



Myocardial Infarction and the Prevention Strategies Keeping it at Bay: A Narrative Review

Ali Abdin

Limassol General Hospital, Department of Cardiology, University of Nicosia, Limassol, Cyprus
Email: abdin.ali@live.unic.ac.cy

How to cite this paper: Abdin, A. (2024) Myocardial Infarction and the Prevention Strategies Keeping it at Bay: A Narrative Review. *Open Access Library Journal*, 11: e12244.

<https://doi.org/10.4236/oalib.1112244>

Received: September 4, 2024

Accepted: October 7, 2024

Published: October 10, 2024

Copyright © 2024 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Myocardial infarction is the most common form of cardiovascular disease worldwide, claiming over 9 million lives per year. As such, understanding the pathophysiology, epidemiology, signs, diagnostic methods, management, and prevention strategies of the disease is vital for the modern day physician and patient in the hopes of reducing its detrimental impact on society. Myocardial infarction is the result of a set of complex and multifactorial components which play a role into the pathogenesis of the disease. The commonest manifestation of myocardial infarction presents as atherosclerotic coronary artery disease, which is becoming more prevalent in today's communities. For this reason, prevention of myocardial infarction must be stressed, especially in a world with changing demographics and dynamic transformations in the lifestyles of individuals. The current review outlines the pathophysiological, epidemiological, and diagnostic components of myocardial infarction a), highlights the management and prevention of the disease b), introduces challenges faced in the prevention of the disease c) and emphasizes the need for addressing these challenges with the aid of both, social and medical sectors of society d). These challenges involve the efficient integration of cardiac rehabilitation in patients with myocardial infarction (d1), the empowerment of individuals and patients to take the initiative in making radical and healthy lifestyle changes (d2) and understanding the unique risk profile of young adults with the hopes of integrating efficient primary preventive measures (d3).

Subject Areas

Cardiology

Keywords

Myocardial Infarction, Cardiovascular Disease, Prevention, Challenges, Review

1. Introduction

Myocardial infarction is the leading cause of death from non-communicable diseases [1]. It affects an estimated 1.7% of the world's population, or 126 million people annually [2]. In spite of advancements in healthcare, 9 million deaths were caused by MI in 2020 alone, thus emphasis on MI cannot be overstated [3].

The fourth universal definition of myocardial infarction (UDMI) set in 2018 and established by the World Health Organization, the European Society of Cardiology, the American Heart Association and American College of Cardiology is the latest definition of myocardial infarction (MI). The clinical criteria set by the UDMI states that MI is defined by "the presence of acute myocardial injury detected by abnormal cardiac markers in the setting of evidence of acute myocardial ischemia" [4].

There exist many different mechanisms that lead to the damage of myocardial tissue, however, such mechanisms could be categorized into two causes, damage as a result of coronary artery occlusion, which is manifested as an S-T segment elevation myocardial infarction (STEMI) or as a non S-T segment elevation myocardial infarction (NSTEMI) [5]. The second category is damage without coronary artery occlusion as a result of an underlying pathology, these are myocardial infarctions with non-obstructive coronary arteries (MINOCA's) [6]. Diagnosis of MI relies on the 12-lead ECG, blood tests and imaging of coronary arteries techniques [7]. Management of the disease involves the utilization of various pharmaceutical therapies and revascularization procedures [8].

Myocardial infarction prevention strategies are the bastions defending the population from the unwelcome enemy that is MI. They rely heavily on the collaboration of patients with their respective medical providers, integration of medical knowledge into the public, and the utilization and involvement of prevention programs by not just patients but also the medical sector. This is true since MI prevention strategies involve the active involvement of both, the public in adopting healthy lifestyle choices and adhering to medical therapies and the medical sector in treating, managing, providing to the public and adapting to the dynamics of the public [9].

Prevention of MI is undoubtedly beneficial to society in two major regards, the first being decreasing the incidence of MI among the public and thus decreasing the mortality of individuals in societies, and the second being it is cost-effective to both, patients, and countries [10]. As such, the prevention of MI must be emphasized not only to patients who already suffer from MI, but to healthy members of society who may potentially suffer from MI, and to medical societies that hold a sway in the course of this disease. This report, therefore, attempts to provide a basic understanding to medical professionals and the general public on the characteristics and management of MI and the prevention strategies involved with MI as well as the challenges faced in implementing said prevention strategies.

2. Methods

This narrative literature review primarily utilized original clinical studies and

original research articles as the main sources of information in the aim of acquiring, referring, and reviewing the latest and the most reliable information available regarding myocardial infarctions. Each resource was thoroughly investigated to ascertain its relevance to this narrative literature review's topic.

The search strategy entailed the use of medical and scientific search engines and databases. These databases primarily included PubMed, ClinicalTrials, AHAJournals, EBESCO, ESC, and GoogleScholar. The keywords inputted into search engines included, "myocardial infarction", "prevention", "management", "epidemiology", "signs", "evaluation", "pathophysiology", with the use of Boolean operators therefore, "myocardial infarctions" AND "prevention" or "myocardial infarction" AND "epidemiology" and so on. Resources only in the English language that were no older than 9 years were investigated and utilized in this narrative review (2015 – current).

3. Pathophysiology

3.1. Pathogenesis

Myocardial infarction, within the clinical setting, is usually caused by thrombotic occlusion of a coronary artery due to a rupture of an unstable atherosclerotic plaque. This phenomenon is known as coronary heart disease or coronary artery disease and is a form of acute coronary syndrome. This occlusion leads to a lack of oxygen perfusion to myocardial cells, followed by their death and the release of cardiac troponin into the bloodstream within an acute setting [11]. Myocardial cells require a constant supply of oxygen for the synthesis of energy in order to contract. A lack of oxygen leads to an acute phase of anaerobic-dependent ATP synthesis and, thus, depletion of stored energy, which will ultimately lead to cardiac cell starvation and death. The consequences of such are experienced immediately in one form or another as cardiac output is reduced, and the development of cardiac arrhythmias occurs due to the loss of the harmonic and rhythmic contraction of myocardial cells [12].

