



Review

Clinical assessment of chest pain and guidelines for imaging

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ABSTRACT

For many emergency facilities, risk assessment of patients with diffuse chest pain still poses a major challenge. In their currently valid recommendations, the international cardiological societies have defined a standardized assessment of the prognostically relevant cardiac risk criteria. Here the classic sequence of basic cardiac diagnostics including case history (cardiac risk factors), physical examination (haemodynamic and respiratory vital parameters), ECG (ST segment analysis) and laboratory risk markers (troponin levels) is paramount. The focus is, on the one hand, on timely indication for percutaneous catheterization, especially in patients at high cardiac risk with or without ST-segment elevation in the ECG, and, on the other hand, on the possibility of safely discharging patients with intermediate or low cardiac risk after non-invasive exclusion of a coronary syndrome. For patients in the intermediate or low risk group, physical or pharmacological stress testing in combination with scintigraphy, echocardiography or magnetic resonance imaging is recommended in addition to basic diagnostics. Moreover, the importance of non-invasive coronary imaging, primarily cardiac CT angiography (CCTA), is increasing. Current data show that in intermediate or low risk patients this method is suitable to reliably rule out coronary heart disease. In addition, attention is paid to the major differential diagnoses of acute coronary syndrome, particularly pulmonary embolism and aortic dissection. Here the diagnostic method of choice is thoracic CT, possibly also in combination with CCTA aiming at a triple rule-out.

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1. Introduction

For many years, cardiovascular disease has been the most frequent cause of death in the industrialized countries all over the world. In the USA and in Europe, every year approximately 15 millions of patients are treated in emergency rooms for suspected myocardial infarction [1]. The rate of actually evidenced acute coronary syndromes (ACS) amounts to 10–20% of these cases; approximately half of the patients with undefined chest pain are discharged from the emergency room on the day of admission after exclusion of ACS or relevant differential diagnoses [2]. Risk assessment of these patients, quick diagnosis and reliable determination of eligibility for discharge still cause substantial problems for the emergency facilities. Prior to the worldwide implementation of chest pain units more than 20 years ago, the rate of undiagnosed ACS amounted to 5–15% [3]. Markedly, more up-to-date studies, however, reveal that in spite of enormous development and experience in the diagnosis and therapy of ACS the risk of uncontrolled or premature discharges is today still quite relevant at 2–5% [4–6]. For

prognostically important differential diagnoses such as pulmonary embolism, high rates of misjudgements are likewise documented, unchanged over many years [7]. Emergency medicine experts receive important support in the diagnosis and therapy of ACS and its differential diagnoses from permanently updated guidelines by national and international professional societies [8–13]. In addition, broad national schemes such as nationwide certification of chest pain units in Germany attempt to systematically counteract the risk of misdiagnoses in the assessment of acute chest pain.

2. Differential diagnoses

Differential diagnoses of the ACS are of particular importance in the context of unclear chest pain (Table 1). They include non-coronary cardiac causes such as valve defects, cardiomyopathies, peri- and myocarditis, hypertensive heart disease and pulmonary embolism underlying acute right ventricular dysfunction. In addition, vascular (aortic dissection), pulmonary (pneumothorax, pleuritis) as well as neuropathic, oesophageal, gastrointestinal, musculoskeletal and psychogenic conditions must be considered. Given the plethora of possible causes, it is expedient to sort the differential diagnoses by priority. The highest risk conditions are, apart from coronary syndrome, pulmonary embolism and aortic dissection. These conditions must be quickly and reliably either

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Table 1
Differential diagnoses of acute coronary syndrome.

High risk	Intermediate risk	Low risk
Pulmonary embolism	Valvular disease	Pleuritis
Aortic dissection	Cardiomyopathy	Neuropathy
	Pericarditis/Myocarditis	Oesophageal disease
	Hypertension	Gastrointestinal disease
	Pneumothorax	Musculoskeletal injury
		Psychogenic condition

detected or excluded, respectively. Intermediate risk results from non-coronary cardiac causes and pneumothorax, conditions which must be reliably diagnosed but whose prognosis generally remains the same over the treatment period. The risk is rather low in most neuropathic, oesophageal, gastrointestinal, musculoskeletal and psychogenic conditions. They are often diagnoses of exclusion, and treatment may often be continued in an outpatient setting. In many cases, however, reliable differential diagnosis after exclusion of a coronary syndrome is not possible at the time of discharge [14].

3. Risk stratification

For risk stratification of patients suspected of coronary syndrome, precise determination and assessment of prognostically relevant criteria is the mainstay. Prime elements of this synopsis are anamnestic, clinical, electro- and echocardiographical as well as laboratory parameters.

