



# Myocardial Infarction in Young Patients

---

## A Review Article

---

A Review Article Submitted in Partial Fulfillment of the Requirements  
for the Degree of Bachelor in Medicine at University of Diyala

**By**

Ali Hoobi Hussien

**Supervisor**

Dr. Asmaa Abbas Ajwad

Department of Physiology and Medical Physics

*2020-2021*

# **Acknowledgement**

I am extremely thankful to my supervisor, Dr. Asmaa Abbas Ajwad, for her guidance, constant supervision, helpful information, and support in completing this project.

I would like also to express my sincere thanks to the faculty of college of medicine at University of Diyala for what they taught me and their encouragement and support.

Last but not least, I would like to express my gratitude toward my father and mother for their endless support and encouragement that helped me to be here today.

## Table of Contents

Introduction .....	5
Risk Factors.....	7
Pathogenesis.....	8
1. Atheromatous CHD .....	8
2. Non-Atheromatous CHD.....	9
3. Hypercoagulable States .....	9
Clinical Presentation and Angiographic Findings .....	10
Management.....	11
Conclusions .....	12
Recommendations .....	12
References .....	13

## List of Figures

<b>Figure 1:</b> Incidence and prevalence of MI in young people. ....	7
---	---

## List of Tables

<b>Table 1:</b> Clinical Presentation of Young Patients with Myocardial Infarction .....	11
--	----

## **ABSTRACT OF the REVIEW ARTICLE**

### **Myocardial Infarction in Young People**

Coronary artery disease (CAD) is a leading cause of morbidity and mortality in both developing and developed countries. Myocardial infarction (MI) may be a minor event in a lifelong chronic disease, there is a possibility that it may even go undetected, but it may also be a major dangerous event leading to sudden death or severe hemodynamic deterioration. Myocardial infarction is considered as the lethal manifestation of coronary heart diseases and can present as sudden death. Its causes among patients with age less than 45 can be divided into three groups: (1) atheromatous coronary artery disease; (2) non-atheromatous coronary artery disease; (2) hyper-coagulable states. There is a considerable overlap between all the groups.

The impact of risk factors for acute myocardial infarction (AMI) strongly differs across populations and though age factor has a crucial effect on the incidence of MI, many studies that have been conducted on humans did not take it into their considerations. Although MI occurs in patients older than 45, young men or women can suffer MI. Fortunately, its incidence is not common in patients younger than 45 years. The protection offered by young age has been slowly taken away by the increased prevalence of risk factors for CHD in adolescents such as smoking, obesity, and lack of physical activity. Better prognosis among young adults can be achieved when the appropriate investigations and treatment are offered.

We organized this article into several sections to cover the most important aspects of MI occurrence in young people including the following: the motivation behind choosing this topic, MI prevalence, risk factors, pathogenesis, clinical presentation, and the possible ways of its management. The article has been ended up with the main conclusions that have been drawn from the work of several previous published studies.

## Introduction

It is well known that coronary heart disease (CHD) is the leading cause of death in the world. Though there is a large body of data available for CHD, literature focusing on premature CHD and myocardial infarction (MI) in the “young” is still insufficient and needs more investigation and work. The documented results showed that coronary heart disease primarily occurs in patients over the age of 40. Despite that, studies have shown that younger people of both genders (Men and women) can be affected too. In this article we are going to shed the light on Myocardial Infarction (MI) occurrence in young patients but first we will generally talk about different aspects related to MI. Myocardial Infarction is defined in pathology as myocardial cell death due to prolonged ischemia. After the onset myocardial ischemia, histological cell death is not immediate, but it takes a finite period of time to develop—as little as 20 min. It takes several hours before myocardial necrosis can be identified by macroscopic or microscopic post-mortem examination. Complete necrosis of myocardial cells at risk requires at least 2-4 h, or longer, depending on the presence of collateral circulation to the ischemic zone, persistent or intermittent coronary arterial occlusion, the sensitivity of the myocytes to ischemia, pre-conditioning, and individual demand for oxygen and nutrients . The entire process leading to a healed infarction usually takes at least 5-6 weeks. Reperfusion may alter the macroscopic and microscopic appearance [1,2]. It becomes clear that the prevalence of CHD is bound to rise in patients aged less than 45 in the years to come.