The extent of the infarction depends upon the size of the infarction, the duration and intermittency of coronary occlusion and the magnitude of residual collateral blood flow. Human cardiac cells do not retain regenerative abilities, therefore scar tissue replaces the dead cardiac cells through the activation of inflammatory mechanisms. The Q-wave in post-MI patients is a testimony to this permanent structural change in myocardial cells [13].

The imbalance between oxygen demand and supply in cardiac cells does not always need to be triggered by thrombotic occlusion of a coronary artery. Acute myocardial injury in the setting of acute myocardial ischemia may occur due to reduced oxygen perfusion, an increased oxygen demand or due to other heart conditions which affect myocardial cells. Such pathologies may include coronary artery spasms, hypotension with shock, respiratory failure, severe anemia, severe hypertension, myocarditis, Takotsubo syndrome, sepsis, and chronic kidney disease [4].

3.2. A Point of Interest

A study in spiny mice (*Acomys cahirinus*) confirmed that spiny mice are protected from ischemia-induced cardiac damage and dysfunction due to their cardiac preservative abilities as a result of a distinct phenotype playing a role in angiogenic responses. This could open an array of possibilities as further investigations and studies could be conducted to help identify the molecular and genetic components involved in the preservation of cardiac cells with the hope of translating such genes to humans through genetic modification technology [14].

4. Epidemiology

Coronary heart disease (CHD) is the leading cause of myocardial infarction in the world and is the leading cause of death by cardiovascular diseases worldwide [15]. According to the World Health Organization, cardiovascular diseases are the leading cause of death in the world, representing 32% (17.9 million) of all global causes of death in 2019 [16]. Of these deaths, 85% were attributed to heart attacks and strokes. Of the 17 million deaths caused by non-communicable diseases in 2019, 38% of them were caused by cardiovascular diseases [1].

On a global scale, CHD affects 126 million individuals (1.7% of the world's population or 1655 per 100,000). 9 million deaths in 2020 were attributed to CHD, with prevalence higher among men than women. Incidence of CHD is typically presented in the fourth decade of life. The prevalence of CHD is expected to rise to 1845 per 100,000 by 2030. Eastern European countries are reported to have the highest prevalence of CHD [17]. An estimated 5% - 20% of survivors of MI die within the first year [2].

The Centers of Disease Control and Prevention reported that 18.2 million adults suffer from CHD alone, with a MI incidence of 805,000 among Americans. 2 in 10 deaths from CHD in the US occur in adults younger than 65 years of age. Nearly 1 in 5 of all MI's in the US are also silent MI's [18].

According to the British Heart Foundation, 100,000 yearly hospital admissions in the United Kingdom are specifically due to MI. Since the 1960s, 7 in 10 of MI cases were fatal whereas today, at least 7 of 10 people survive MI's, leaving an estimate of 1.4 million people alive in the UK who have survived an MI at least once [3]. This survival rate generally applies to today's Western communities.

5. Disease Presentation

5.1. Symptoms

Typical symptoms of MI include diffuse chest pain, diaphoresis with bilateral arm radiating pain, cold-sweats, weakness, fatigue, dyspnea, and syncope. Other symptoms may include vertigo, anxiety, cough, a choking sensation, wheezing, vomiting, palpitations, and the sensation of an irregular heart rate [19]. If present, pain is usually deep, retrosternal, heavy, aching and diffused rather than localized to one specific region of the body, which is not altered by positional movement and does not necessarily occur during exertion [20]. Such symptoms may last from

minutes to hours, depending on the degree of myocardial ischemia and the extent of myocardial damage sustained.

5.2. Clinical Symptoms

The clinical signs between patients may vary. Clinical findings may include an increased respiratory rate, pallor, cold extremities, reduced cognition, elevated or decreased blood pressure, a low-grade fever, and an irregular pulse. Additional heart murmurs and arrhythmias may be reported upon auscultation. Atypical signs may include bradycardia, hypotension, raised jugular venous pressure and oedema [21].

6. Diagnosis

6.1. Patient History

Attaining a patient history of the aforementioned typical symptoms is key in beginning the diagnosis of a MI as most evaluations of MI begin with the patient reporting chest pain. A past medical history of drug abuse, heart diseases, irregular blood pressure, high cholesterol, autoimmunity, medical operations may also be considered [22].

6.2. Protocol in the Case of MI with Coronary Artery Occlusion

The typical evaluation of a patient with myocardial infarction (MI) follows a widely universal protocol, usually beginning with the patient reporting chest pain followed by an immediate ECG reading, a blood test and angiography [5]. Although up to a third of patients with myocardial infarction may not experience chest pain, within the clinical setting of MI, it is primarily the chest pain that elicits the patient to seek medical aid. Likewise, most patients with chest pain have not suffered a myocardial infarction [5]. In the instance where a patient does not report chest pain, yet the clinician is under the suspicion that a patient may have experienced a myocardial infarction, an electrocardiogram (ECG) reading of the patient's heart must be promptly commenced in order to exclude or confirm an S-T elevation myocardial infarction (STEMI). In the case that an ECG reading does not confirm a STEMI, cardiac troponins are tested for in order to confirm cardiac damage. An immediate coronary angiography is employed for the identification of the coronary artery affected in the case of a STEMI, while a delayed angiography procedure is undertaken (24h-48h) in the case of a NSTEMI free of complications [7].

