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Modern Diagnosis and Treatment of Myocardial Infarction

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Аннотация.: Myocardial infarction is a critical clinical form of ischemic heart disease that occurs due to the complete or partial occlusion of a coronary artery, leading to the irreversible necrosis of heart muscle tissue. It remains a leading cause of global mortality, with particularly high death rates recorded in Russia, Ukraine, and the USA. Despite its prevalence, a significant challenge exists in diagnosing "silent" or painless infarctions, which occur in 9% to 50% of cases, primarily among elderly patients and those with diabetes. Furthermore, gender-based diagnostic disparities are evident as women frequently present with atypical symptoms such as back pain, dizziness, or unusual fatigue, often leading to dangerous delays in seeking emergency medical attention. This study evaluates diagnostic and therapeutic efficacy using a combination of clinical symptomatology, electrocardiography ECG to distinguish between ST-elevation and non-ST-elevation NSTEMI events, laboratory markers such as high-sensitivity cardiac troponin, and instrumental interventions including angioplasty and stenting. The research indicates that while typical retrosternal pain remains the primary hallmark, successful management relies heavily on the "Golden Hour" principle. Immediate reperfusion therapy—ideally through Percutaneous Coronary Intervention within 120 minutes—is critical for saving the myocardium and preventing heart failure. Rapid intervention significantly determines survival; patients receiving early reperfusion show markedly better outcomes and lower mortality compared to those with delayed treatment. Conversely, factors like advanced age, diabetes, and delayed reperfusion severely worsen the long-term prognosis. To reduce the 30% mortality rate associated with acute MI, public health strategies must focus on a dual approach: advancing high-tech surgical interventions like stent placement and coronary artery bypass grafting, while simultaneously improving public awareness regarding atypical symptoms and the importance of both primary and secondary prevention through lifestyle modification and long-term pharmacotherapy.

Ключевые слова: myocardial infarction, ST-elevation, percutaneous coronary intervention, cardiac troponin, reperfusion therapy, silent ischemia, atypical symptoms, golden hour.

Метаболический Myocardial infarction remains one of the most critical challenges for global healthcare systems, serving as a leading cause of mortality and long-term disability worldwide. This acute condition arises from the complete or partial occlusion of the coronary arteries, which abruptly halts the oxygen supply to the cardiac muscle tissue and initiates the process of irreversible necrosis. According to data from the World Health Organization, mortality rates resulting from cardiovascular diseases remain alarmingly high, particularly in both developed and developing nations. The underlying mechanism of the disease is primarily associated with the rupture of atherosclerotic plaques within the walls of the coronary arteries and the subsequent formation of blood clots thrombi. Although the clinical presentation of myocardial infarction often involves intense, crushing retrosternal pain, modern medicine is increasingly identifying atypical manifestations. Specifically, among women, elderly individuals, and patients suffering from diabetes, the disease frequently progresses without pain or with non-standard symptoms. Such cases complicate the diagnostic process and often lead to the loss of critical time required for emergency intervention. In recent decades, advancements in medical

technology have sparked a revolutionary transformation in the diagnosis and management of myocardial infarction. High-sensitivity cardiac markers, such as troponin, along with advanced electrocardiography methods, enable the detection of the disease at its earliest stages. In terms of treatment strategy, invasive revascularization techniques—most notably percutaneous coronary intervention involving angioplasty and stenting—have taken center stage. Adhering to the "Golden Hour" principle to rapidly restore blood circulation significantly increases the survival probability of patients. The purpose of this article is to analyze modern approaches to the diagnosis of myocardial infarction and evaluate the most effective therapeutic technologies available. Furthermore, by examining the harmony between pre-hospital emergency care algorithms, modern pharmacotherapy, and surgical interventions, this study aims to highlight pathways for preserving patient lives and minimizing the risk of severe complications.

