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Heart matters: Understanding heart attacks

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Abstract: Coronary heart disease (CAD), the leading cause of myocardial infarctions, or heart attacks, is most often caused by atherosclerosis. Heart attacks are a worldwide health issue because they can result in tissue damage or even death due to the occlusion of blood flow to the heart. In order to treat, prevent, and diagnose cardiovascular diseases, one must be aware of the causative factors. Symptoms present differently in both genders, and therefore it is difficult for the clinical picture, diagnosis, and treatment. Methods of prevention and therapy in the modern world are described, and the role of micro-vascular disease in women becomes more and more acknowledged, so it is necessary to develop more advanced diagnostic criteria and therapeutic strategies. The etiology, clinical epidemiology, methods of prevention, diagnosis, and treatment of heart attacks are discussed in this study.

Keywords: Blood clots, atherosclerosis, coronary artery disease, and myocardial infarction

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INTRODUCTION

Myocardial infarctions, or heart attacks, are acute illnesses of a disruption of the circulation to a portion of the heart muscle. This most frequently results in a rupture of the atherosclerotic plaque within the coronary artery, occluding the channel with a thrombus. Through the reduction or even eradication of the delivery of blood to the injured cardiac muscle, heart attack creates ischemic injury or necrosis. Severity of heart attack depends on how long the blockage has taken place and where in the heart it is occurring (Libby *et al*., 2019). Most of the patients had chest tightness or pain during initial presentation, which extend to their jaw, neck, or left arm. The symptoms were mostly mild, and the most common was chest pain. The other symptoms are nausea, vomiting, sweating, and shortness of breath. In the elderly and in women, presentation is more indolent or less classical and challenging to diagnose (Mehta *et al*., 2020). Sudden cessation of the flow of blood to part of the heart muscle is a feature of heart attack. This is typically due to a thrombus causing disruption of the atherosclerotic plaques of one of the coronary arteries, which blocks the flow of blood. The tissue that this artery is supposed to perfuse will become ischemic and damaged or necrosed in case of blockage not cleared or eliminated. Atherosclerosis, which occurs as a result of the build-up of plaques or fatty material on the innermost wall of coronary arteries, is the main risk factor for myocardial infarction (American Heart Association, 2021). Plaque has the ability to harden arteries and decrease the delivery of blood to the heart muscle. Platelets clot upon breaking of the plaque and may quickly block the artery. Depending on the extent of heart tissue ischemia due to occlusion, myocardial necrosis and cell death can result (Libby, 2021; Falk, 2006). Symptoms can vary from shortness of breath, nausea, vomiting, and diaphoresis, squeezing or tight chest pain or discomfort that may radiate to the left arm, neck, or jaw. Yet, they can present in most presentations, and there are some populations—women, elderly, diabetic patients—who possess very low levels of pain tolerance so that they are hard to diagnose (Wang *et al*., 2016; Vaccarino *et al*., 2018). Electrocardiogram, clinical evaluation, and biochemical markers were employed for the diagnosis of myocardial infarction. Combined with other ECG changes, an elevated or flattened ST segment may signal myocardial infarct or ischemia. Molecular markers such as blood-stream proteins cardiac troponins (MB) and CK, signaling myocardial damage, confirmed the diagnosis. Along with the established definite treatment, some new imaging techniques are utilized, ranging from echocardiography to coronary angiography. They are helpful for identifying obstructed coronary arteries as well as assessing myocardial damage.

The action is enhanced when myocardial infarction is handled early because delay would exacerbate the difficulty of harming the heart tissues. Aspirin and anticoagulants are a few of the initial drugs used in preventing the formation of blood clot. Thrombolytics are used in combination with percutaneous cardiac intervention as a reperfusion therapy for the restoration of

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blood flow. Unlike thrombolytics that only dissolve the clot, Percutaneous Coronary Intervention (PCI) entails stent placement or balloon angioplasty to reopen the artery and re-establish blood flow. Long-term treatment regimens typically associated with them are dietary changes, exercise, and smoking cessation. Statins, ACE inhibitors, and beta-blockers are employed in myocardial infarction therapy, a potentially fatal disorder resulting from ischemia and tissue injury due to the acute occlusion of cardiac muscle blood supply.