6.3. Electrocardiogram

An ECG reading must be acquired within 10 minutes upon the arrival of a patient to the hospital or promptly after the physician suspects MI. The 12-lead ECG is the gold standard for spotting an S-T segment elevation. The S-T elevation should be greater than 5 mm in men younger than 40 years or greater than 2 mm in men older than 40 years of age, and 1.5 mm in women in leads V2-V3. Alternatively, a

STEMI diagnosis may also be made if the ST-segment elevation is greater than 1 mm in all other leads. An S-T segment depression of 5 mm in 2 contiguous leads or/and a T-wave inversion greater than 1 mm in two contiguous leads with prominent R-waves or an R:S ratio greater than 1 could be an early indicator of an acute MI, which could eventually lead to the S-T segment elevation expected in a STEMI [20]. Identification of an S-T segment depression will aid in the exclusion of left ventricular aneurysms and other non-cardiac causes of myocardial injury [23]. In the case of uncertainty, serial tracings over several hours are obtained to confirm the stabilization of the S-T segment elevation, or the development of a chronic Q-wave as expected after a MI [7].

6.4. Biomarkers

Biomarkers are detected in the blood. The major biomarkers tested for in the case of myocardial infarction are troponins which are released upon myocardial injury. Cardiac Troponin I and Cardiac Troponin T (cTnI and cTnT respectively) are the established biomarkers tested for upon suspicion of a MI where ECG findings could not confirm a STEMI [24]. These biomarkers must be above the 99th percentile upper reference limit. Although creatine kinase and its MB isoenzyme (CK-MB) and myoglobin may also be tested for, research has shown that cardiac troponins I and T are much more specific and sensitive, which is especially critical in the case of diagnosing asymptomatic cases [25]. The intervals of serial sampling of cTn depends on the sensitivity of the cTn assays used. With contemporary highly sensitive cTn assays, the interval could be reduced from 12 hours to 3 hours till onset of symptoms, which is commonly utilized in the emergency department [26].

6.5. Protocol in the Case of MI without Coronary Artery Occlusion

Up to 6% of patients who have suffered a MI have not experienced coronary artery occlusion thus the traditional classification of MI into coronary artery occlusion-caused STEMI's and NSTEMI's becomes obsolete to clinicians in such instances. However, based on certain imaging modalities and a systemic approach to the evaluation of patients by clinicians as per the AHA guidelines for cases of myocardial infarction with non-obstructive coronary arteries (MINOCA), such an issue may be tackled. **Figure 1** provides an algorithmic overview of evaluating MINOCA's within the clinical setting. AHA MINOCA guidelines rely heavily on coronary vascular imaging techniques, contrast cardiac MRI, and coronary functional assessments in order to exclude coronary artery occlusion as the cause of MI. Although cases of MINOCA are not as common as its counterpart (involving coronary artery occlusion), it remains a vital consideration clinicians must calculate when evaluating patients with MI [6].

7. Disease Management

7.1. Early Management of STEMI's

Initial drug therapy entails the immediate administration of a single-loading dose

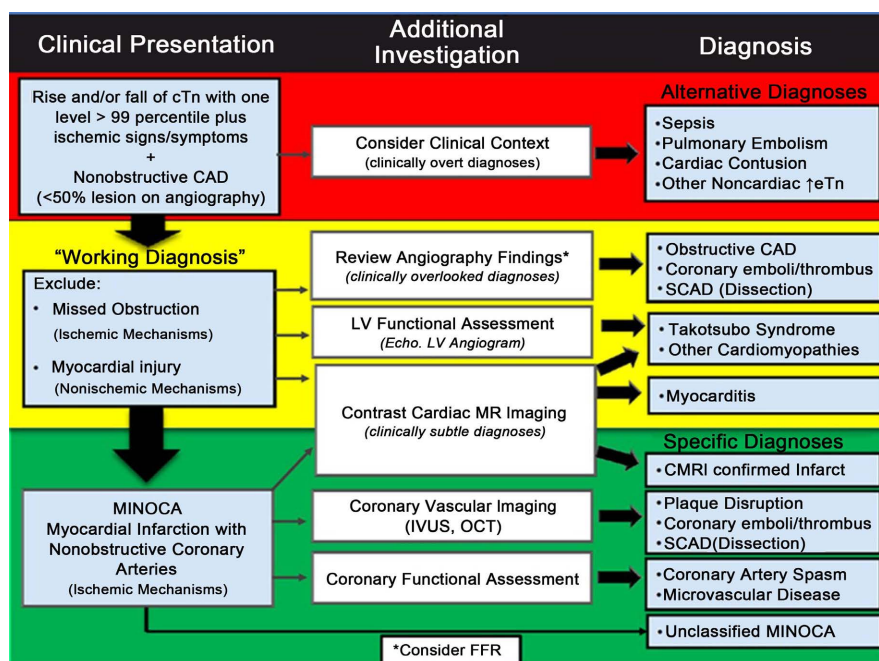


Figure 1. Visual Summary: A clinical approach to the diagnosis of MINOCA as per AHA guidelines. Abbreviations: CAD: coronary artery disease, CMRI: cardiac magnetic resonance imaging, cTn: cardiac troponin, FFR: fractional flow reserve, IVUS: intravascular ultrasound, LV: left ventricular, MR: magnetic resonance, OCT: optical coherence tomography, SCAD: spontaneous coronary artery dissection [6].

of 300 mg of aspirin. NICE guidelines recommend percutaneous coronary intervention (PCI) (revascularization) therapy to be performed upon eligible patients as quickly as possible after their admission into the hospital. For patients that do not undergo PCI, Ticagrelor is offered along with Aspirin and Clopidogrel may be considered as an alternative if the patient is at high risk of bleeding. In the case of PCI, dual antiplatelet therapy should be administered to the patient, consisting of Prasugrel and Clopidogrel (or an alternative if at risk of bleeding) along with antithrombin therapy (unfractionated Heparin) and Bivalirudin if femoral access for PCI is indicated. Thrombus extraction and stenting may be considered [8].

Figure 2 shows an overview of the NICE STEMI early management guidelines.