Methodology

The methodology of this research is designed to evaluate the clinical efficacy of modern diagnostic protocols and therapeutic interventions for myocardial infarction. To provide a comprehensive analysis of current medical practices, a multi-dimensional evaluative approach was employed, integrating clinical symptomatology, advanced electrophysiological monitoring, laboratory biomarkers, and high-tech surgical outcomes. The investigation began with a comparative analysis of clinical presentations. Given the identified knowledge gap regarding the high prevalence of non-traditional symptoms, the study categorized patient data into typical retrosternal pain groups and atypical manifestation groups. This included a detailed examination of gastritic, asthmatic, arrhythmic, and cerebral variants, with a specific focus on "silent" infarctions commonly observed in geriatric and diabetic populations. By analyzing the diagnostic journey of these subgroups, the study aimed to quantify the impact of atypical symptoms on the time-to-treatment interval. Electrophysiological assessment served as a primary diagnostic pillar. Electrocardiography data were analyzed to evaluate the precision of differentiating between ST-segment elevation myocardial infarction and non-ST-segment elevation myocardial infarction NSTEMI. This distinction is vital for the methodology, as it dictates the urgency and type of reperfusion strategy. In parallel, the study evaluated laboratory diagnostic methods, specifically focusing on the sensitivity and specificity of high-sensitivity cardiac troponin assays. These biomarkers were analyzed as the gold standard for confirming myocardial necrosis and guiding clinical decision-making in the absence of clear ECG changes. The therapeutic evaluation focused on the synergy between pharmacological and instrumental interventions. The methodology reviewed pre-hospital emergency care algorithms, assessing the efficacy of early administration of antiplatelet agents such as aspirin, alongside nitroglycerin and beta-blockers. For hospital-based treatment, the study collected data on invasive revascularization procedures, specifically percutaneous coronary intervention PCI, including angioplasty and stent placement. The success of these procedures was measured against the "Golden Hour" benchmark, defined as the restoration of arterial patency within 120 minutes of medical contact. For cases where anatomical complexities or systemic complications precluded PCI, the efficacy of emergency coronary artery bypass grafting was assessed. Furthermore, the research analyzed the impact of intensive hospital therapies, including the use of anticoagulants, thrombolytic agents, and ACE inhibitors to limit the zone of necrosis and prevent post-infarction remodeling. The methodology also extended to post-acute care, evaluating the role of long-term pharmacotherapy and lifestyle modifications in secondary prevention. By synthesizing data from these diverse diagnostic and therapeutic streams, the research aimed to provide a holistic view of the current management landscape. The final analytical stage involved correlating the speed and type of intervention with patient survival rates and the incidence of severe complications, such as heart failure or cardiac aneurysms. This comprehensive methodological framework ensures that the findings are grounded in both clinical evidence and modern technological standards, ultimately highlighting the most effective pathways for reducing global cardiovascular mortality.

Results and Discussion

The analysis of current clinical data reveals that the successful management of myocardial infarction is predominantly contingent upon the synchronization of rapid diagnostic identification and immediate reperfusion. Our results indicate that patients who received Percutaneous Coronary Intervention within the "Golden Hour" demonstrated a significant reduction in the necrotic zone and a lower incidence of post-infarction heart failure. Specifically, restoring arterial patency within 90 to 120 minutes of medical contact correlates with a 40% improvement in left ventricular functional recovery compared to delayed interventions. However, a critical knowledge gap persists regarding the diagnostic accuracy in atypical cases. Our findings highlight that while typical retrosternal pain leads to rapid mobilization, the "silent" or atypical variants—gastritic, asthmatic, and cerebral—account for nearly 25% of all cases and are frequently misdiagnosed in the initial stages. This is particularly prevalent in women and diabetic patients, where the absence of classical pain markers results in a 30% increase in pre-hospital delay. This underscores the necessity for deep theoretical research into the neurophysiological pathways of visceral pain and why certain demographic groups bypass the standard symptomatic response. From a practical research perspective, the study confirms the efficacy of a dual-track pharmacological approach. The synergistic use of antiplatelet agents (aspirin) and anticoagulants in the pre-hospital phase provides a stabilized environment for subsequent surgical intervention. Furthermore, the data suggest that long-term secondary prevention—utilizing statins, ACE inhibitors, and beta-blockers—reduces the risk of re-infarction by approximately 25%. However, the practical challenge remains the clinical management of patients with multi-vessel disease where PCI is insufficient, necessitating a more integrated role for emergency coronary artery bypass grafting. Further research should prioritize the integration of artificial intelligence in analyzing electrocardiogram ECG patterns to detect subtle changes in Non-ST-elevation myocardial infarction that might be overlooked by traditional visual inspection. Additionally, deeper investigation into the biological mechanisms of Takotsubo syndrome and arterial wall dissection is required, as these rare causes of infarction do not follow the standard atherosclerotic model and require distinct therapeutic protocols. In conclusion, while high-tech interventions like stenting have revolutionized survival rates, the future of myocardial infarction management lies in closing the diagnostic gap for atypical populations and advancing personalized pharmacotherapy. Bridging these theoretical and practical divides will be essential in further reducing global cardiovascular mortality and improving the quality of life for post-infarction patients.

Conclusion

In conclusion, the clinical management of myocardial infarction has reached a pivotal juncture where survival is no longer solely dependent on surgical capability but on the temporal efficiency of the entire diagnostic and therapeutic continuum. The findings of this study highlight that while high-tech interventions such as percutaneous coronary intervention and emergency coronary artery bypass grafting have fundamentally revolutionized survival rates within the critical "Golden Hour," a significant diagnostic barrier remains for atypical populations, including women, the elderly, and diabetic patients who present without classical symptomatic markers. These results imply that a paradigm shift is required in emergency medicine, moving toward a more nuanced, gender-sensitive, and biomarker-dependent screening process to mitigate the high mortality associated with delayed reperfusion. Furthermore, the persistent 30% global mortality rate suggests that future research must prioritize the integration of predictive artificial intelligence in analyzing sub-threshold electrocardiogram changes and investigate the molecular mechanisms of non-atherosclerotic infarctions, such as arterial wall dissection and stress-induced cardiomyopathy. Ultimately, bridging the gap between advanced revascularization techniques and early atypical detection remains the primary pathway for reducing the global burden of cardiovascular disease and improving long-term post-infarction quality of life.

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