MODERN ASPECTS OF MAGNETIC RESONANCE TOMOGRAPHY IN MYOCARDIAL INFARCTION

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Abstract According to current clinical guidelines, cardiac magnetic resonance imaging (MRI) is recommended as a key study in the diagnostic algorithm for myocardial infarction, since it allows excluding diseases such as myocarditis, takotsubo syndrome and cardiomyopathy, and also provides visual confirmation of myocardial necrosis. In addition, data are accumulating that support the prognostic value of MRI for this group of patients. This literature review discusses the diagnostic role of MRI in patients with myocardial infarction.

Keywords: myocardial infarction, magnetic resonance imaging, pathogenesis, epidemiology.

СОВРЕМЕННЫЕ АСПЕКТЫ МАГНИТНО-РЕЗОНАНСНОЙ ТОМОГРАФИИ ПРИ ИНФАРКТЕ МИОКАРДА

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Аннотация Согласно текущим клиническим рекомендациям, магнитно-резонансная томография (МРТ)сердца рекомендуется как ключевое исследование в алгоритме диагностики инфаркт миокарда, так как она позволяет исключить такие заболевания, как миокардит, синдром такоцубо и кардиомиопатии, а также предоставляет визуальное подтверждение миокардиального некроза. Кроме того, накапливаются данные, поддерживающие прогностическую ценность МРТ для этой группы пациентов. Это литературный обзор посвящен обсуждению диагностической роли МРТ у пациентов с инфаркт миокарда.

Ключевые слова: инфаркт миокарда, магнитно-резонансная томография, патогенез, эпидемиология.

MIOKARD INFARKTIDA MAGNIT-REZONANS TOMOGRAFIYA TEKSHIRUVINING ZAMONAVIY ASPEKTLARI

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Annotatsiya Mavjud klinik ko'rsatmalarga ko'ra, yurak magnit-rezonans tomografiyasi (MRT) miokard infarkti diagnostikasi algoritmida asosiy tadqiqot sifatida tavsiya etiladi, chunki u miyokardit, takotsubo sindromi va kardiyomiyopatiya

kabi kasalliklarni istisno qilishga imkon beradi, shuningdek, miokard nekrozini vizual tasdiqlash imkonini beradi. Bundan tashqari, ushbu bemorlar guruhi uchun MRTning prognostik qiymatini tasdiqlovchi ma'lumotlar to'planmoqda. Ushbu adabiyotlar sharhida miyokard infarkti bo'lgan bemorlarda MRT diagnostik roli muhokama qilinadi.

Kalit so'zlar: miokard infarkti, magnit-rezonans tomografiya, patogenez, epidemiologiya.

Relevance of the research Non-obstructive myocardial infarction (NOMI) is characterized by the absence of hemodynamically significant stenoses (< 50%) of the coronary arteries (CA) during angiography in patients with myocardial infarction (MI) [1]. The prevalence of Non-obstructive myocardial infarction is 5–6% among patients diagnosed with myocardial infarction; it is higher among women and among patients with non-ST-segment elevation MI (NSTEMI) compared to patients with ST-segment elevation MI (STEMI) [2]. In 2017, the EOC proposed for the first time criteria for the diagnosis of myocardial infarction, which included: 1) verified myocardial infarction, according to the third universal definition; 2) absence of stenosis ≥ 50% of the coronary artery; and 3) absence of another clinically obvious specific cause that could serve as an alternative cause of the acute condition. However, this definition was too broad and included a heterogeneous spectrum of etiologic factors, some of which are not directly related to the development of ischemia [3]. In this regard, in the updated fourth definition of myocardial infarction, structural myocardial changes and extracardiac pathology causing an increase in troponin levels (e.g., myocarditis or pulmonary embolism - PE) are considered separately from myocardial infarction and are designated as "an increase in troponin without coronary artery obstruction". Accordingly, to make a final diagnosis of myocardial infarction, it is necessary to exclude: 1) obvious extracardiac causes of an increase in troponin (e.g., sepsis, PE); 2) ischemic heart disease (IHD) involving small-diameter epicardial vessels (e.g., complete occlusion of a small segment or significant stenosis of the distal branch of the coronary artery ≥ 50%); 3) non-ischemic mechanisms of myocardial injury that mimic MI (e.g., myocarditis, takotsubo syndrome) [2].

According to current clinical guidelines, cardiac magnetic resonance imaging (MRI) is recommended as a key study in the diagnostic algorithm for myocardial infarction, since it can exclude myocarditis, takotsubo syndrome, and cardiomyopathy, and provide imaging confirmation of myocardial necrosis [2, 4, 5]. Currently, more and more data are accumulating indicating the prognostic role of MRI in this category of patients. In rare cases, myocardial infarction may be complicated by the development of left ventricular (LV) maneuvers, LV thrombosis, or life-threatening ventricular arrhythmias [6]. This descriptive review is devoted to the discussion of the diagnostic and prognostic role of MRI in patients with myocardial infarction. Numerous studies have confirmed that MRI contributes to an accurate diagnosis in patients with myocardial infarction in 30–90% of cases [7].