7.2. Conservative Treatment versus Invasive Revascularization

Aggressive and invasive revascularization therapy has shown to be more effective in long-term survivorship of patients with MI, especially those complicated with cardiogenic shock, as opposed to conservative treatment with drugs [27]. This is also true in the case of patients with ischemic heart disease [28], heart failure and coronary artery disease [29]. A 31% risk reduction in cardiovascular death was found in patients who underwent complete revascularization as opposed to culprit-lesion-only revascularization [30]. Although few studies have shown that survivorship in the case of invasive revascularization is no different to that of conservative treatment, the general medical consensus points towards invasive revascularization as the more effective treatment for eligible patients.

7.3. Early Management of NSTEMI's

Initial drug therapy includes the administration of a single-loading dose of 300 mg of aspirin and Fondaparinux (an antithrombin). Risk of the patient's 6-month mortality is assessed via the GRACE risk scoring system. In the case the patient is high risk, immediate angiography is performed, unfractionated Heparin is administered in the case of PCI, Prasugrel or Ticagrelor is administered with Clopidogrel. Stenting may be indicated. In the case the patient is low risk, administration of Ticagrelor with Aspirin is indicated, or Aspirin alone if patient is at risk of bleeding [8]. **Figure 3** shows an overview of the NICE NSTEMI early management guidelines.

7.4. Management of MINOCA's

Management of MINOCA's varies depending on the underlying pathology. ACE inhibitors, ARBs and statins have been shown to reduce mortality in MINOCA patients. A benefit in B-blockers has also been witnessed [31]. For MINOCA patients with plaque rupture (2 thirds of MINOCA patients), the use of dual antiplatelet therapy is recommended for 1 year, followed by single antiplatelet therapy for life [32].

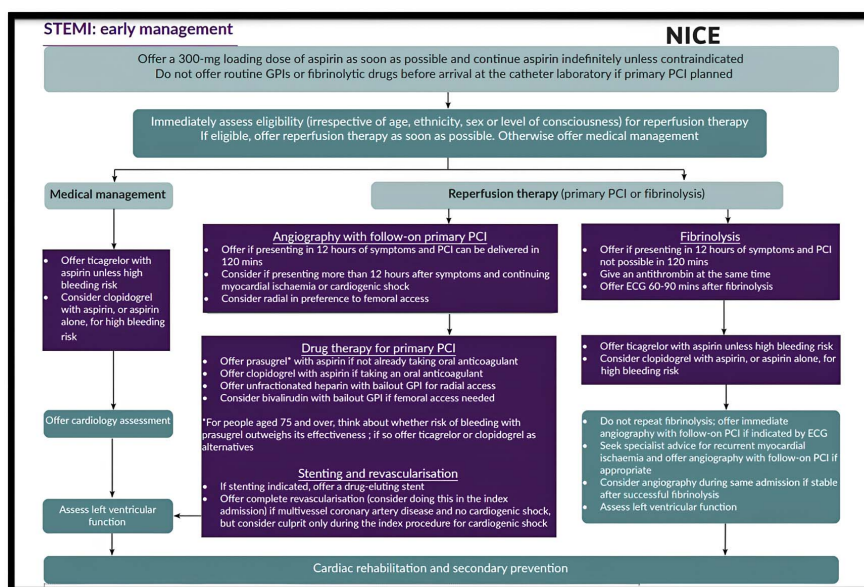


Figure 2. Visual Summary: A clinical approach to the early management of STEMI as per NICE (NG185) guidelines. Abbreviations: PCI: percutaneous coronary intervention, ECG: electrocardiogram, GPI: Glycoprotein inhibitors [8].

8. Prevention

Prevention of myocardial infarctions and cardiovascular diseases is split into three categories: primary, secondary, and tertiary prevention. Primary prevention entails the employment of strategies that help in preventing the onset of the disease, while secondary prevention strategies include the early diagnosis of the

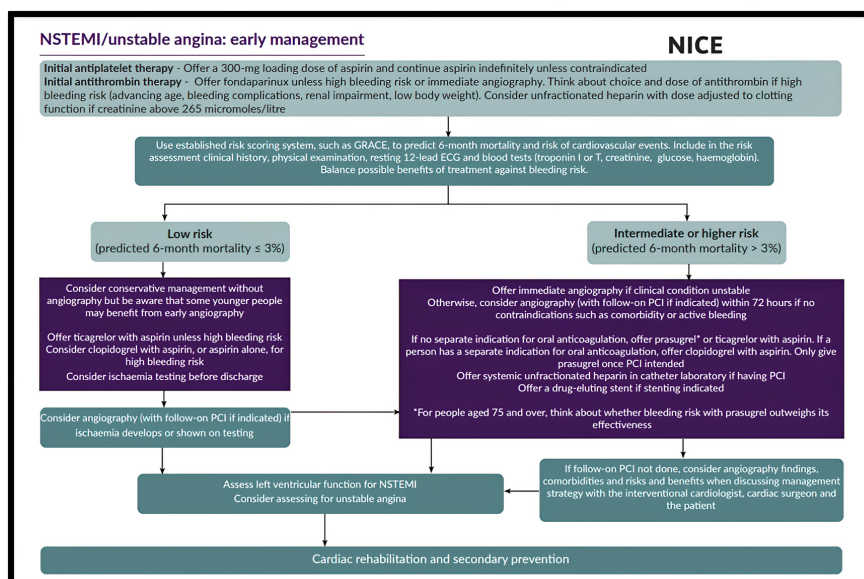


Figure 3. Visual Summary: A clinical approach to the early management of NSTEMI as per NICE (NG185) guidelines. Abbreviations: PCI: percutaneous coronary intervention. [8]

disease prior to the occurrence of serious and permanent damage with the aim of reducing its potentially detrimental impact on the patient's health. Tertiary prevention strategies include those that help *manage* the progression of the disease to reduce mortality and the improve quality of life [33].

