COMPARATIVE ANALYSIS OF LABORATORY AND INSTRUMENTAL DIAGNOSTIC METHODS IN ISCHEMIC HEART DISEASE

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Abstract. *This article presents a comparative analysis of laboratory and instrumental diagnostic methods used in the diagnosis of ischemic heart disease. The diagnostic value of cardiac biomarkers, electrocardiography, echocardiography, coronary angiography, and coronary computed tomography angiography is evaluated. The advantages, limitations, sensitivity, and clinical significance of each diagnostic approach are discussed. The study emphasizes that the combined use of laboratory and instrumental methods improves diagnostic accuracy, supports early detection, and contributes to appropriate treatment planning for patients with ischemic heart disease.*

Keywords*: Ischemic heart disease, laboratory diagnosis, instrumental diagnosis, cardiac biomarkers, electrocardiography, echocardiography, coronary angiography.*

Introduction

Ischemic heart disease (IHD) is one of the most common cardiovascular disorders and remains the leading cause of morbidity and mortality worldwide. The disease develops because the heart muscle receives an insufficient blood supply due to narrowing or blockage of the coronary arteries. Early diagnosis is essential for preventing serious complications such as myocardial infarction, heart failure, arrhythmias, and sudden cardiac death. Therefore, timely detection of ischemic heart disease has become a major priority in modern cardiology. Currently, both laboratory and instrumental diagnostic methods are widely used in the diagnosis of ischemic heart disease. Laboratory investigations, including cardiac troponin I, cardiac troponin T, creatine kinase-MB, myoglobin, lipid profile, and C-reactive protein, provide important information about myocardial injury and cardiovascular risk. Instrumental examinations, such as electrocardiography, echocardiography, exercise stress testing, Holter monitoring, coronary angiography, and coronary computed tomography angiography, evaluate the anatomical and functional condition of the heart and coronary arteries.

Each diagnostic method has its own advantages and limitations regarding sensitivity, specificity, and diagnostic accuracy. Laboratory tests identify biochemical changes associated with myocardial damage, whereas instrumental methods visualize structural and functional abnormalities of the heart. Therefore, comparing laboratory and instrumental diagnostic methods is essential for improving diagnostic accuracy, selecting the most appropriate treatment strategy, and enhancing patient outcomes. The integration of these diagnostic approaches has become one of the key directions in contemporary cardiovascular medicine.

Relevance

Ischemic heart disease remains one of the leading causes of death worldwide. Accurate and timely diagnosis is essential for reducing complications and improving patient survival. Since laboratory and instrumental diagnostic methods provide different clinical information, comparing their diagnostic value is important for selecting the most effective diagnostic strategy and improving the quality of patient care.

Purpose

The purpose of this study is to compare the diagnostic value of laboratory and instrumental methods in patients with ischemic heart disease, evaluate their advantages and limitations, and determine the most effective approach for early diagnosis and clinical decision-making.

Main part

Ischemic heart disease (IHD) is one of the most common cardiovascular disorders and remains the leading cause of morbidity and mortality worldwide. The disease develops when the oxygen demand of the myocardium exceeds the oxygen supplied through the coronary arteries.

The primary cause of IHD is atherosclerosis, which leads to the formation of atherosclerotic plaques and narrowing of the coronary arteries. Major risk factors include arterial hypertension, diabetes mellitus, dyslipidemia, obesity, cigarette smoking, physical inactivity, chronic stress, advanced age, and genetic predisposition. Reduced coronary blood flow causes myocardial ischemia, resulting in metabolic disturbances and impaired cardiac function. If left untreated, prolonged ischemia may lead to myocardial infarction, heart failure, and life-threatening arrhythmias. The most common clinical symptom is chest pain or angina pectoris, which may radiate to the left arm, shoulder, neck, or jaw. Patients may also experience shortness of breath, fatigue, palpitations, and decreased exercise tolerance. In diabetic patients, the disease may progress without typical symptoms, making early diagnosis more challenging. Therefore, understanding the etiology and pathogenesis of IHD is essential for effective prevention, timely diagnosis, and successful treatment.

Laboratory investigations play a crucial role in the diagnosis and management of ischemic heart disease. Cardiac biomarkers are essential for detecting myocardial injury and assessing disease severity. Cardiac troponin I and cardiac troponin T are considered the most sensitive and specific biomarkers for myocardial damage. Creatine kinase-MB (CK-MB) is also widely used, particularly in the diagnosis of acute myocardial infarction. Myoglobin is an early marker that increases shortly after myocardial injury. Lipid profile analysis, including total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and triglycerides, is important for evaluating cardiovascular risk. Inflammatory biomarkers such as C-reactive protein contribute to risk assessment and prognosis. Blood glucose and glycated hemoglobin measurements are valuable for identifying diabetes mellitus, a major risk factor for IHD. Laboratory findings should always be interpreted together with the patient's clinical presentation and imaging results. These tests are essential for early diagnosis, monitoring treatment effectiveness, and predicting clinical outcomes. Advances in laboratory technologies have significantly improved the speed and accuracy of biochemical testing.