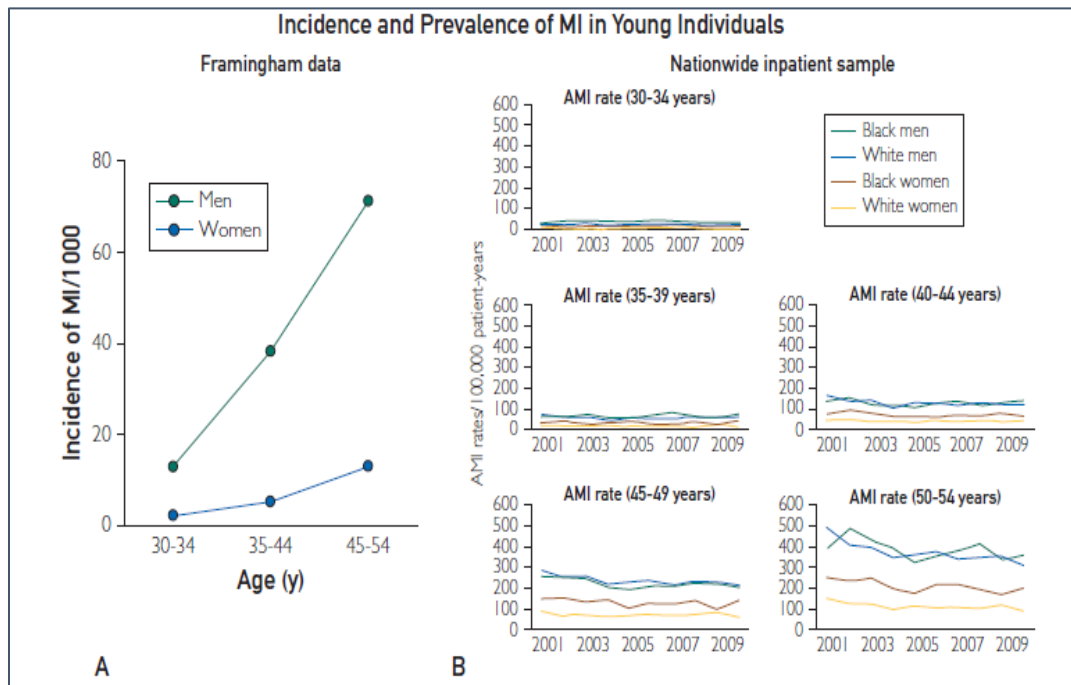
In this article, we went over the general description of MI term, its incidence, epidemiology, prognosis, pathogenesis, clinical presentation, and its treatment and management. We also showed the results of some previous studies that have been conducted on young MI patients with MI disease. We also discussed the differences and their causes between those studies.

## **Incidence and Prevalence in Young People**

The term “young” varies from 40 to 55 years of age [3,4]. Others have suggested 45 years as a cut-off when defining “young” with respect to MI [5,6]. There is a paucity of data on MI in the “young” relative to literature on CHD as a whole. Perhaps the most well-known of all epidemiological studies in cardiovascular medicine is the Framingham Heart Study which reported a 10-year incidence of “young” MI (defined as <55 years of age) as high as 51.1/1000 in men and 7.4/1000 in women [7]. In contrast, McManus et al. reported an incidence of 66/100,000 of MI among patients aged between 25 and 54 years [8]. While this may appear relatively low, McGill et al. demonstrated an unexpectedly high prevalence of CHD in men under the age of 35 years with 20% shown to have advanced coronary artery lesions at autopsy. Fournier et al. have reported higher rates of “young” MI with an incidence of approximately 4% in those aged 40 years. Meanwhile, Doughty et al. demonstrated >10% of all MI patients admitted at their institution were “young”, where they defined “young” as 45 years of age. One of the highest rates of MI in the “young” was reported by Loughnan et al. who examined admissions to hospitals in Melbourne, Australia over a six-year period and reported that 20% were younger than 55 years of age. This represented approximately 0.1% of the Melbourne population aged less than 55 years during the study period. In contrast approximately 1% of the Melbourne population older than this age experienced MI over the same period [9].