8.1. Primary Prevention Strategies

Based on the 2019 AHA guidelines on the primary prevention of cardiovascular disease (CVD), primary prevention should focus on two aspects, firstly, the evaluation and counselling of patients who are at high risk of CVD, and secondly, the adoption of healthy life-style choices by patients. Atherosclerotic cardiovascular disease (ASCVD) risk estimations should be calculated for patients over the age of 40 who are under evaluation for CVD prevention before the commencement of pharmacological therapy.

The daily use of 75 - 100 mg of Aspirin is recommended unless the patient is at risk of bleeding (Clopidogrel as an alternative). Individuals are encouraged to consume a plant-based Mediterranean diet and minimize on the consumption of trans-fat, red meat, processed meat, refined carbohydrates, and sweetened beverages, and as such, obese patients are encouraged to engage in counselling in the aim of achieving healthy weight loss. Individuals are also encouraged to engage in 150 minutes of moderate intensity exercise or 75 minutes of vigorous-intensity exercise weekly—this is especially emphasized in diabetic type 2 patients. Assistance to smokers should be provided and tobacco use must be discouraged. Statin therapy should be considered as the first line of defense in preventing ASCVD in patients with LDL $>$ 190 mg/dL, with diabetes mellitus, between the ages of 40 - 75 and considered at risk of ASCVD [9].

ASCVD risk estimator is a tool created by AHA, intended for assessing the risk of ASCVD in patients with LDL-C levels under 190 mg/dL, without ASCVD and not on LDL-C lowering therapy. This calculator inputs the sex, age, race, cholesterol levels, blood pressure levels, and patient medical history into account in order to calculate the ASCVD risk and provides the patient with recommended advice [34].

8.2. Secondary & Tertiary Prevention Strategies

Secondary and tertiary prevention strategies involve the utilization of the same life-style changes as in primary prevention. Secondary prevention strategies, however, employ the use of ACE inhibitors, dual antiplatelet therapy, beta-blockers, with statins. Additionally, cardiac rehabilitation is recommended to patients, which is adapted based on their clinical condition, life-style, levels of stress and knowledge of health [8]. Refer to **Figure 4** for an overview of secondary prevention methods as per NICE guidelines. Furthermore, AHA recommends the administration of the influenza vaccine to prevent myocarditis, and screening for cardiovascular diseases in depressed patients [35]. Tertiary prevention strategies involve aggressive approaches to the *management* of the patient with the primary aim of preventing the occurrence of life-threatening MI. Such strategies include revascularization procedures and treatment of the underlying pathology [36].

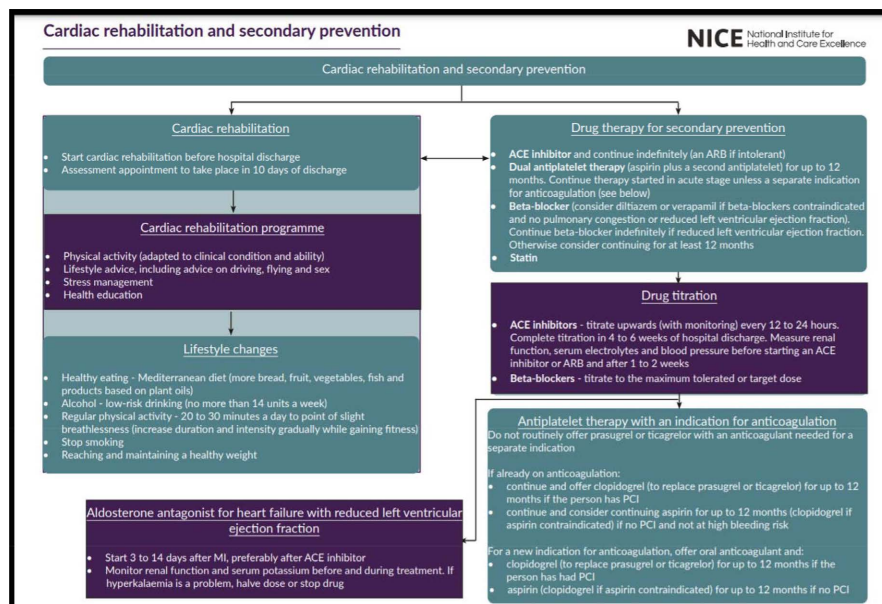


Figure 4. Visual Summary: An overview of secondary prevention strategies of NSTEMI's & STEMI's as per NICE (NG185) guidelines. Abbreviations: ACE: angiotensin converting enzyme, PCI: percutaneous coronary intervention [8].

9. Challenges Faced in Prevention

9.1. Patient Initiative in Prevention

Adoption of healthy lifestyle habits, recognition of MI symptoms, adherence to

medication and seeking out medical aid are all key factors involved in the prevention of MI. All these factors, however, heavily depend on the patient taking the initiative [10].

In spite of the vast plethora of research information proving the harmful effects of certain behaviors such as smoking, physical inactivity, alcohol abuse and an unhealthy diet have on the health of the patient's cardiovascular system, individuals in societies engage in such risky behavior regardless. Such an example of this was made clearer by the cross-sectional survey, EUROASPIRE, that was serially conducted in eight individual European countries on patients with ischemic heart disease who suffered MI. The survey established that 48.6% of patients who were smoking at the time of their MI, persisted smoking, a third of the patients were obese, reporting no to little engagement in physical activity and suffered from hypertension with high levels of LDL (>1.8 mmol/L) [10]. In another study that investigated the variations among patients in awareness of myocardial symptoms in the US, males of a low socioeconomic background were of the most likely not to seek out medical aid during a MI due to their lack of awareness of the symptoms of MI [37].

