

Complications of Exercise Echocardiography. Analysis of a Cohort of 19,239 Patients

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Highlights

We analyzed complications of exercise echocardiography in 19,239 studies, performed in a 21-year-period, finding just 19 cases with major complications, without any death.

Keywords:

Exercise echocardiography; complications; stress echocardiography

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Introduction

Exercise echocardiography (ExE) is the technique of stress echocardiography recommended in guidelines [1-2] as the first choice for patients in whom this procedure is indicated. In our stress echocardiography laboratory, exercise echocardiography accounts for 93% of the stress echocardiograms performed [3]. This is like this because over the years we have realized that almost every patient that enters walking in the stress echo room is able to walk on the treadmill, provided that special protocols are employed in those with limitations. It is clear that not every patient is suitable for a Bruce protocol, but instead a Bruce modified or a Naughton exercise protocol can be offered. Also, in current treadmill exercise equipment, a change to manual settings is possible, allowing for changing velocity and slope on demand. For example, some older patients can tolerate greater slope but not higher velocity of the treadmill.

During a 21 year-period, from March 1995 to February 2016, we have performed 19,239 ExE on a treadmill in 15,841 patients in our institution. Major considered life-threatening complications were acute myocardial infarction (AMI), sustained ventricular tachycardia (SVT), ventricular fibrillation, cardiac rupture, death, stroke, shock, syncope, and complete auriculo-ventricular (A-V) block. Minor complications were conduction abnormalities other than complete A-V block leading to, the cessation of the test, and other than SVT arrhythmias, non sustained ventricular tachycardia (NSVT), atrial fibrillation/flutter, and paroxysmal supraventricular tachycardia (PSVT). Table 1 lists the clinical characteristics of

Table 1. Clinical and ExE data of the 19,239 cases.

Age (y)	63±12
Male gender, n (%)	12,281 (63.8)
History of CAD*	6,648 (34.6)
Pretest probability of CAD **	
Low (<15%), n (%)	2,043 (16.2)
Intermediate (15-65%), n (%)	9,343 (74.2)
High (>65%), n (%)	1,205 (9.6)
Diabetes Mellitus, n (%)	3,786 (19.7)
Hypertension, n (%)	10,459 (54.4)
Hypercholesterolemia, n (%)	9,831 (51.1)
Smoking, n (%)	4,391 (22.8)
Achieved METs	9.2±3.2
Positive ExE, n (%)**	8,271 (43)

METs, metabolic equivalents; ExE, exercise echocardiography. * Defined as previous myocardial infarction or revascularization procedures. ** Assessed in patients without history of CAD. *** Defined as resting and/or exercise induced wall motion abnormalities with exercise (3,8)

the studied cases. An intermediate or high pretest probability of coronary artery disease or a history of this disease was reported for most of the studies. Reported major complications in all the tests were: AMI in 2 cases, SVT in 10, complete A-V block



in 4, syncope in 2, and stroke in 1. One of the patients with severe conduction abnormalities during exercise followed with cardiac arrest that required cardiopulmonary resuscitation. The ExE was normal in this patient. The two cases of syncope had exercise-induced pulmonary hypertension and a final diagnosis of pulmonary thromboembolism. One of the patients with sustained ventricular tachycardia evolved to ventricular fibrillation that required cardioversion. This patient had a hypertrophic cardiomyopathy with a positive ExE and an already depressed left ventricular systolic function at rest. No deaths occurred. The number of severe complications was 19 (0.10%); with the inclusion of minor complications the total number was 111 (0.58%). Table 2 shows the ExE results in patients with complications. As expected the higher percentage of positive ExE was observed in cases complicated with tachyarrhythmias, particularly SVT.

This report confirms previous literature reporting the small percentage of complications in patients submitted to exercise echocardiography, [4-5] ranging from 0.02 to 0.04%; in contrast to the percentage in patients submitted to pharmacological stress echocardiography with dobutamine. With dobutamine the percentage of complications ranged from 0.18-0.31% in several studies, with some reports informing cardiac rupture, ventricular fibrillation, and death [6].

Minor complications like frequent premature ectopic beats or exaggerated increase in blood pressure may have been not reported or considered as complications in our study. Anyway we have recently observed that an increased blood pressure with exercise does not confer worse prognosis [7].

This low frequency of complications during ExE could not be achieved by centers with lower experience, in the beginnings of their learning curve, or studying mainly patients with even higher pretest risk probabilities. Also, we must point out that a lower percentage of complications could result from an approach based on peak imaging as it is performed in our center. [8] Peak imaging may allow for premature cessation of the exercise in case of extensive ischemia that could be neglected if a postexercise imaging approach was just the only way to examine the patients.

Table 2. Major and minor complications and ExE results.

Major	n=	Positive ExE (%)
Complete A-V block	4	2 (50)
SVT	10	8 (80)
Stroke	1	0 (0)
Syncope	2	0 (0)
Myocardial infarction	2	2 (100)
Minor		
2:1 A-V block	7	2 (29)
Nodal rhythm	1	0 (0)
Pacemaker lack of stimulation	1	1 (100)
NSVT	44	29 (66)
Atrial fibrillation/Flutter	11	2 (18)
PSVT	28	18 (64)

Abbreviations: SVT, sustained ventricular tachycardia; NSVT, non-sustained ventricular tachycardia, PSVT, paroxysmal supraventricular tachycardia.

In conclusion, ExE resulted to be a safe technique with a very low number of complications and not a single death in a large cohort of patients studied in a single center.

Declarations of Interest

The authors declare no conflicts of interest.

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The authors state that they abide by the requirements for ethical publishing in biomedical journals [9].

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