observed event, are discussed. In conclusion, the safety of dobutamine stress testing in patients with ventricular pre-excitation has not been established; further prospective studies are needed to decide whether dobutamine stress testing is safe in certain subsets of this population. (Cardiol J 2011; 18, 4: 437–440)

Key words: dobutamine, stress test, pre-excitation

Introduction

Exercise stress testing may provide some insight into the physiological behavior of the accessory pathway in patients with Wolff-Parkinson-White (WPW) syndrome and it may estimate their risk of sudden arrhythmic death, as abrupt (i.e. not gradual) loss of pre-excitation may indicate that the accessory pathway could not conduct rapidly during atrial fibrillation (AF) [1]. However, the role of pharmacological stress testing, specifically with dobutamine, in arrhythmic risk stratification of patients with WPW, has not been described, nor has the risk for developing an arrhythmia during such testing been fully ascertained. A small study suggested that dobutamine can facilitate anterograde accessory pathway conduction, which could increase the risk of ventricular fibrillation in patients during testing if they were to go into AF [2]. A patient with ventricular pre-excitation who underwent dobutamine stress echocardiography (DSE) at our institution for evaluation of atypical chest pain has

provided an opportunity to discuss the risks of dobutamine stress testing and whether the test might predict sudden death in individuals with WPW. Theoretically, inducing tachyarrhythmia by dobutamine infusion could potentially be used for risk stratification of asymptomatic patients with WPW. However, it is unclear whether disappearance of the pre-excitation delta wave during dobutamine infusion carries the same prognostic significance as when it occurs during exercise test. This important question should be further investigated in a prospective study.

Case report

A 44 year-old African American man with hypertension, hyperlipidemia, prior alcohol abuse, and a questionable previous myocardial infarction was referred to our institution for further evaluation of chest pain. He stated that the 'knife-like' pain began in the sub-xyphoid area and then moved around his chest, and that it was associated with shortness

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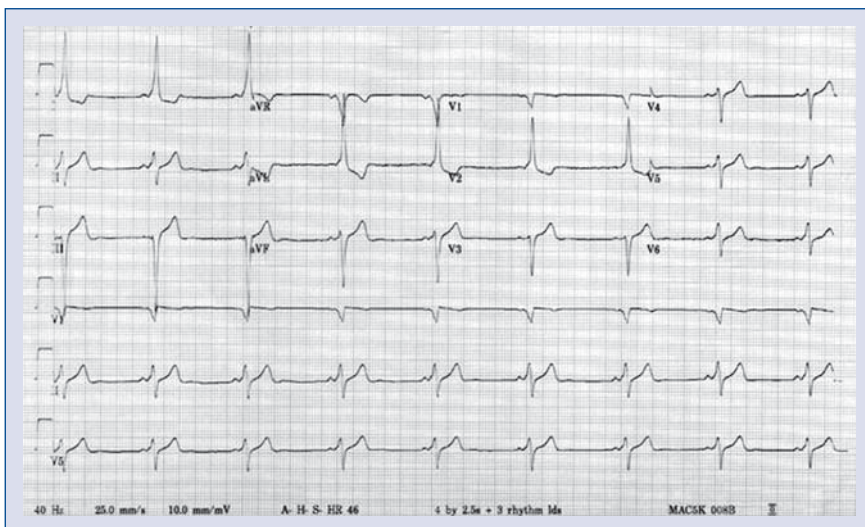


Figure 1. Baseline ECG prior to dobutamine stress echocardiography.