Such studies may point towards the need for public health interventions using mass-media public awareness campaigns with the aim of educating individuals of not only the symptoms of MI, but also of the prevention strategies involved in lifestyle changes people could make in order to prevent the occurrence of the disease. Such mass-media campaign awareness programs in Australia proved be successful as they substantially reduced the incidence of MI [38].

The lack of patient adherence to medication is an issue not only in regard to increased healthcare costs in the long-run, but to patient mortality as well. Such an issue is heavily influenced by socioeconomic factors, which in turn play a role in the perception of the disease by the public, and thus patient's willingness to seek out medical aid and advice. To tackle such an issue, physicians must focus on reaching out to their patients with regular consultations, with the aim of understanding the patient's wishes and establishing the patient's understanding of the condition. This could be established by formulating plans and good rapport with the patient [10].

9.2. Cardiac Rehabilitation in Prevention

Patient risk stratification, availability of healthcare services and referral to structured prevention programs are vital aspects of MI prevention, especially in secondary prevention, that require more attention [10]. Low participation in cardiac rehabilitation programs is an issue in this regard.

Cardiac rehabilitation has been proven to be very effective however immensely underutilized as only 20% of eligible patients in the US enroll into it, and 6.5% remain to complete the entirety of the program. Enrolment of females and individuals of low socioeconomic background is also limited [39]. The same is true for the UK and European countries, as only 15% of patients in the UK with heart

failure are referred to for cardiac rehabilitation [40] and 51% of patients across Europe, according to the EUROASPIRE 4 database [41].

To address such an issue, cardiac rehabilitation must be made more available to individuals, especially of those of low socioeconomic status and females by reducing its cost or providing it as a free service entirely that can be acquired irrespective of physical location (*i.e.* online) and furthermore, referral to the program by physicians must increase and also be encouraged to patients who are deemed at high risk of MI. This could be made more possible by auditing patients online and referring them through more tools, such as the AHA ASCVD risk estimator as patients may be more willing to access online web pages rather than attend regular check-ups with their physician within the course of a referral [10].

9.3. Primary Prevention Targeted towards Young Adults

Cardiovascular diseases, most commonly MI due to plaque rupture, among young adults is on the rise due to their dynamic and unstudied risk profile [42]. Economic, social, and technological distinctions in the younger generation make it difficult to apply research information from previous cohort studies onto them. As such, further population-wide health interventions must be conducted in order to assess the risk factors among young adults, the efficacy of new individual behavioral interventions that could help reduce said risk factors and the implementation of such studies on a wide scale through clinical trials and cohort studies in the hope of rooting out the primordial causes of heart disease from an early phase [43]. **Figure 5** provides an overview by AHA of potential risk factor interventions on young adults for the primary prevention of cardiovascular diseases that involve the active participation of socioenvironmental, pharmacologic, and behavioral sectors of society [44].

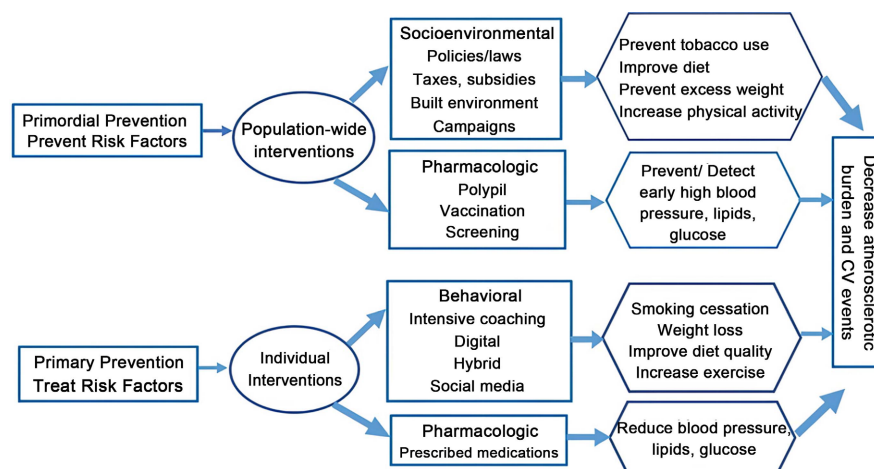


Figure 5. Visual Summary: An overview of primary prevention strategies of cardiovascular diseases in young adults. Primordial prevention involves strategies taken that help minimize the incidence of risk factors. Primary prevention involves strategies taken to help reduce the incidence of the disease [44].

10. Conclusions

The complexities surrounding myocardial infarction highlight the multifaceted nature of the disease, which continues to be a leading cause of mortality worldwide despite advancements in medical interventions. While this review has outlined the current understanding of MI pathophysiology, diagnosis, management, and prevention strategies, it is clear that gaps remain, particularly in the implementation of effective prevention programs.

Future clinical research should prioritize the following areas to mitigate the global burden of MI:

- ✓ *Personalized Prevention Strategies:* Given the changing demographics and risk profiles, particularly among younger populations, there is a critical need for research into personalized prevention strategies. Future studies should explore how genetic, environmental, and lifestyle factors interact to increase MI risk, enabling the development of tailored prevention programs that address the unique needs of diverse populations.
- ✓ *Integration of Emerging Technologies:* Advancements in wearable technology, artificial intelligence, and telemedicine offer promising avenues for enhancing MI prevention and management. Clinical trials should be conducted to evaluate the efficacy of these technologies in real-world settings, particularly their role in improving patient adherence to lifestyle modifications and medication regimes.
- ✓ *Long-term Efficacy of Cardiac Rehabilitation:* The underutilization of cardiac rehabilitation programs, despite their proven benefits, warrants further investigation. Research should focus on identifying barriers to participation and developing strategies to increase enrollment and completion rates, especially among women and socioeconomically disadvantaged groups.
- ✓ *Public Health Interventions:* Large-scale public health campaigns have shown success in reducing MI incidence. Future efforts should aim to refine these interventions by targeting specific high-risk populations and incorporating behavioral science insights to enhance their effectiveness. Additionally, the role of policy changes, such as taxation on unhealthy foods or subsidies for healthy lifestyle choices, should be explored.
- ✓ *Primary Prevention in Young Adults:* The rising incidence of MI in young adults underscores the need for early intervention. Future research should focus on identifying early biomarkers and developing prevention strategies that can be implemented in childhood or adolescence, potentially altering the disease trajectory before it begins.

