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Stress echo in chest pain unit: the SPEED trial

Gigliola Bedetti[a], Emilio M. Pasanisi[b,*], Giancarlo Tintori[c], Lucas Fonseca[d], Simone Tresoldi[e], Calogero Minneci[f], Zoltan Jambrik[b,1], Bruno Ghelarducci[b], Andres Orlandini[g], Eugenio Picano[b]

[a]*Cardiology Dept., Civile Hospital, Imola, Italy*
[b]*CNR, Institute of Clinical Physiology, Via G. Moruzzi, 1, 56125 Pisa, Italy*
[c]*Emergency Medicine Division, Santa Chiara Hospital, Pisa, Italy*
[d]*Cardiology Dept. S. Lucia Hospital, Brasilia, Brazil*
[e]*Cardiology Dept., "Fatebenefratelli" Hospital, Erba, Italy*
[f]*Cardiology Dept., New Hospital S. Giovanni di Dio, Firenze, Italy*
[g]*Cardiology Dept., Instituto Cardiovascular Rosario, Argentina*

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Abstract

Background: Emergency room (ER) evaluation of patients with acute chest pain and non-diagnostic electrocardiography (ECG) remains a frequent and difficult problem.
Aim: To assess safety and prognostic implications of pharmacological stress echocardiography in the ER chest pain unit (CPU).
Methods: A total of 552 patients (321 males, age 58±12.6 years) with acute chest pain, negative serial enzymes and/or troponin, and ECG recordings, and normal/unchanged resting left ventricular function were prospectively enrolled and underwent pharmacological (dipyridamole or dobutamine) stress echo. Six echo labs that had passed the preliminary quality control for stress echo reading entered the study. Follow-up was obtained in all patients after a median period of 13 months.
Results: No significant adverse events were observed during the test. Stress echocardiography was negative in 502 patients (91%) and positive in 50 (9%). The 502 patients with negative stress echocardiography were discharged with no or unchanged anti-ischemic medications. While the 50 patients with positive stress echo were admitted to the coronary care unit, 44 of these underwent coronary angiography with the result that 42 out of 44 showed significant coronary artery disease. There were 45 events in the follow-up: six in the 502 patients with negative and 39 in the 50 patients with positive stress echo (1.2% vs. 78%, $p<0.001$). The negative predictive value of stress echocardiography was 98.8% for all events and 99.6% for hard events.
Conclusions: Stress echocardiography is a feasible, safe, and effective tool for early stratification of patients admitted to the ER with acute chest pain and non-ischemic ECG and resting echo.

Keywords: Chest pain; Stress echocardiography; Emergency room; Prognosis

Each year in the United States, about 4 million people undergo evaluation at the Emergency Department for acute chest pain: >50% are admitted to the hospital [1–3], 2% to 10% with acute myocardial infarction are inadvertently discharged from the emergency department [4,5]. If on one hand inappropriate admission of non-cardiac chest pain patients is an enormous, avoidable cost for society and an avoidable loss of time for the patient, these missed diagnoses account for 20% of malpractice indemnities [6,7]. Unnecessary admissions in Coronary Care Units cost

* Corresponding author. Tel.: +39 050 3152736; fax: +39 050 3152374.
E-mail address: pasanisi@ifc.cnr.it (E.M. Pasanisi).
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over 2000 US dollars per day, and impose both undue stress on patients and potential morbidity [8].

This situation has brought increasing interest toward development of a new diagnostic algorithm able to rule out ischemic syndromes in patients who complain acute chest pain but that do not have electrocardiographic or myocardial enzyme changes. In particular, a resting echocardiography evaluation and a stress testing procedure are now recommended for these patients [9–11]. In only one setting rest and stress echocardiography can provide information on regional wall motion abnormalities at rest and after stress [12]. The purpose of this study was to investigate the degree of feasibility and usefulness of stress echocardiography in these patients.