Health technology and research need to improve to increase the possibility of accurate diagnosis, treatment, and management of patients with this disease. With minimization of risk factors and limiting the possibilities of recurrence for cardiovascular complications through ongoing interventions like drug therapy and modification of lifestyle, acute intervention like thrombolytics or percutaneous coronary intervention is weighed. The prognosis of MI patients has improved step by step with the introduction of treatment and diagnostic methods. "Heart Matters": The aim of the "Understanding Heart Attacks" campaign is to increase awareness about the cause, symptom, and risk of heart attacks among the general public. Second, it should promote healthy living, increase public awareness of prevention measures, and strongly emphasize the early diagnosis and early medical treatment to enable prevention of an unfavorable outcome.

MATERIALS AND METHODS

"Heart Matters: Understanding Heart Attacks" utilizes a process including clinical trials, statistical information, expert opinion, and a review of the literature. Utilizing evidence-based research to investigate pathophysiology, risk factors, prevention, and available treatments, it applies this to provide a detailed insight into heart attacks.

Epidemiology of heart attack

Recent studies on the epidemiology of heart attack suggest that incidence of MI varies by age, gender, region and the socio-economic status. High income countries may report better survival rates from the heart attack with a decline in heart attack rates due to the advancement in emergency care during the onset of heart attack and better management following the heart attack including early diagnosis, improved prevention and advanced treatment options (Alwan *et al.,* 2011). Cardiovascular diseases (CVDs) including heart attacks are the leading cause of death all over the world, accounting for about 32% of all global deaths (WHO, 2021). Contrary to this, lower and middle income countries bears the greatest burden of CVDs with over 80% of deaths caused due to CVDs and this increase is attributed to rapid epidemiological transitions such as physical inactivity, poor nutrition and increased smoking (Virani *et al.,* 2021). Global public health initiatives aim to reduce the modifiable risk factors and improve the awareness related to heart attacks, such as dyslipidemia, hypertension, obesity and smoking. In Pakistan, the prevalence of heart attacks is alarmingly high, contributing approximately 30-40% of all deaths (Jafar *et al.*, 2020). Urban areas have higher prevalence of MI than the rural areas which is likely due to urbanization, changes in lifestyle and increased exposure to risk factors such as physical inactivity, unhealthy diets and smoking (Hussain *et al*., 2021). A published study conducted in Pakistan reported that nearly 26% of adults have diabetes while 40% have hypertension, both of which are the leading risk factors for heart attack (Khan *et al*., 2020).

Atherosclerosis

Endothelial damage, which destroys the endothelial lining of the inner wall of the blood artery, is the initial phase of the chronic, degenerative disease of atherosclerosis. Diabetes, hypertension, smoking, and hypercholesterolemia can also harm the endothelium. LDL cholesterol crosses the artery and oxidizes after endothelial integrity is compromised, drawing immune cells like macrophages to the site of injury and resulting in inflammation. Macrophages aggregate, become foam cells, and are seen as fatty streaks after the uptake of oxidized LDL. Last but not least, atherosclerotic plaques are caused by the proliferation of smooth muscle cells, foam cell generation, and the deposition of extracellular matrix.

Most of the plaque, covered in a fibrous cap, is composed of necrotic tissue and lipids. Each time plaques of any size constrict arterial conduits and reduce blood flow, a patient is susceptible to experiencing an array of heart emergencies including a heart attack or stroke. Plaque rupture aggravates the condition by putting thrombogenic material into the bloodstream and augmenting occlusion of blood flow due to platelet clumping and clotting. Because atherosclerosis is a major causative factor for peripheral arterial disease, cerebrovascular disease, and coronary heart disease, treatment of it can become potentially preventive against some of the more lethal cardiovascular consequences (Libby, 2021; Ross, 1999). Anti-inflammatory drug and therapy such as statins are best suited to reduce the development of atherosclerosis in the short term when combined with dietary and exercise change but increase the risk of more fatal cardiovascular events (Khera *et al*., 2016).