3.1. Clinical symptoms

In general, chest pain is the leading symptom in patients with ACS diagnosed upon admission. There is an agreement that assessment of the pain character usually indicates the diagnostic direction but is unreliable as an exclusive tool for initial assessment and to be evaluated with caution [15]. Table 2 gives an overview of typical and atypical symptoms of angina pectoris. Retrosternal, long-lasting and nitrate-sensitive rest pain – described by Braunwald – emanating into arm, jaws or abdomen, in combination with vegetative symptoms such as dyspnoea, cold sweat and nausea, is considered as typical angina pectoris [16]. The intensity of the complaints likewise seems to be correlated to a certain degree with the risk of myocardial infarction and death [17]. Pain lasting for more than 20 min or persisting is particularly suggestive of infarction. Furthermore, triggering by stress and cold is considered as typical for angina pectoris. In women, diabetics and generally the elderly, the aforesaid symptoms are often expressed less strongly or less typically. Symptoms considered as rather atypical for angina pectoris include brief pain (a few seconds to minutes), small area of pain (few cm²), mechanical triggering (palpation, rotation) and position-dependence of the pain. For differential diagnosis, the breath-dependent pain symptomatology, with the focus on inspiration, in pulmonary embolism and the sharp immediate pain with emanation into neck and jaws in proximal, into back and abdomen

Table 2
Angina pectoris.

Typical symptoms	Atypical symptoms
Prolonged angina (>20 min)	Brief pain (few seconds or minutes)
Recurrent angina	Position-dependence
Retrosternal extension	Small area of pain (few cm ²)
Emanating into arm, jaws or abdomen	Mechanical triggering
Triggering by stress or cold	
Nitrate-sensitive angina	
Vegetative symptoms	

in distal aortic dissection, are of interest. However, even in these cases the pain frequently manifests atypically, sometimes only as a transient episode which does not appear very impressive upon admission.

3.2. Risk anamnesis

In the extended anamnesis of suspected ACS, prognostically important cardiac risk factors include diabetes mellitus, arterial hypertension, hypercholesterinaemia, nicotine abus, family history and advanced age, with diabetes mellitus being of special importance. Recent coronary events such as myocardial infarction or coronary procedures such as percutaneous catheterization (PCI) or coronary bypass surgery (CABG) in the preceding weeks or months likewise significantly increase the prognostic risk in the context of acute complaints. For differential diagnosis, patients must be questioned about previous infections, (especially those which could cause acute chest pain such as peri-/myocarditis and pleuritis), pulmonary embolisms and deep vein thromboses, as well as previous oesophageal, gastroenterological, orthopaedic or possibly psychiatric conditions.

3.3. Clinical findings

Systematic physical examination of patients suspected of ACS includes in particular the classic examination techniques for the assessment of haemodynamics and cardiac insufficiency. Blood pressure and heart rate must be documented immediately. In auscultation, signs of congestion in the pulmonary veins, but with regard to differential diagnosis also findings typical for valvular diseases (aortic stenosis?), are of particular importance. Furthermore, indications of deep vein thromboses (pulmonary embolism?), of central or peripheral arterial occlusions (aortic dissection?) and other cardinal findings are important. Generally, in the context of acute chest pain, haemodynamically or respiratorically unstable patients are to be considered, according to all the above guidelines, as high risk patients and urgently subjected to heart catheterization [8,10,11].

3.4. Electrocardiography

The 12-lead ECG has top priority in the basic diagnostics of ACS, and according to the guidelines it must be taken no later than 10 min after the patient's arrival in the emergency room. In the context of angina pectoris complaints, an ST elevation myocardial infarction (STEMI) is considered as evidenced if an ST-segment elevation of more than 0.2 mV is detected in more than two precordial leads, or of more than 0.1 mV in more than two limb leads or a newly occurred complete left bundle branch block is found. Because of the particularly poor prognosis of STEMI, this constellation justifies immediate reperfusion therapy without any further additional diagnostics [9,12,13]. Furthermore, alternating ST-segment changes or persisting ST-segment depressions of more than 0.1 mV are prognostically significant [18]. Specifically, deep T inversions in the precordial leads imply high risk. Furthermore, in the context of chest pain, T-wave negativity seems to be linked to rather moderately increased risk [19]. All in all, compared to ST-segment changes, T-wave negativity is of lower prognostic significance and in particular less specific [20]. Basically, in the context of angina pectoris complaints, all haemodynamically relevant and thus potentially life-threatening cardiac arrhythmias such as ventricular tachyarrhythmias must be considered as absolute high risk-situations with urgent indication for heart catheterization [8,10,11]. Regarding differential diagnosis, in tachycardic arrhythmias, T-wave negativity, right bundle branch block or e.g., SI/QIII type in combination with chest pain pulmonary embolism

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