

ECHOCARDIOGRAPHIC FINDINGS IN PATIENTS WITH ACUTE CORONARY SYNDROME AND NORMAL ANGIOGRAM

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Abstract

Coronary angiograms performed at the time of an acute coronary syndrome typically present vessel occlusions, ruptured plaques or thrombotic lesions that require reperfusion therapy. However, occasionally, no coronary artery stenoses are detected. Myocardial ischemia frequently causes left ventricular wall motion abnormalities that can be seen easily by echocardiography. In our study we aimed to analyze echocardiographic findings in patients with acute coronary syndrome and normal angiogram. After standardized risk stratification, a total of 897 patients were classified as an acute coronary syndrome and underwent a coronary angiography immediately. In 76/897 patients angiography excluded coronary macroangiopathy. Routine echocardiographic assessment in patients with normal angiogram showed in 21.1% a reduced left ventricular systolic function and 32.9% presented with segmental wall motion abnormalities.

In summary, by detection of segmental wall motion abnormalities in 1/3 of patients with suspected acute coronary syndrome and normal angiogram, obviously, an echocardiographic evaluation in this patient population is of clinical relevance. Recommendations for performing echocardiography in patients with suspected acute coronary syndromes independent of angiographic findings are strongly supported. Further analyses should implement echocardiographic techniques as contrast and tissue doppler imaging.

Key words: Echocardiography, acute coronary syndrome, normal angiogram

INTRODUCTION

Acute coronary syndrome comprises different manifestations of coronary artery disease [1]. Angiograms performed at the time of an acute coronary syndrome may present different coronary morphologies. In many cases, there are acute vessel occlusions, ruptured atherosclerotic plaques or thrombotic lesions that require reperfusion therapy. However, occasionally, no coronary artery stenoses are detected. In these cases, different diagnoses may explain the unexpected angiographic findings. For example peri-myocarditis, coronary spasms, muscle bridges, or hypertensive heart disease may mimic the clinical situation of an acute coro-

nary syndrome [2-4]. However, myocardial ischemia may not be detected by coronary angiography in all cases.

Myocardial ischemia frequently causes left ventricular wall motion abnormalities that can be seen easily by echocardiography. Echocardiographic findings precede electrocardiographic abnormalities and angina. Presence and severity of myocardial dysfunction can be documented rapidly, so that echocardiography is an important modality for risk stratification in the emergency room [5-7]. Echocardiography is a useful tool in the prognostic evaluation of myocardial infarction [8]. Left ventricular angiography may not be appropriate in critically ill patients. Therefore, echocardiography is implemented in the guidelines concerning management of patients with acute coronary syndromes [9].

However, which echocardiographic findings can be obtained in patients with acute coronary syndromes but normal angiogram? How many of these patients have wall motion abnormalities? May echocardiography identify patients with different diagnoses requiring further diagnostic procedures or a specific therapy? In our study we aimed to analyze echocardiographic findings in patients with acute coronary syndrome and normal angiogram.

MATERIALS AND METHODS

Between 1996 and 2000, a total of 897 coronary angiographies were performed as an emergency procedure due to suspected acute coronary syndrome in our institution. Acute coronary syndromes were defined according to the standard risk stratification combining electrocardiography (ST-segment elevation > 1mm in two or more contiguous leads, ST-segment depression of at least 0.5mm in two or more contiguous leads, T-wave inversion of at least 1mm), elevated troponin T (cTnT, quantitatively > 0.1 µg/l) and clinical symptoms [1, 10]. However, guideline-oriented risk stratification changed over the period patients were included in this analysis; cTnT could be only determined qualitatively by bed-side test until 1997 and was not available as a routine quantitative marker until 1998 in our institution. Normal coronary arteries were defined as the absence of coronary lesions with diameter stenosis >50% and with a normal perfusion (TIMI III) [11].

Transthoracic echocardiography was performed in patients without coronary artery disease at the day of angiography. Overall ejection fraction was measured by the modified Simpson's method. Left ventricular segmental wall motion was analyzed by B-mode echocardiography according to the 16-segment model [12]. Ultrasound examinations were performed by using a HP SONOS 5500 (Philips, Eindhoven, The Netherlands) by experienced sonographers.

