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Acute coronary syndromes – ST-elevation myocardial infarction and non-ST elevation myocardial infarction - literature review

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Abstract

Background. The term Acute Coronary Syndrome (ACS) is used for patients with suspected or confirmed acute myocardial ischemia or myocardial infarction. Despite advances in health system preventive programs, ACS is often the first clinical manifestation of cardiovascular disease with high morbidity and mortality rates and the most common cause of death worldwide.

Aim. The aim was to review the diversity of recent literature about ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) – recommendations for diagnosis, management, and protective strategies in patients with cardiovascular disease.

Methods. The research was made using PubMed and Google Scholar databases using the keywords: „acute coronary syndrome“, „ST-elevation myocardial infarction“, „non-ST elevation myocardial infarction“, „cardiac biomarkers“, „risk stratification“.

Results. Patients history, ECG and specific cardiac biomarkers are the main factors evaluating the patient with chest complaints. ECG should be performed immediately, though normal ECG does not exclude ACS. ST-elevation or anterior ST depression should be considered a STEMI until proven otherwise. The most specific biomarker of choice is high-sensitivity cardiac troponin (hs-cTn). Immediate reperfusion strategy and antithrombotic therapy for 12 months as well as protection strategies significantly decrease morbidity, mortality and re-infarction in patients with CAD.

Conclusions. Understanding of underlying pathophysiological mechanisms associated with the development of myocardial injury after acute coronary artery occlusion, the availability of gold standard biomarkers and early reperfusion techniques in time-sensitive clinical cases are helpful in reducing diagnosis, treatment delays and mortality. In addition, protective strategies and secondary prevention increase the quality of life in patients with CAD.

Keywords: acute coronary syndrome; ST-elevation myocardial infarction; non-ST myocardial infarction; cardiac biomarkers; CK-NB; percutaneous coronary intervention; antithrombotic therapy.

1. Introduction

Acute Coronary Syndrome (ACS) is one of the most common manifestations of ischemic heart disease which results from perfusion-dependent imbalance between supply and demand and leads to end organ cardiomyocyte necrosis. ACS is the leading cause of death from cardiovascular disease (CVD) worldwide, accounting for 38% of all cardiovascular disease deaths in men and 44% in women. ACS refers to clinical presentations of ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI) or unstable angina. A STEMI is usually caused by a complete occlusion of one of the heart's arteries, while an NSTEMI is caused by reduced flow through the artery caused by coronary artery plaques or stenosis. ACS encompass a spectrum of conditions that include patients presenting with recent changes in clinical symptoms or signs, with or without changes on 12-lead electrocardiogram (ECG) and with or without acute elevations in cardiac troponin (cTn) concentrations. This review focuses on determination of frequency of two ACS types: STEMI, NSTEMI, epidemiology, diagnostic challenges and management in all classification types of myocardial infarction and protection strategies for patients with CVD.

2. Methods

Scientific literature was reviewed using PubMed and Google Scholar databases for full-text original articles or reviews using the keywords: „acute coronary syndrome", „ST-segment elevation myocardial infarction", „non-ST elevation myocardial infarction", „cardiac biomarkers", „risk stratification", „CK-NB" and their combinations during the period of five years (2018-2024). The results of primary literature search were filtered and duplicates were removed.

3. Results

3.1. Pathophysiology

Pathophysiological mechanisms of acute coronary syndrome require clarification. STEMI is a life-threatening and time-sensitive emergency that occurs from complete occlusion of the coronary artery. Patients with NSTEMI present with a more heterogenous condition (reduced coronary artery blood flow without complete occlusion, coronary artery spasm, embolism, myocarditis). The CAD begins with accumulation of atherosclerotic plaques in the coronary arteries until it ruptures or erodes, thrombus formed over a plaque is associated with vasoconstriction of vessel ending in critical reduction of blood flow to the myocardium. NSTEMI lesions have lesser coronary stenosis than that in STEMI (1). Causes of T-wave inversion in NSTEMI are likely to be multifactorial being associated with total occlusion of an infarct-related artery accompanied by transmural infarction (2). These patients generally present with severe chest pain and large myocardial risk areas. Patients with an existing infarct might be beyond the stage of ST-segment elevation and only present post-ischemic T-wave inversion (3,4). In STEMI patients, T-wave inversion is associated with complete restoration of coronary perfusion (5).

3.2. Epidemiology

Despite advances in understanding of pathophysiology and improvements in the management and prevention, ACS remains a major cause of mortality and morbidity worldwide (6) and the leading cause of CVD death, accounting for 38% of all cardiovascular disease deaths in males and 44% in females (7). Patients with NSTEMI generally have a higher long-term mortality risk due to prevalence of comorbidities and multi-vessel coronary artery disease (8).

The Universal Definition of Myocardial Infarction classifies myocardial infarction to five different subtypes. Type 1 MI occurs because of plaque rupture, ulceration or dissection in the presence of unstable atherosclerotic coronary artery disease (CAD) that comprises blood flow with resultant myocardial necrosis. Type 2 MI is caused by disequilibrium between oxygen supply and demand produced by factors other than unstable CAD (toxic effects of endogenous circulating compounds – catecholamines, endothelial dysfunction). Type 3 MI involves patients with cardiac death resulting from symptoms associated with myocardial ischemia but for whom cardiac biomarker results are lacking. Type 4 (a and b) MI is linked to percutaneous coronary intervention and stent thrombosis, respectively while Type 5 MI is related to coronary artery bypass grafting (9). According to classification STEMI and NSTEMI due to atherothrombotic events are included to Type 1 myocardial infarction.

