ELECTROCARDIOGRAPHIC SIGNS OF ACUTE MYOCARDIAL INFARCTION IN LEFT BUNDLE BRANCH BLOCK

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Introduction

In case of a patient presenting with chest pain the task of physicians is to differentiate between two diagnoses - unstable angina pectoris or acute myocardial infarction in order to prescribe the optimal therapy in time. Acute myocardial infarction is defined by typical chest pain, signs of ischemia and/or myocardial lesions in electrocardiogram and elevated cardiac enzymes [1]. Since it takes several hours for the biomarkers of myocardial necrosis to increase, the exact number of hours depending on the required markers, the clinical state and electrocardiogram are the basic guidelines for setting the initial diagnosis as well as the subsequent optimal reperfusion therapy. Electrocardiogram may indicate myocardial ischemia, but it can not explain the etiology because other myocardial diseases can also cause electrocardiographic changes and thus become a differential diagnostic problem [2]. The complete block of the left bundle branch (LBBB) largely complicates the interpretation of the electrocardiogram in patients with chest pain. Physicians are not always able to compare earlier electrocardiograms of patients, and therefore, they

Summary

Introduction. Acute myocardial infarction is characterized by typical chest pain, electrocardiographic changes in terms of lesion and/or myocardial ischemia and increased cardiac enzymes. It is often difficult to make diagnosis in the presence of non-specific chest pain, the short duration of symptoms and electrocardiographic signs of a complete left bundle branch block. Literature Review. Many authors have tried to set the electrocardiographic criteria that can increase the possibility of correct diagnosis of acute myocardial infarction in such situations. The most widely used and recognized criterion is Sgarbossa scoring system that includes concordant ST segment elevation > 1 mm ST segment, discordant derivation of ST segment > 1 mm in the leads V1-V3 and discordant ST segment elevation > 5 mm with acceptable sensitivity and specificity. In subsequent studies, the sensitivity and specificity increased by replacing the third criterion with ST/S ratio < -0.25. Conclusion. The knowledge of certain electrocardiographic signs in patients with acute coronary syndrome and left bundle branch block increases the chances of early diagnosis and the possibility of better and timely treatment.

Key word: Myocardial Infarction; Acute Disease; Bundle-Branch Block; Electrocardiography; Diagnosis; Early Diagnosis; Signs and Symptoms

Sažetak

Uvod. Akutni infarkt miokarda karakterišu tipični bol u grudima, promene u elektrokardiogramu u smislu lezije i/iši ishemi je miokarda i porast kardiospecifičnih enzima. Dijagnoza je često otežana pri nespecifičnim tegobama, kratkim vremenom od njihovog nastanka i elektrokardiografskim znacima kompletnog bloka leve Hisove grane. Pregled literature. Mnogi autori pokušali su da daju elektrokardiografske kriterijume koji bi u takvoj situaciji mogli sa većom sigurnošću da ukažu na dijagnozu akutnog infarkta miokarda. Najčešće korišćen i priznat jeste Sgarbossa skoring sistem koji uključuje konkordantnu elevaciju ST segmenta > 1 mm, derivaciju ST segmenta > 1 mm u V1-V3 odvodima i diskordantnu elevaciju ST segmenta > 5 mm sa prihvatljivom senzitivnošću i specifičnošću. U kasnijim studijama je senzitivnost i specifičnost povećana zamenom trećeg kriterijuma sa ST/S odnosom < -0,25. Zaključak. Poznavanjem određenih elektrokardiografskih znakova kod bolesnika sa akutnim koronarnim sindromom i blokom leve grane povećava se mogućnost rane dijagnosticne i same mogućnosti bolje i pravovremene terapije. Ključne reči: Infarkt miokarda; Akutna oboljenja; Blok Hisove grane; Elektrokardiografiija; Dijagnoza; Rana dijagnoza; Znaci i simptomi

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cannot know if the LBBB is new, or whether an acute myocardial infarction is hiding under a previously presented block.

The left ventricle activation lasts longer in the presence of LBBB and instead of the usual initial activation of the septum from left to right it goes the other way round. Thus, there is no Q wave, which is indicative of acute myocardial infarction. If there is still a Q wave in the leads V5V6, it indicates a high probability of the existence of myocardial infarction. In addition, changes in the ST segment and T wave occurring in LBBB make it impossible to recognize the characteristic signs of myocardial lesions and ischemia. The existing QS formation in the right precordial leads in this case does not involve the anterior wall scar. ST segment elevation is already normally present in the leads V1V4, which also makes the interpretation difficult.

Prevalence of LBBB in patients with suspected acute myocardial infarction is relatively low and varies from 1-5% [3/5]. According to the latest guidelines of the European Society of Cardiology, chest pain, followed by the new LBBB in the electrocardiogram, requires the same treatment as acute myocardial infarction with ST-segment elevation (STEMI) [6]. It is believed that a newly developed LBBB is "STEMI equivalent". Since reperfusion therapy carries risks, the need for this therapy in all patients with LBBB and chest pain must be carefully assessed. Studies have shown that a small number of patients with LBBB are diagnosed as having acute myocardial infarction and LBBB. The combination of these three characters has the sensitivity of 78% and the specificity of 90% [14].

Sgarbosa criteria are (Figure 1):
1. ST segment elevation > 1 mm in the same direction with the QRS complex (concordant). This means that in the lead where ST elevation > 1 mm is recorded the sum of QRS complex must be positive. This criterion carries 5 points by itself, therefore it is sufficient for the diagnosis of acute myocardial infarction according to these criteria.
2. Denivelation of ST segment > 1 mm in the leads V1, V2 or V3. This criterion carries 3 points.
3. ST segment elevation > 5 mm, and the reverse of the QRS complex (disconcordant), carrying 2 marks.