By addressing these research gaps, we can develop more effective prevention strategies that not only reduce the incidence of MI but also improve overall cardiovascular health outcomes on a global scale.

Conflicts of Interest

The author declares that they have no known competing financial or personal interests that could influence the contents of this paper.

References

- [1] WHO (2021) Cardiovascular Diseases (CVDs). [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
- [2] Ye, Q., Zhang, J. and Ma, L. (2020) Predictors of All-Cause 1-Year Mortality in Myocardial Infarction Patients. *Medicine*, **99**, e21288. <https://doi.org/10.1097/md.00000000000021288>
- [3] Foundation, B.H. (2021) UK Factsheet. British Heart Foundation.
- [4] Thygesen, K., Alpert, J.S., Jaffe, A.S., Chaitman, B.R., Bax, J.J., Morrow, D.A., *et al.* (2018) Fourth Universal Definition of Myocardial Infarction. *Journal of the American College of Cardiology*, **72**, 2231-2264. <https://doi.org/10.1016/j.jacc.2018.08.1038>
- [5] Barstow, C., Rice, M. and McDivitt, J. (2017) Acute Coronary Syndrome: Diagnostic Evaluation. *AFP Journal*, **95**, 170-177.
- [6] Tamis-Holland, J.E., Jneid, H., Reynolds, H.R., Agewall, S., Brilakis, E.S., Brown, T.M., *et al.* (2019) Contemporary Diagnosis and Management of Patients with Myocardial Infarction in the Absence of Obstructive Coronary Artery Disease: A Scientific Statement from the American Heart Association. *Circulation*, **139**, e891-e908. <https://doi.org/10.1161/cir.0000000000000670>
- [7] Sweis, R. and Jivan, A. (2020) Acute Myocardial Infarction. MSD Manual Professional Version.
- [8] NICE (2020) Acute Coronary Syndromes. <https://www.nice.org.uk/guidance/ng185>
- [9] Arnett, D., Blumenthal, R. and Albert, M. (2019) 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*, **140**, 596-646.
- [10] Piepoli, M.F., Corrà, U., Dendale, P., Frederix, I., Prescott, E., Schmid, J.P., *et al.* (2016) Challenges in Secondary Prevention after Acute Myocardial Infarction: A Call for Action. *European Journal of Preventive Cardiology*, **23**, 1994-2006. <https://doi.org/10.1177/2047487316663873>
- [11] Nikolaos, N.F. (2015) Pathophysiology of Myocardial Infarction. Albert Einstein College of Medicine.
- [12] Daniele, G.C. (2017) The Pathophysiology of Myocardial Infarction-Induced Heart Failure. Universidade da Força Aérea.
- [13] Heusch, G. and Gersh, B. (2017) The Pathophysiology of Acute Myocardial Infarction and Strategies of Protection Beyond Reperfusion: A Continual Challenge. *European Heart Journal*, **38**, 774-784.
- [14] Peng, H., Shindo, K., Donahue, R., *et al.* (2021) Adult Spiny Mice (*Acomys*) Exhibit Endogenous Cardiac Recovery in Response to Myocardial Infarction. University of Kentucky.
- [15] AHA (2021) Heart Disease and Stroke Statistics Update Fact Sheet.
- [16] Sushritha, K., Sharma, A., Suman, K., Harish Goud, P. and Akari, S. (2020) Epidemiological Study of Risk Factors in Myocardial Infarction Patients. *Journal of Young Pharmacists*, **12**, s108-s112. <https://doi.org/10.5530/jyp.2020.12s.57>
- [17] Khan, M.A., Hashim, M.J., Mustafa, H., Baniyas, M.Y., Al Suwaidi, S.K.B.M., AlKatheeri, R., *et al.* (2020) Global Epidemiology of Ischemic Heart Disease: Results from the Global Burden of Disease Study. *Cureus*, **12**, e9349. <https://doi.org/10.7759/cureus.9349>