Coronary artery

Coronary arteries provide oxygen-carrying blood to the cardiac muscle. Left and right coronary arteries are the two very important and large coronary arteries. Majority of these branches develop into small arteries that provide

blood to the two halves of the heart. The left anterior descending and circumferential arteries on the left are two other direct branches of the left coronary artery. Left Circumflex artery supplies the posterior and lateral walls of the left ventricle, while LAD artery supplies the anterior wall and interventricular septum. The rest of the supply to the right atrium, right ventricle, and right heart comes from the right coronary artery.

It also generally gives access to the left ventricle's posterior descending artery (PDA) and the lower part of the ventricle. The aforementioned arteries explain that without oxygen-rich blood and nutrients, the heart muscle cannot work optimally. When the arteries are stenosed or blocked, the heart's function is severely impaired. A lipid-laden plaque on the innermost lining of an artery is one of the major inducers of atherosclerosis-caused coronary artery disease. Atherosclerosis pathophysiology leads to narrowing and constriction of the arteries, decreasing blood supply to the cardiac muscle (Fuster *et al*., 2011; Grady *et al*., 2019)

Blood clot

The clottable substance is sticky, similar to jelly. Vessel damage causes leakage. One of the most important physiological events that prevent excess bleeding and repair wounds is coagulation. Platelet, clotting factor, and blood artery wall in combination create a blood clot is not easy to see. Platelets enter rapidly into the injured blood vessel and agglutinate to act as a transient plug. Another level of hardness is a protein known as fibrin mesh, which lies between entwined platelets. Although this process is required in order to effectively trap blood in the area of a wound or injury, a poorly formed clot has harmful health consequences when clotting factors, synthesized mainly in the liver, chemically interact with each other to become thrombin, an enzyme that contracts platelet plugs and converts fibrinogen to fibrin to create a firm clot.

For example, there is no additional damage that can be seen if a clot is established in an artery. The reduction of blood flow and development of conditions such as pulmonary embolism (PE) and deep vein thrombosis (DVT) could be attributed to it. Myocardial infarction, or otherwise known as heart attack, is induced by a blood clot in one of the coronary arteries caused by coronary artery disease. This suppresses blood to the heart muscle (Hirsch *et al*., 2001; Kearon *et al*., 2008).

Diagnostic modalities of heart attack

Heart attacks are diagnosed with the help of diagnostic testing, past illness history, family history, symptoms, and presentation. Laboratory testing is one of the routine methods of diagnosis. When heart muscle cells are damaged or killed, proteins and enzymes leak into the blood. They can be traced and quantified to find out whether a heart attack is likely or not. Among the most important laboratory tests are CBC, Troponin, Cardiac Enzymes and Biomarkers, and Lipid Profile assays. Testing for serum myoglobin and creatine kinase (CK-MB) is also performed regularly. The most critical checkup in arriving at an initial diagnosis of a patient's condition when he/she suffers from a heart attack is the electrocardiogram (ECG), which examines the rhythm of the beat, the rate of the heart beating, amplitude of the waveform, and the timing of the heartbeat together with its electric impulses. ECG can detect myocardial infarction (MI) in relative stenosis with non-ST elevation of the ST segment (NSTEMI) or MI (myocardial infarction or heart attack) in complete stenosis with ST segment elevation (STEMI), based on the percentage of blockage of the coronary arteries. It also diagnoses the condition in 80% of patients.

In those patients who are most at risk of having a heart attack, imaging examinations such as coronary angiography are used to identify the location of heart vessel blockage and make final diagnoses. To administer contrast material into the coronary artery bloodway, a flexible tube called a "catheter" is placed into a blood vessel in the neck, groin, or arm during the "Cardiac Catheterization" process. The circulation of blood within the vessel and obstructions are also assessed using the X-ray's radiation (Li *et al*., 2024).