RESULTS

Patient assessment was done by risk stratification and all patients were managed as an acute coronary syndrome. Coronary artery disease was found in 821 patients (91.5%), whereas no coronary artery disease was documented in 76 patients (8.5%) (53±13.9 years, 71.1% male). The group with normal angiogram was characterized as unstable angina without ST-elevation (n = 66, 86.8%) and acute ST-elevation myocardial infarction (n = 10, 13.2%). The patient group with coronary artery disease had unstable angina without ST-elevation (n = 445, 54.2%) and ST-elevation myocardial infarction (n = 376, 45.8%) (Table 1). In this group, mechanical revascularization was performed in 86.3%.

Table 1. Baseline characteristics and risk stratification.

	No CAD	CAD
Number	8.5% (n = 76)	91.5% (n = 821)
Male	71.1% (n = 54)	73.8% (n = 607)
Age (years)	53+14	62.6+12
Arterial hypertension	60.5% (n = 46)	80.3% (n = 659)
Diabetes mellitus	11.8% (n = 9)	27.8% (n = 228)
Dyslipidemia	67.1% (n = 51)	86.1% (n = 707)
Smoking	57.8% (n = 44)	69.8% (n = 573)
Elevated troponin	30.3% (n = 23)	64.3% (n = 528)
Elevated CK	21.1% (n = 16)	47.9% (n = 393)
ECG-ischemia/LBBB	57.8% (n = 44)	64.8% (n = 533)
Unstable angina	86.8% (n = 66)	54.2% (n = 445)
STEMI	13.2% (n = 10)	45.8% (n = 376)

CK = creatine phosphokinase, LBBB = left bundle branch block, STEMI = ST-elevation myocardial infarction

In the group of patients with normal angiogram, troponin was positive in 30.3%, and creatine phosphokinase was elevated in 21.1% prior to angiography. Signs of ischemia in the electrocardiogram had 57.8%. In comparison, 64.8% of the patients with coronary artery disease had signs of ischemia in the electrocardiogram, 64.3% had elevated troponin levels (Table 1).

Prior to angiography, patients in the group with normal angiogram were treated with systemic thrombolysis (n = 6, 7.9%), heparin (n = 67, 88.2%), glycoprotein IIb/IIIa-inhibitors (n = 9, 11.8%), acetylsalicylic acid (n = 56, 73.7%) and thienopyridines (n = 4, 5.3%).

Invasive findings in the group without atherosclerotic coronary artery disease were coronary spasms (n = 5, 6.6%), and muscle bridges (n = 4, 5.3%). Com-

plete diagnostic evaluation revealed cardiomyopathy (n = 2, 2.6%), hypertensive heart disease (n = 11, 14.5%), and peri-/myocarditis (n = 8, 10.5%). No specific diagnosis could be attributed to 46 patients (60.5%) (Table 2).

Table 2. Diagnoses.

No coronary artery disease	n = 76 (100%)
No specific findings	n = 46 (60.5%)
Coronary spasm	n = 5 (6.6%)
Muscle bridge	n = 4 (5.3%)
Cardiomyopathy	n = 2 (2.6%)
Hypertensive heart disease	n = 11 (14.5%)
Peri-/Myocarditis	n = 8 (10.5%)

In the majority of patients with normal angiogram echocardiography obtained a normal left ventricular ejection fraction (Table 3). A moderate reduced ejection fraction had 15.8% of patients, whereas 5.3% presented with an ejection fraction lower than 40%. Analyzing the segmental wall motion behaviour, 67.1% patients showed a normal contractility. Echocardiography documented wall motion abnormalities in inferior (14.5%), anterior (11.8%) and septal regions (6.6%). No pericardial effusion was documented, no case of apical ballooning. Due to the limited number of patients, there was no association between angiographic and echocardiographic findings of segmental wall motion abnormalities.

Table 3. Echocardiographic findings in patients with normal angiogram.