Moreover, the time of MRI after the initial symptoms is a determining factor in the diagnostic accuracy of MRI in cases of suspected myocardial infarction. MRI performed within 2 weeks from the initial manifestation of symptoms is associated

with the highest probability of identifying the underlying etiology of myocardial damage in these patients [8]. Recent reports from foreign researchers show that earlier MRI, less than 14 days after the onset of symptoms, improves the diagnostic value from 72 to 94% when combined with a peak increase in troponin > 211 ng/L [8].

As noted, in patients with suspected myocardial infarction, MRI can exclude myocarditis, Takotsubo syndrome, and nonischemic cardiomyopathies. It is generally accepted that MRI examination in patients with myocardial infarction should be performed optimally within 7 days of symptom onset to prevent false-negative results or underestimation of the extent of the disease [9]. The MRI examination protocol for the evaluation of patients with myocardial infarction should include assessment of cardiac structure and function using cine imaging, the presence and nature of cardioedema using T2-weighted imaging (T2w-STIR), and the presence and nature of myocardial injury using late gadolinium enhancement (LGE). In addition, it is recommended to use new methods of tissue characterization, such as T1 mapping with extracellular volume (ECV) assessment. According to MRI data, zones of late gadolinium accumulation in subendocardial or transmural localization indicate ischemic genesis of myocardial damage, while its subepicardial or intramyocardial localization can be caused by non-ischemic causes, such as myocarditis or cardiomyopathy [9]. Acute myocarditis is an inflammatory disease of the myocardium, characterized by an extremely diverse etiology [10]. Diagnosis of myocarditis remains a difficult task even at this stage of development of modern medicine due to the heterogeneity of clinical manifestations and the absence of specific signs of clinical, laboratory and traditional instrumental research methods [10].

Despite the fact that endomyocardial biopsy is considered the "gold standard" for diagnosing myocarditis, cardiac MRI is the key diagnostic method for this condition. In 2018, the MRI criteria for diagnosing myocardial inflammation "Lake-Louise Criteria 2018" were updated [11], according to which the main MRI criterion for acute myocarditis is the presence of myocardial edema (on T2-weighted images or T2 mapping) and the presence of signs of non-ischemic myocardial damage (increased native T1 and extracellular volume (ECV) or the presence of LGE). Additional criteria include the presence of pericardial effusion and systolic dysfunction of the LV (impaired regional or global contractility of the LV). Cardiac MRI plays a key role in the initial diagnosis of myocardial infarction, as has been noted above, but at the moment more and more data are accumulating indicating the prognostic role of MRI in this category of patients. In the work of M. Armillotta et al., 175 patients with myocardial infarction were included in the final analysis [12].

According to the MRI results, patients with myocardial infarction were classified into two phenotypes: LGE-positive phenotype (ischemic subendocardial or transmural LGE pattern) or LGE-negative (cases without LGE, but with regional myocardial damage determined by myocardial edema in the coronary blood supply zone with a typically ischemic “wave front” and/or regional wall motion abnormality consistent with coronary blood supply). A total of 121 (69.1%) patients were found to have areas of delayed gadolinium accumulation (LGE “+” group). The mean follow-up period was 36.1±15.2 months, and MRI was performed on average 6 ± 2.9 days after the acute onset of symptoms. During the follow-up, HF (15.7% vs. 1.9%, p = 0.008) and MACE

(20.7% vs. 7.4%, p = 0.029) occurred statistically significantly more frequently in the LGE "+" group of patients compared with the LGE "–" group. A prospective multicenter study by N. Vicente-Ibarra et al. included 120 consecutive patients with MRI-confirmed myocardial infarction [13]. During the three-year follow-up period, 43 (35.8%) patients developed MACE in the form of death, nonfatal MI, stroke, or rehospitalization. According to multivariate analysis, involvement of three or more LV myocardial segments (LGE) almost tripled the risk of MACE.

In a recent study, L. Bergamaschi et al. assessed the prognostic role of MRI in myocardial infarction [14]. The study included 437 patients with myocardial infarction who were divided into three subgroups according to the phenotype detected by MRI: 1) the presence of delayed gadolinium enhancement (LGE) zones and abnormal myocardial mapping (M-mapping) indices (LGE+/M+); 2) regional ischemic myocardial injury with abnormal mapping indices and without LGE (LGE–/M+); and 3) the absence of pathological MRI indices (LGE–/M–). The primary endpoint was the development of major adverse cardiovascular events (MACE). The mean follow-up period was 33.7±12.0 months, and MRI was performed on average 4.8±1.5 days after the acute manifestation. The final cohort included 198 patients with myocardial infarction; 116 (58.6%) formed the LGE+/M+ group. During follow-up, MACE occurred significantly more frequently in the LGE+/M+MI subgroups than in the LGE+/M– and LGE–/M– subgroups (20.7% versus 6.7 and 2.7%, respectively; p = 0.006). According to multivariate Cox regression analysis, the degree of LV fibrosis (% LGE) was an independent predictor of MACE along with T2 mapping values. Thus, at present, more and more data are accumulating, indicating the prognostic role of MRI in the group of patients with myocardial infarction. Conclusion Cardiac MRI plays a key role in the initial differential diagnosis of myocardial infarction, in addition, at present, more and more data are accumulating, confirming the prognostic role of MRI in this category of patients [15]. Further studies using T1 mapping techniques are needed for differential diagnosis and determining the prognosis in patients with myocardial infarction.

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