The incidence of CHD is declining in the UK in all age groups. The actual prevalence of the disease was found to be 0.5% in men and 0.18% in women between 35 and 44 years, 20.5% in men, and 17.1% in women over the age of 60 years. In fact, the percentages in young patients may be lower than the actual values because of atypical presentation and reluctance to submit themselves for further investigations. However, CHD in younger population aged less than 40 years was found to represent only 3% of all patients with CHD [10]. In another study [11], acute Myocardial infarction incidence was found to be increased exponentially with age in both genders. There are limited data on the incidence of MI in young patients. The Framingham Heart Study’s 10-year follow-up data revealed that the incidence of MI was 12.9, 38.2, and 71.2 per 1000 in men and 2.2, 5.2, and 13.0 per 1000 in women in the age groups of 30 to 34, 35 to 44, and 45 to 54 years, respectively

(Figure 1). Out of 708 MIs among 5127 participants, more than 25% were silent, and the proportion of unrecognized MIs was higher in women.



**Figure 1:** Incidence and prevalence of MI in young people. A: Ten –year follow up data in younger patients enrolled in the Framingham Heart study demonstrating higher incidence of MI in men, especially beyond age of 45 years. The incidence in the corresponding age of 45 years. The incidence in the corresponding age brackets in women was approximately one-fifth to one-seventh that of men. B: MI trends in men and women 30 to 54 years old from the Nationwide Inpatient Sample (2001-2010). Comorbidity increased in both genders during period of the study. Women had a higher in-hospital mortality but also a significant decline compared with men.

## Risk Factors

The prevalence of risk factors is on the rise in young adults and children which will result in an increased disease burden in the near future. Smoking, which has been traditionally recognized as the most common risk factor for heart disease, has been shown to be increasingly prevalent in young adults and adolescents reaching up to 9%. In the UK, the smoking burden was found to be more among girls who also continued to stay as smokers for longer in their life [10]. This would have an impact on the cardio- protection offered by hormones like estrogen in young women.

Obesity is another growing concern among young adults and children and it has increased by threefold in the UK in the past two decades [12,10]. Insulin resistance, which by itself is a marker for CHD, has been found among 24% of school children in the USA [13]. Metabolic syndrome and insulin resistance were found in two thirds of young people with MI [10]. The disproportionate rise in prevalence of heart disease among certain ethnic groups like people of Asian Indian origin has been of great interest and these people tend to get MI at a younger age in addition to more complex coronary artery abnormalities.

Cocaine use was found to be the commonest cause for the presentation of non-traumatic chest pain in the emergency department among young adults and can result in MI in the younger population [10]. There is a fourfold increase in the number of cases in the past 10 years. In the UK, 45% of young adults have admitted use of recreational drugs, including cocaine, at least once. It becomes clear that the prevalence of CHD is bound to rise in patients aged less than 45 in the years to come. The under reporting of the illness and the challenges involved in risk factors modification in this subset of patients would make the management of the potentially growing problem more difficult.

## **Pathogenesis**

The causes for MI among patients aged less than 45 can be divided into:

### **1. Atheromatous CHD**

The atheromatous process starts in early childhood. In a necropsy study of 760 young adult patients who died of various causes, advanced CHD was found in 20% of men and 8% of women between the ages of 30 and 34 years of age. The etiology of atheromatous CHD was linked to the conventional risk factors as in adults. Among young patients with reported atheromatous process, cigarette smoking was found to be common in up to 92%. In a study of patients who had percutaneous coronary intervention (PCI), the prevalence of smoking was found to be higher in patients less than 40 years as compared with patients over 60 years (58.7% and 43%, p, 0.01). In another study done in London among young patients with MI, positive family history of premature CHD was found in 39% of participants. The children born of parents



with premature CHD tend to have more prevalence of lipid abnormalities, insulin resistance, and obesity strengthening the belief of a common genetic linkage. These people tend to have more arterial abnormalities than the rest of the patients who had MI younger than 45 years of age [10] .

## **2. Non-Atheromatous CHD**

Congenital coronary artery anomalies can present for the first time as MI in young adults. These are quite rare and may be a surprise to the cardiologist in the catheterization laboratory. Cases of myocardial bridging, where the coronary arteries are embedded within a tunnel in the myocardium beneath a layer of muscles, have also been reported in young people presenting with MI. Myocardial bridging can result in significant ischemia during systolic contraction and can result in MI. The chest pain is often atypical and women are at a higher risk during their peripartum period. The left anterior descending artery was found to be the culprit artery in most of the cases. Unfortunately the diagnosis is often made at necropsy. Successful treatment with stenting or surgery has been reported.