Studies have shown that patients with LBBB are less likely to receive reperfusion therapy, and if they do receive it, it takes longer to introduce it and the recommended therapy is administered less [4]. Taking into account that structural changes may be the reason for the appearance of LBBB, and that its presence is related to old age, bringing along a variety of chronic diseases and changes in the conductive system, it is believed that the LBBB is the marker of overall cardiac risk, not an independent factor of mortality and morbidity [3].

All this makes us teach our students even today that LBBB is "blind" for acute myocardial infarction. Is it really so?

Literature Review

Wacker et al analyzed the number of electrocardiographic signs considered to be important for the diagnosis of acute myocardial infarction in LBBB in 1978, which was followed by determining the localization of myocardial infarction by perfusion scan with thallium-201 [11,12]. They have concluded that a number of electrocardiographic changes (the combination of which has 67% sensitivity) are important for the diagnosis of myocardial infarction [13]:

1. ST segment elevation (54% sensitivity),
2. abnormal Q waves (31% sensitivity),
3. Cabrera sign (notching at 40 milliseconds in the upslope of the S wave in the lead V3 and V4 - 23% sensitivity)
4. an initial positivity in V1 lead and Q wave in V6 (sensitivity 20%, but 100% specificity for myocardial infarction of anteroseptal region)

Twenty years later, Sgarbosa et al analyzed the patients with LBBB and acute myocardial infarction included in the GUSTO-1 study where two modes of fibrinolytic therapy were compared [14]. Out of 26003 study patients, 131 had newly developed LBBB. In all patients the diagnosis of acute myocardial infarction was confirmed by the elevated values of myocardial necrosis biomarkers in addition to typical clinical and electrocardiographic signs. They made scoring system based on three electrocardiographic signs in the patients with acute myocardial infarction and LBBB. The combination of these three characters has the sensitivity of 78% and the specificity of 90% [14].
was higher than or equal to three. If the sum of points was 2, the specificity was 80% [14,16,17].

Smitt et al. went one step further in their attempt to increase the sensitivity of this scoring system with additional electrocardiographic criteria. Their main objection to previous studies was that the patients were diagnosed on the basis of positive markers of myocardial necrosis and thus could not be divided into groups with STEMI and non Q wave myocardial infarction. Coronary angiography of the same patient indicates the occlusion of left anterior descending artery.

Slika 1. Registruje se konkordan Tina elevacija ST segmenta do +1 mm u V5 odvodu uz diskonkordan tinu elevaciju ST segmenta do +5 mm V1V4 kao znak akutnog infarkta miokarda. Koronarografski nalaz kod istog bolesnika koji ukazuje na okluziju prednje descend entne arterije.

The following changes in the electrocardiogram can be recorded as additional signs:
1. Deep negative T waves in the leads with predominant negative sum of the QRS complex (V1V3 leads) may indicate ischemia or non Q-wave myocardial infarction.
2. The presence of QS formation in the leads DI, V5 and V6 or in the leads DII, DIII, and Vf can indicate myocardial infarction.
3. Positivisation of previously negative T waves may raise suspicion of ischemia but can not confirm its presence.
4. Myocardial infarction may be suspected if a new S cog appears in the lateral leads (DI, aVL, V6) in the patients who have already had LBBB.

Neeland and colleagues [23] have proposed an algorithm for patients with suspected acute myocardial infarction and LBBB (old or newly developed). In the presence of hemodynamic instability or signs of heart failure, these patients are immediately referred to percutaneous coronary intervention (PCI), which is the treatment of choice, or if it can not be done, fibrinolytic therapy is administered. In case of clinical stability of patients, Sgarbossa criterion is taken into consideration in terms of concordant ST segment elevation on the electrocardiogram. If it is present, it is considered to be the “equivalent” of STEMI and reperfusion therapy (PCI or fibrinolytic therapy) is applied. If no signs of concordant elevation on the electrocardiogram are seen, immediate echocardiography and/or the serial biomarkers of myocardial necrosis have to be done. In this way, the patients are divided into those with STEMI, non Q myocardial or unstable angina pectoris, i.e. acute coronary syndrome is excluded.

Conclusion
In acute myocardial infarction, complete block of the left bundle branch in the electrocardiogram (newly developed or old) is a major diagnostic problem in patients with acute coronary syndrome. A large number of patients are not diagnosed with acute myocardial infarction, and it is of great importance to define the electrocardiographic criteria measured in only one lead, is a significantly better sign of acute myocardial infarction. Having replaced the third rule (excessive ST segment elevation greater than 5 mm) in Sgarbossa criteria, it provides the sensitivity of 91% and the specificity of 90% [18].

Literature gives the following signs as electrocardiographic signs of myocardial infarction in LBBB [19]:
1. Cabrera sign – notching at 40 milliseconds in the upslope of the S wave in lead V3 and V4, which has a low sensitivity of 26% but a relatively good specificity of 86% (20,21).
2. Chapman sign – notching in the ascending limb of the R wave in DI, aVL or V6, which has very low sensitivity of only 3% and the specificity of 92% [22].

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that could certainly suggest the correct diagnosis and thus affect the timely treatment. The most commonly used sign is the presence of concordant ST segment elevation > 1 mm, which is a part of Sgarbossa scoring system that gives the acceptable sensitivity and specificity.

References