Instrumental diagnostic methods are indispensable for confirming the diagnosis of ischemic heart disease and evaluating cardiac function. Electrocardiography (ECG) is the most commonly used initial investigation and provides important information about myocardial ischemia, infarction, and cardiac arrhythmias. Holter monitoring allows continuous ECG recording over 24–48 hours and is useful for detecting intermittent ischemic episodes and rhythm disturbances. Echocardiography evaluates cardiac chamber size, ventricular function, wall motion abnormalities, and valvular heart disease. Exercise stress testing is performed to identify myocardial ischemia induced by physical activity. Coronary angiography remains the gold standard for visualizing coronary artery stenosis and guiding interventional treatment.

Coronary computed tomography angiography offers a non-invasive alternative for assessing coronary artery disease. Cardiac magnetic resonance imaging provides highly detailed information about myocardial structure, tissue viability, and ventricular function. Recent advances in artificial intelligence have further enhanced the interpretation of ECGs and cardiac imaging, improving diagnostic accuracy. The combination of instrumental and laboratory diagnostic methods provides a comprehensive assessment of patients with ischemic heart disease and supports evidence-based clinical decision-making.

Laboratory and instrumental diagnostic methods play complementary roles in the diagnosis of ischemic heart disease. Laboratory tests primarily identify biochemical evidence of myocardial injury, whereas instrumental examinations evaluate the structural and functional condition of the heart. Cardiac troponins are highly specific for myocardial necrosis but do not provide information about coronary anatomy or cardiac function. In contrast, electrocardiography, echocardiography, coronary angiography, and coronary computed tomography angiography visualize ischemic changes and determine the severity of coronary artery disease. Laboratory tests are rapid, inexpensive, and suitable for emergency diagnosis, while instrumental methods provide comprehensive clinical information for treatment planning.

The combined interpretation of both diagnostic approaches significantly improves diagnostic accuracy, reduces false-negative results, and supports appropriate therapeutic decision-making. Integrating laboratory and instrumental investigations is considered the most effective strategy for diagnosing ischemic heart disease.

Early diagnosis of ischemic heart disease requires a comprehensive evaluation that combines clinical assessment, laboratory investigations, and instrumental examinations. Patients presenting with chest pain should undergo immediate electrocardiography together with measurement of cardiac biomarkers.

Echocardiography provides additional information regarding ventricular function and myocardial contractility. Coronary computed tomography angiography and invasive coronary angiography are recommended when coronary artery disease is strongly suspected. Combining different diagnostic methods improves sensitivity and specificity, enabling physicians to identify myocardial ischemia at an early stage. A multidisciplinary diagnostic approach also reduces unnecessary invasive procedures and improves treatment outcomes. Early diagnosis remains one of the most effective strategies for preventing myocardial infarction, heart failure, and cardiovascular mortality.

Recent advances in cardiovascular medicine have introduced innovative technologies for the diagnosis of ischemic heart disease. Artificial intelligence has become an important tool for interpreting electrocardiograms, echocardiographic images, and coronary computed tomography scans. Machine learning algorithms improve diagnostic accuracy and reduce interpretation time.

Three-dimensional cardiac imaging, molecular biomarkers, and precision medicine approaches have further enhanced cardiovascular diagnosis. Wearable devices and remote cardiac monitoring systems allow continuous assessment of patients outside the hospital environment.

Telecardiology has improved access to specialist consultation, particularly in rural and underserved regions. Future research is expected to focus on integrating artificial intelligence, molecular diagnostics, and advanced imaging technologies into routine clinical practice. These innovations will contribute to earlier diagnosis, personalized treatment, improved patient outcomes, and reduced cardiovascular mortality.

Conclusion

In conclusion, both laboratory and instrumental diagnostic methods play an essential role in the diagnosis and management of ischemic heart disease. Laboratory investigations provide valuable information about myocardial injury and cardiovascular risk, while instrumental examinations assess the structural and functional status of the heart and coronary arteries.

Each method has its own advantages and limitations; however, their combined application significantly improves diagnostic accuracy, supports early detection, and facilitates appropriate treatment planning. The integration of modern diagnostic technologies, including artificial intelligence and advanced cardiac imaging, is expected to further enhance the quality of cardiovascular care.

Therefore, a comprehensive diagnostic approach remains the most effective strategy for improving clinical outcomes and reducing morbidity and mortality associated with ischemic heart disease.

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