RESULTS

By emphasizing the causes, risk factors, symptoms, and treatments, this review study takes into account numerous significant findings in our knowledge of heart attack. Among them is that atherosclerosis is the major cause of myocardial infarction. Blood clots that can injure heart tissue and stop blood flow are greatly increased by plaque deposits in the coronary arteries. The study also stresses the need for identifying risk factors such as diabetes, hypertension, high cholesterol and smoking.

The importance of early detection and intervention is emphasized throughout the study. Since many people, especially women, have unusual symptoms that make early detection more challenging, the study also emphasizes the range of heart attack symptoms. Surgery like coronary artery bypass grafting (CABG) and angioplasty are required for severe blockages; antiplatelets and thrombolytics are essential for dissolving clots and stopping more damage.

DISCUSSION

The significance that atherosclerosis contributes in the pathophysiology of myocardial infarction is among the most significant discoveries highlighted. The slow

accumulation of lipid-rich plaques in the coronary vessel walls is known as atherosclerosis (Severs *et al*., 2024). These plaques could eventually burst, causing a thrombus to form that restricts the circulation to the heart muscle, resulting in myocardial tissue ischemia and necrosis. The location and extent of the blockage determines the clinical consequences, which typically encompass shortness of breath, significant chest pain, and other widespread heart attack symptoms (Osuman *et al*., 2024).

Additionally points out the significance it is to identify danger factors that can be changed and those that must. Risk factors that can be altered include poor diet, smoking, obesity, high blood pressure, high cholesterol, and physical inactivity (Mozaffarian *et al*., 2008).

These can be addressed by individual behavior alterations and efforts to improve public health, which have been significantly affected by lifestyle decisions. Because it accelerates up atherosclerosis and sometimes coexists with other risk factors, diabetes mellitus in particular is a serious hazard because it increases the risk of heart attack or stroke. But, because they also have an impact, non-modifiable characteristics like age, gender and family history demand for a more considered approach to risk assessment as well as prompt screening (Govindarajan *et al.,* 2017).

The myocardial infarction symptomatology is a further significant subject discussed. Although the classic symptoms, such as crushing chest pain disseminating to the arm or jaw, have become well-known, atypical presentations can be challenging to evaluate, especially in women, the elderly, and patients with diabetes. These could include moderate pain, nausea, dizziness, or exhaustion, which could cause treatments to be prolonged and result in more adverse effects. (Porreca *et al*., 2009).

The review emphasizes both short-term and long-term management techniques regarding treatment. The main objective during the acute phase is to restore blood flow as quickly as necessary (Bonanno *et al*., 2022). Depending on the severity and location of the blockage, this may comprise coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), or thrombolytic treatment (Deb *et al.* 2013). Significant pharmacological treatments for patient management and risk reduction include aspirin, beta-blockers, statins, and antiplatelet prescription drugs. Lifestyle change with compliance with medication, and cardiac rehabilitation are the main focuses of long-term treatment, which substantially improves quality of life and minimizes incidence (Griffo *et al*. 2013).

Additionally, the review highlights the significance of preventive cardiology. Combining successful public awareness their efforts with early risk factor screening, particularly among high-risk populations, may significantly reduce the incidence of myocardial infarction. Furthermore, new developments in imaging technologies, biomarkers and genetics potential to advance risk prediction and enable early interventions (Sah *et al*., 2025).

This review restates the concept that myocardial infarction is a complicated medical condition that requires a multidisciplinary approach for successful management. Early detection and changes in lifestyle are still the mainstays of prevention, while rapid medical treatment is essential in minimizing harm as well as improving prognosis (Franklin *et al*., 2011).

CONCLUSION

Public health initiatives and education are crucial to promoting heart health and lowering the rising incidence of cardiovascular disease globally. In order to properly manage heart attacks, the review study "Heart Matters: Understanding Heart Attacks" highlights the significance of early detection, prevention, and education. The study also highlights the potential risk reduction benefits of adopting healthy lifestyle choices, such as eating a balanced diet, exercising regularly and managing stress. More research and education are required to improve heart attack prevention, diagnosis, and treatment methods.

Conflict of interest

The author(s) declare that there is no conflict of interest regarding the publication of this manuscript.

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