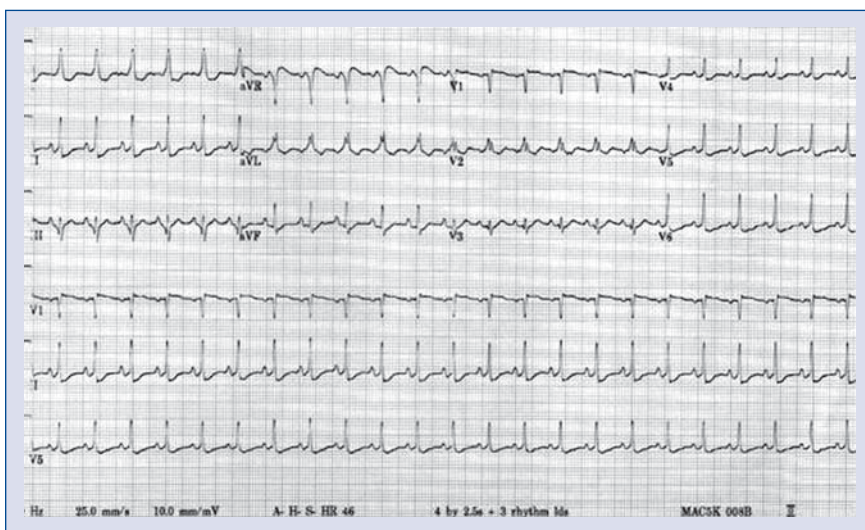


Figure 2. Peak stress ECG (note less obvious pre-excitation).

of breath and arm numbness. Cardiac biomarkers were normal and his electrocardiogram (ECG) showed sinus rhythm with abnormal ST-T wave changes. Given the atypical features of his history and the ST-T wave changes, the managing team elected to perform non-invasive testing. As it was felt that the patient may not be able to achieve his target heart rate with treadmill exercise, DSE was ordered. This is preferred to adenosine or dipyridamole radionuclide pharmacological stress testing at our institution. At baseline, the patient was in sinus bradycardia (52 bpm) with obvious pre-excitation and ST-T wave abnormalities, due at least in part to his abnormal (pre-excited) depolarization se-

quence (Fig. 1). With dobutamine infusion, the patient achieved a heart rate of 150 bpm and developed premature ventricular contractions with 1 mm ST depression in II, AVF, V5, and V6. Delta waves gradually became smaller but were still present (Fig. 2). In recovery (Fig. 3), with a heart rate of 81 bpm, the delta waves returned to their baseline appearance, but non-diagnostic changes in the ST-T waves persisted. Transthoracic echocardiography revealed normal left ventricular size and function at rest and no regional wall motion abnormalities during dobutamine stress. The left ventricular ejection fraction increased from 55 to > 70%, with near cavity obliteration and hyperdynamic contractility.

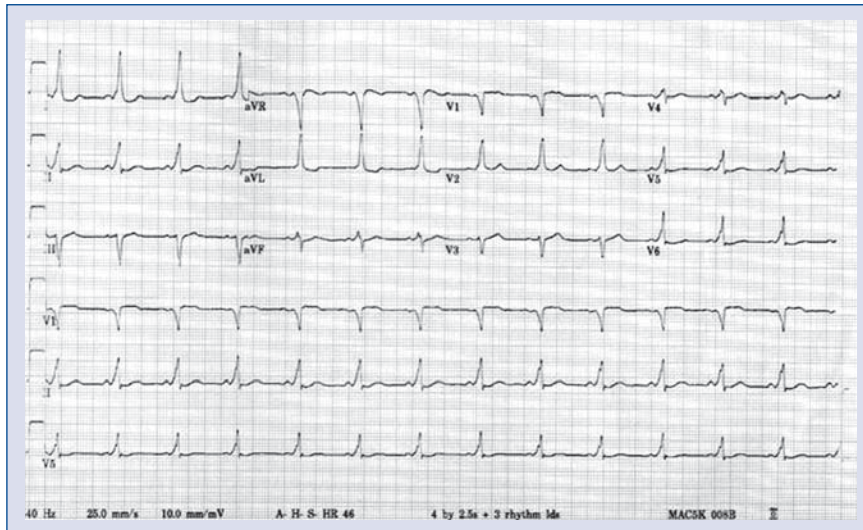


Figure 3. ECG on recovery with baseline appearance of delta waves.

During his hospitalization, the patient mentioned that in addition to chest pain, he previously had episodes of near-syncope and possible syncope. He was therefore referred to the Electrophysiology Service, and underwent successful accessory pathway ablation. After discharge, the patient was seen in the cardiology clinic about two months later. He reported some chest pain symptoms, but denied any syncopal episodes. There was sufficient concern to admit the patient for further evaluation. However, the patient did not want to be admitted at that time.