- [18] Centers of Disease Control and Prevention (2020) Heart Disease Facts. <https://www.cdc.gov/heartdisease/facts.htm>
- [19] Per, A., Lawesson, S.S. and Karlsson, J.E. (2018) Characteristics of Patients with Acute Myocardial Infarction Contacting Primary Healthcare before Hospitalisation: A Cross-Sectional Study. BMC Family Practice—Research Article, Östergötland.
- [20] Ojha, N. and Dhamoon, A. (2021) Myocardial Infarction. StatPearls.
- [21] Salimi, M., Hochkirchen, B. and Nawid, S. (2021) Myocardial Infarction. <https://next.amboss.com/us/article/wS0hbf#saatNQ>
- [22] Newson, L. and Gronow, H. (2016) Cardiovascular History and Examination. <https://patient.info/doctor/cardiovascular-history-and-examination>
- [23] Tcheng, J., Ong, P. and Watson, T. (2018) Prehospital Diagnosis and Management of Acute Myocardial Infarction. In: Watson, T.J., Ong, P.J.L. and Tcheng, J.E., Eds., *Primary Angioplasty: A Practical Guide*, Springer, 15-29.
- [24] Sabesan, M. (2015) Diagnostic Markers of Acute Myocardial Infarction. Sri Ramachandra University.
- [25] Wang, X.-Y., Zhang, F., Zhang, C. and Zheng, L.R. (2019) The Biomarkers for Acute Myocardial Infarction and Heart Failure.
- [26] Montecucco, F., Carbone, F. and Schindler, T.H. (2015) Pathophysiology of ST-Segment Elevation Myocardial Infarction: Novel Mechanisms and Treatments. *European Heart Journal*, **37**, 1268-1283. <https://doi.org/10.1093/eurheartj/ehv592>
- [27] Bangalore, S., Gupta, N., Guo, Y., Lala, A., Balsam, L., Roswell, R.O., *et al.* (2015) Outcomes with Invasive vs Conservative Management of Cardiogenic Shock Complicating Acute Myocardial Infarction. *The American Journal of Medicine*, **128**, 601-608. <https://doi.org/10.1016/j.amjmed.2014.12.009>
- [28] Baine, K.R., Alemayehu, W., Welsh, R.C., Kumar, A., King, S.B. and Kirtane, A.J. (2021) Long-Term Clinical Outcomes Following Revascularization in High-Risk Coronary Anatomy Patients with Stable Ischemic Heart Disease. *Journal of the American Heart Association*, **10**, Article 18104. <https://doi.org/10.1161/jaha.120.018104>
- [29] Wolff, G., Dimitroulis, D., Andreotti, F., Kołodziejczak, M., Jung, C., Scicchitano, P., *et al.* (2017) Survival Benefits of Invasive versus Conservative Strategies in Heart Failure in Patients with Reduced Ejection Fraction and Coronary Artery Disease. *Circulation: Heart Failure*, **10**, Article 3255. <https://doi.org/10.1161/circheartfailure.116.003255>
- [30] Baine, K.R., Engström, T., Smits, P.C., Gershlick, A.H., James, S.K., Storey, R.F., *et al.* (2020) Complete vs Culprit-Lesion-Only Revascularization for ST-Segment Elevation Myocardial Infarction. *JAMA Cardiology*, **5**, Article 881. <https://doi.org/10.1001/jamacardio.2020.1251>
- [31] Sykes, R., Doherty, D., Mangion, K., Morrow, A. and Berry, C. (2021) What an Interventionalist Needs to Know about MI with Non-Obstructive Coronary Arteries. *Interventional Cardiology Review*, **16**, e10. <https://doi.org/10.15420/icr.2021.10>
- [32] Abdu, F.A., Mohammed, A., Liu, L., Xu, Y. and Che, W. (2020) Myocardial Infarction with Nonobstructive Coronary Arteries (MINOCA): A Review of the Current Position. *Cardiology*, **145**, 543-552. <https://doi.org/10.1159/000509100>
- [33] Karunathilake, S.P. and Ganegoda, G.U. (2018) Secondary Prevention of Cardiovascular Diseases and Application of Technology for Early Diagnosis. *BioMed Research International*, **2018**, 1-9. <https://doi.org/10.1155/2018/5767864>
- [34] AHA (2021) ASCVD Risk Estimator.

- https://tools.acc.org/ldl/ascvd_risk_estimator/index.html#!/calculate/estimator/
- [35] Arnett, D.K., Blumenthal, R.S. and Albert, M.A. (2019) 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*, **140**, e596-e646.
- [36] Karunathilake, S.P. and Ganegoda, G.U. (2018) Secondary Prevention of Cardiovascular Diseases and Application of Technology for Early Diagnosis. *BioMed Research International*, **2018**, 1-9. <https://doi.org/10.1155/2018/5767864>
- [37] Mahajan, S., Valero-Elizondo, J., Khera, R., Desai, N.R., Blankstein, R., Blaha, M.J., *et al.* (2019) Variation and Disparities in Awareness of Myocardial Infarction Symptoms among Adults in the United States. *JAMA Network Open*, **2**, e1917885. <https://doi.org/10.1001/jamanetworkopen.2019.17885>
- [38] Nehme, Z., Andrew, E., Bernard, S., Patsamanis, H., Cameron, P., Bray, J.E., *et al.* (2016) Impact of a Public Awareness Campaign on Out-of-Hospital Cardiac Arrest Incidence and Mortality Rates. *European Heart Journal*, **38**, ehw500. <https://doi.org/10.1093/eurheartj/ehw500>
- [39] Agency for Healthcare Research and Quality (2021) TAKEheart: AHRQ's Initiative to Increase Use of Cardiac Rehabilitation. <https://takeheart.ahrq.gov/case-cardiac-rehabilitation/challenge>
- [40] Foundation, B.H. (2019) Cardiac Rehabilitation: The Big Picture. <https://www.bhf.org.uk/for-professionals/healthcare-professionals/data-and-statistics/cardiac-rehabilitation-the-big-picture>
- [41] Hansen, D., Piepoli, M.F. and Doehner, W. (2018) The Importance of Rehabilitation in the Secondary Prevention of Cardiovascular Disease. *European Journal of Preventive Cardiology*, **26**, 273-276. <https://doi.org/10.1177/2047487318809459>
- [42] Gulati, R., Behfar, A., Narula, J., Kanwar, A., Lerman, A., Cooper, L., *et al.* (2020) Acute Myocardial Infarction in Young Individuals. *Mayo Clinic Proceedings*, **95**, 136-156. <https://doi.org/10.1016/j.mayocp.2019.05.001>
- [43] Shah, N., Kelly, A., Cox, N., Wong, C. and Soon, K. (2016) Myocardial Infarction in the "Young": Risk Factors, Presentation, Management and Prognosis. *Heart, Lung and Circulation*, **25**, 955-960. <https://doi.org/10.1016/j.hlc.2016.04.015>
- [44] Gooding, H.C., Gidding, S.S., Moran, A.E., Redmond, N., Allen, N.B., Bacha, F., *et al.* (2020) Challenges and Opportunities for the Prevention and Treatment of Cardiovascular Disease among Young Adults: Report from a National Heart, Lung, and Blood Institute Working Group. *Journal of the American Heart Association*, **9**, Article 16115. <https://doi.org/10.1161/jaha.120.016115>