EF (%)	65+14
EF >60%	78.9% (n = 60)
EF 40-60%	15.8% (n = 12)
EF < 40%	5.3% (n = 4)
Normal wall motion	67.1% (n = 51)
Hypokinesis inferior	14.5% (n = 11)
Hypokinesis anterior	11.8% (n = 9)
Hypokinesis septal	6.6% (n = 5)

EF = ejection fraction

DISCUSSION

Among a patient population who underwent emergency coronary angiography for suspected acute coronary syndrome, significant coronary lesions could be documented in the majority of patients and most of them underwent catheter based revascularization. In a small group of patients, no angiographically detectable coronary artery disease was found. Echocardiography showed in 1/3 of patients in this group left ventricular segmental wall motion abnormalities and 21.1% had a reduced left ventricular systolic function. Particularly in patients with a conservative management of acute coronary syndromes, an individual risk stratification is of relevance. Patients with persistent wall motion ab-

normalities are at higher risk for adverse events [8]. Echocardiography is especially important for those patients that are not obviously at high risk. Patients without clinical evidence of left ventricular dysfunction may have significant wall motion abnormalities [8]. Our findings may be addressed by different aspects.

First, an acute coronary syndrome is followed by myocardial ischemia with left ventricular segmental wall motion abnormality but coronary angiography does not detect a target lesion. Spontaneous peripheral embolism of a ruptured coronary plaque may re-establish coronary blood flow rapidly [13]. Furthermore, early antithrombotic therapy that is initiated prior to angiography may dissolve intraluminal thrombi which therefore may not be seen by subsequent angiography [14]. A relevant number of our patients without coronary artery disease was treated with a multi-drug antithrombotic regimen prior to angiography. Most of them were on heparin, six patients underwent thrombolysis and in nine patients glycoprotein IIb/IIIa-inhibitors were administered. Thus, the fact of a normal angiogram does not exclude a previous thrombotic coronary event. This subgroup of patients has an increased risk of ischemia related morbidity and mortality. Echocardiographically documented segmental wall motion abnormalities in these patients stratifies this particular subgroup at increased risk for adverse cardiac events, although there is no clinical evidence of left ventricular dysfunction. These patients may require a specific pharmacological treatment including antiplatelets, CSE-blocker, beta-blocker or ACE-inhibitors although the angiogram did not reveal any obvious coronary lesion.

Second, invasive findings of muscle bridges and coronary spasms are strongly linked to occurrence of myocardial ischemia [15, 16]. Myocardial bridges are associated with an impaired endothelial function [17] and may alter hemodynamic forces by the contraction of the bridge itself [18]. Coronary spasms can cause platelet aggregation and myocardial ischemia [19]. Therefore, documentation of wall motion abnormalities in these cases may be expected.

In our study, 14.5% of patients had hypertensive heart disease. Arterial hypertension and hypertensive heart disease may contribute to myocardial ischemia due to an increase in myocardial resistance and reduction of coronary flow reserve. Myocardial perfusion abnormalities are frequently found with angiographically normal coronary arteries associated with left ventricular hypertrophy or microvascular disease [20]. As reported in a large study, in hypertensive patients, wall motion abnormalities occurred in of 12.5% patients and was associated with left ventricular hypertrophy [21].

Moreover, in case of absence of myocardial ischemia, echocardiography may help to identify different diagnoses. It can easily provide a non-invasive bi-plane assessment of the left ventricle, heart valves and pericardium. For example peri- or myocarditis may cause dyscontractilities [22]. In patients with hypertensive heart disease or cardiomyopathies, echo data provide major information for guiding long-term patient management. A total of 27.5% of our patient population were addressed as cardiomyopathy, pericarditis or

hypertensive heart disease representing a relevant amount of patients in a group of suspected coronary artery disease. Left ventricular function was decreased severely in 5.3% of patients. These patients need further assessment to evaluate their individual risk profile and to identify patients requiring special treatment.

In summary, by detection of segmental wall motion abnormalities in 1/3 of patients with suspected acute coronary syndrome and normal angiogram, obviously, echocardiography is of clinical relevance. By identifying patients at increased risk for adverse events or with different diagnoses requiring further diagnostic evaluation or treatment, clinical management of these patients includes echocardiographic findings. Recommendations for performing echocardiography in patients with suspected acute coronary syndromes independent of angiographic findings are strongly supported.

However, further studies are needed to evaluate the impact of echocardiographic examinations in patients with acute coronary syndromes and normal angiography on clinical outcome and prognosis. These analyses should implement echocardiographic techniques as contrast and tissue doppler imaging [23, 24].

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