Discussion

Ventricular pre-excitation (short PR-interval with delta waves) occurs when one or more accessory pathways enable conduction from the atrium to the ventricle to bypass the atrio-ventricular (AV) node and activate a portion of the ventricle prematurely, widening and distorting the QRS complex. The delta waves become larger as the amount of pre-excited tissue increases. Patients with WPW syndrome have both ventricular pre-excitation and arrhythmias, which may be AF, AV re-entry, or both. Patients with the WPW pattern have characteristic ECG findings of pre-excitation but no subjective or objective evidence of arrhythmia. The WPW pattern may occur intermittently and even disappear over time [3–5].

Although the mechanism is not entirely understood, ventricular pre-excitation is associated with a higher incidence of AF [6]. A minority of individuals with both pre-excitation and AF are at some risk of sudden arrhythmic death, if during AF the

physiological properties of the accessory pathway allow it to conduct from the atrium to the ventricle so rapidly that ventricular fibrillation occurs. Atrial fibrillation will present as an irregular, wide complex tachycardia (each QRS usually with varying degrees of pre-excitation) at exceedingly fast rates. In this setting, the shortest interval from one pre-excited QRS to another may be used to estimate the risk of sudden death [7].

The degree of pre-excitation may also change with exercise stress testing. Mulpuru et al. [8] described a patient with a WPW pattern with paradoxical septal wall motion on baseline echocardiography that disappeared along with the delta wave during peak exercise on treadmill; both reappeared on recovery. Such a sudden disappearance of pre-excitation during exercise may indicate poor atrial to ventricular conduction via the accessory pathway, and so be associated with a lower risk of sudden death.

Plain treadmill exercise stress test for assessment of ischemia is contraindicated in patients with WPW pattern, as baseline repolarization changes preclude accurate assessment of ischemia [9]. Thus, these patients should undergo stress test with non-invasive imaging (echocardiographic or radionuclide). The treating team felt that the patient may not be able to achieve the target heart rate during treadmill exercise stress test, and ordered a DSE. Recently, a concern was raised that radionuclide stress tests are associated with high exposure to radiation [10, 11]. Therefore, echocardiographic imaging is usually preferred over radionuclide tests in our institution.

Dobutamine is a synthetic β -1 selective catecholamine that increases heart rate, myocardial contractility, and systolic blood pressure. It is indicated when patients needing non-invasive stress imaging cannot tolerate (or have contraindications to) other testing modalities including adenosine or dipyridamole. Dobutamine has been known to cause arrhythmias during pharmacological stress testing such as: premature atrial and ventricular contractions, atrial fibrillation and flutter, supraventricular tachycardias, junctional rhythms, non-sustained ventricular tachycardia and rate-related left or right bundle branch blocks [12, 13]. The safety of dobutamine stress testing, and its value in assessing the risk of sudden death in patients with pre-excitation, have not been thoroughly investigated. However, Molenda et al. [2] studied 15 patients with intermittent ventricular pre-excitation and found that dobutamine significantly shortened the refractory periods, improved accessory pathway conduction, and increased the incidence of arrhythmias.

In our patient, the extent of pre-excitation lessened with dobutamine, but the delta waves did not completely disappear. This was probably, at least in part, because dobutamine facilitated AV nodal conduction and increased the amount of ventricular tissue activated in the normal (His-Purkinje) fashion, relative to the amount of tissue activated via the accessory pathway. Theoretically however, the accelerated sinus rate may be approaching the refractory period of the accessory pathway, thus revealing some intrinsic property of the latter. If a rate of 150 bpm is beginning to cause conduction block in the pathway, then the pathway would probably not conduct rapidly during AF. (The reader is reminded that these possible scenarios do not take into account the electrophysiology of atrial tissue between the sinus node and the accessory pathway, which can also affect the degree of pre-excitation.)

Whether pharmacological stress testing with dobutamine is safe in patients with WPW syndrome has not been established. The sudden loss of pre-excitation during dobutamine stress testing may not have the same prognostic implications as it does when it occurs during exercise stress testing, where it has been associated with a lower risk of sudden death. Given the arrhythmic complications attributed to dobutamine, exercise stress testing with either echocardiographic or radionuclide imaging would, if possible, be the preferred option for non-invasive cardiac evaluation in these patients. However, exercise may also induce arrhythmia.

It has not been studied whether the risk of arrhythmia for patients with WPW is greater with dobutamine than with exercise. During exercise stress testing, information regarding the patient's functional capacity would be obtained. This is something that in itself has prognostic implications, in addition to assessment of perfusion or regional function.

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