3.3. Diagnosis

Acute chest discomfort (pain, tightness, heaviness, burning) is the leading characteristic symptom, typically presenting as retrosternal discomfort, heaviness or pressure radiating to left arm, neck or jaw, lasting several minutes or occasionally persistent. Dyspnea, diaphoresis, nausea and vomiting, occasionally palpitations and syncope may be present as well. Atypical symptoms, such as epigastric discomfort, sharp chest pain, increasing breathlessness may lead to under-diagnosis. Prompt assessment of vital signs is recommended at first medical contact, acquisition of initial ECG. The 12-lead ECG is the first-line diagnostic tool in patients with suspected ACS. It is recommended to interpret the findings by a qualified physician in 10 min. (10).

Biomarkers add an important information in the diagnosis and management of patients with suspected ACS, especially high-sensitivity cardiac troponin (hs-cTn), the biomarker of cardiomyocyte injury. Levels of cTn rise rapidly, within 1 hour after symptoms onset, remain elevated for several days (11). Despite the fact, that in patients with NSTEMI four variables may affect hs-cTn concentrations (age, renal dysfunction, time from chest pain onset, sex), absolute changes in biomarkers levels are still of diagnostic and prognostic value (12). The use of biomarkers other than cTn for the diagnosis of ACS is not recommended.

In emergency rooms transthoracic echo-cardiography (TTE) can be useful to identify ongoing ACS when used by trained professionals. Computed tomography (CT) plays a role only in ruling out alternative life-threatening conditions (eg, aortic dissection etc), especially in the era of hs-cTn assays available. Cardiac magnetic resonance (CMR) is the imaging test of clinical value in diagnosis uncertainty and may be useful in confirming takotsubo cardiomyopathy or myocarditis, working diagnosis of myocardial infarction with non-obstructive coronary arteries (MINOCA).

3.4. Management

An initial diagnosis of ACS there is an indication for initiating an emergency reperfusion strategy and the patient should undergo pre-hospital triage if possible in accordance with protocols for patients with STEMI pathway. The time to treatment may be shorter when ACS working diagnosis is made in prehospital setting and patients of regionalization may bypass emergency department straight into percutaneous coronary intervention (PCI) laboratory (13). Initial measures should also include oxygen therapy (in hypoxemic patients

only, oxygen saturation < 90%), nitrates to relieve ischaemic symptoms (should not be given to patients with hypotension), intravenous opioids (morphine, 5-10 mg), intravenous beta-blockers (metoprolol, demonstrating the greatest cardio-protective effect).

In patients with diagnosis of STEMI reperfusion strategy should be immediate angiography and PCI as needed, being superior to fibrinolysis in reducing mortality. If PCI is not available in 120 min of ECG-based diagnosis, patient should undergo fibrinolysis and be transferred to a PCI center (14–16). For NSTEMI very high-risk patients (life-threatening arrhythmias, hemodynamic instability, cardiac arrest) the immediate invasive strategy - angiography and PCI if needed- should be available as soon as possible. Patients who do not meet very high-risk criteria (non-elevated troponins, patients not meeting criteria for MI), a selective invasive approach is a clinical choice.

3.5. Antithrombotic therapy

Oral antiplatelet therapy – aspirin, clopidogrel, prasugrel, tricagreol - should be initiated as soon as possible considering the bleeding risk and PCI intervention timing in both – STEMI and NSTEMI – acute coronary syndrome patients (17–19). Following PCI prasugrel or ticagreol and aspirin are recommended for 12 months after ACS (20–22). De-escalation (switching from prasugrel/ticagreol to clopidogrel) could be considered after 30 days after index ACS event to reduce the risk of bleeding (20).

3.6. Protection strategies

Most CVD are preventable by reducing risk factors, smoking cigarettes, high arterial blood pressure, elevated total cholesterol and LDL-cholesterol, diabetes mellitus, which have an additive effect on occurrence of cardiovascular diseases. Reduced risk of re-infarction and consequent death may be achieved by healthy lifestyle management, changing nutrition habits and limiting alcohol consumption, willingness for physical activity, reconsidering of psychological stress, anxiety and depression, resumption of usual activities as well as lipid-lowering therapy in combination. Clinical decision for beta-blockers, antiplatelet agents (23), nitrates and calcium channel blockers, renin-angiotensin-aldosterone system inhibitors prescription should be considered individually (24).

4. Conclusions

ACS are classified based on clinical manifestation, ECD findings and high-sensitivity troponin values, non-invasive imaging may be helpful in diagnosis confirmation in STEMI and NSTEMI patients as well. Reperfusion strategy and fibrinolytic therapy in acute phase is time sensitive and antithrombotic therapy is indicated in all ACS patients for 12 months at least. Mortality and morbidity, risk of re-infarction may be decreased if protection strategies after ACS are employed personally.

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