1. Methods

The Stress Pharmacological Echocardiography in Emergency Department (SPEED) trial was performed in six emergency departments: (1) CNR, Institute of Clinical Physiology, and Emergency Medicine Division, S. Chiara Hospital, Pisa, Italy; (2) Cardiology Department, Civile Hospital, Imola, Italy; (3) Cardiology Department, Institute Cardiovascular Rosario, Argentina; (4) Cardiology Department, S. Lucia Hospital, Brasilia, Brazil; (5) Cardiology Department, Erba Hospital, Erba, Italy; (6) Cardiology Department, New Hospital S. Giovanni di Dio, Florence, Italy. All six echo labs had an established experience in stress echocardiography, met the quality-control requirements for stress echocardiographic interpretation before starting patient enrollment, and belonged to the stress echocardiographic network of the Echo Persantine International Cooperative (EPIC) and Echo Dobutamine International Cooperative (EDIC) studies [12]. The criteria of quality control for stress echo reading have been detailed elsewhere [13]. After passing the quality control test, the center could start recruiting patients and the reading of stress echo from recruiting center was directly entered in the data bank [13].

1.1. Patient's selection

For our study we evaluated all patients showing up at the emergency room (ER) for acute chest pain of suspected cardiac origin and unexplained by trauma, radiographic abnormality or extra-cardiac conditions could induce myocardial ischemia (Braunwald's type IIIA angina) [14]. Evaluation comprised patient history (including coronary risk factors, previous cardiac disease, chest pain characteristics), physical examination, measurements of bilateral arm blood pressure, chest roentgenogram, 12-lead electrocardiogram (ECG), and an initial total and MB isoforms serum creatine kinase and troponin measurement. Low to intermediate-risk patients were selected based on clinical and electrocardiographic findings [9–11]. The study prospectively enrolled only those patients without acute electrocardiographic ischemic changes and enzymes and/or troponin modifications. Patients with electrocardiogram signs of acute myocardial infarction or ischemia (>0.1 mV ST-segment change, acute T wave inversion), significant valvular heart disease, and severe arrhythmias were excluded. All patients gave their informed consent before undergoing stress echocardiography.

1.2. Chest pain unit (CPU): the accelerated diagnostic protocol

All patients included were sent to the chest pain center so we could perform a fast diagnostic algorithm according to ESC guidelines for low-intermediate risk patients [9] that consisted of resting echocardiogram, serial blood enzyme or/and troponin measures, electrocardiographic monitoring and, after an observation period, a stress test to detect myocardial ischemia. When one of these tests was positive, the algorithm was interrupted and the patient was admitted to the coronary care unit. If all tests were negative the patient was discharged. However, all patients who underwent stress echocardiography entered a follow-up program.

1.2.1. Clinical data

Chest pain patients triage was performed by a clinical chest pain score based on localization, characteristics, irradiation and associated symptoms. Patients with chest pain score<4 had a low probability of angina (atypical chest pain) and patients with chest pain score>4 had a high probability of angina (typical chest pain) (Fig. 1).

1.2.2. Electrocardiography

After admission a 12-lead electrocardiogram was performed at the 4th, 8th and 12th hour or connected and whenever the patient had a new episode of chest pain; the patient was admitted to the coronary care unit if life threatening arrhythmias or acute electrocardiographic changes were observed [9].

1.2.3. Enzyme determination

Creatine phosphokinase, creatine phosphokinase-MB isoenzyme and troponin were measured on admission. If

Table 1
Demographic and clinical characteristics of study population

Patients	552
Mean age (years) (±S.D.)	58±12.6
Gender (males/females)	321/231
<2 risk factors	433(78%)
Chest pain score>4/<4(atypical/typical chest pain)	267/285(48/52%)
Previous CAD	103(19%)
Antianginal therapy applied	51(9%)

Risk factor: smoking, hypercholesterolemia (>200 mg/dl), hypertension, diabetes, previous history of CAD and familial history of CAD.