Septic vegetation from infected aortic valve was reported to have caused MI in younger people. Intravenous drug misusers are at a higher risk. MI has been reported to occur as a result of bacteremia in the absence of vegetation in young people. The management usually entails treatment of the underlying source of sepsis as well. A rare cause of MI in younger adults is coronary artery aneurysms in which the mechanism of MI is thought to be either attributable to embolization from the aneurysmal sac or extra luminal compression [10].

## **3. Hypercoagulable States**

Antiphospholipid syndrome is associated with recurrent arterial and venous thrombosis. It is often the disease of the young in their 30s. It can be primary or secondary associated with other autoimmune diseases like systemic lupus erythematosus. Thrombotic occlusion of a coronary artery can result in acute MI. These patients tend to have premature atherosclerosis and increased platelet adhesiveness. The titers of antiphospholipid antibodies need not be associated with disease activity and detailed evaluation is recommended to arrive at a diagnosis in suspected people. Nephrotic syndrome is associated with hypercoagulability

attributable to the combination of various factors like disturbances of the fibrinolytic system, dyslipidemia, and a decrease in anticoagulant factors. Reduction in concentration of antithrombin III, a coagulation inhibitor was particularly responsible for the thrombophilic tendency in most of the subjects.

Factor V Leiden mutation is associated with a procoagulant state and has been reported to result in MI in young people; smokers are particularly at higher risk. Contraceptive pill use increases the risk of developing MI in young women because of its procoagulant activity [10].

## **Clinical Presentation and Angiographic Findings**

Up to two-thirds of “young” MI patients will present with non-ST elevation myocardial infarction (NSTEMI) with approximately a third presenting with STEMI. It appears that, overall, the incidence of STEMI is reducing among the “young” but the proportion of “young” patients diagnosed with STEMI is increasing. Most “young” MI patients do not report a history of previous angina, MI or congestive heart failure and they report this less frequently in their histories than their older counterparts. Egiziano et al. reported only about 25% of “young” MI patients complained of chest pain in the month prior to their acute presentation for MI. The rate was even lower among “young” women. By way of comparison, in a study of all-comers with MI, chest pain was reported among two thirds of patients and those presenting with chest pain had a median age of 67 years. Coronary angiography usually reveals less extensive disease in “young” MI patients than older patients. Zimmerman et al. reported normal coronary arteries in 16% of men and 21% of women. By comparison only 2% of older men and 11% of older women had normal coronary arteries. Three vessel disease is infrequent with Fournier et al. reporting it in less than 10% of “young” MI patients. In that study there was no report of left main coronary artery stenosis in “young” MI patients which is supported by other authors. Single vessel disease is more frequent among “young” MI patients compared to their older counterparts and the left anterior descending artery is most commonly affected. Spontaneous coronary artery dissection is not an infrequent finding at angiography in “young” MI patients. Tweet et al. described the occurrence of spontaneous coronary artery dissection in a group of “young” patients with a mean age of 43 years, who were mostly female. Approximately 50% of these patients presented with STEMI and conservative management was

associated with an uncomplicated in-hospital course [8][5][9]. Table 1 shows the clinical presentation of MI young patients.

**Table 1:** Clinical Presentation of Young Patients with Myocardial Infarction

Item	Feature
1	Two-thirds present with none ST-elevation myocardial infarction
2	Chest pain characteristics similar to those in older patients
3	Women have 5-times higher odds of having myocardial infarction with non-obstructive coronary artery disease
4	Look for drug use (cocaine) or source of thromboembolism
5	Suspect myocarditis in patients with a history of viral illness who present with worsening heart failure or chest pain

## Management

Initial management of MI in younger patients differs slightly from the standard management in adults. Initial administration of oxygen, diamorphine, nitrates, and aspirin should be considered in all patients. In patients with history of cocaine use, beta blockers should be delayed for 48 hours as unopposed a stimulation may result in severe coronary spasm and paradoxical worsening of chest pain. Benzodiazepines are recommended in the initial management of MI in cocaine misuser. Nitrates should be continued in these people to counteract coronary spasm. In patients with hemodynamic instability specialist advice should be sought early and the scope for early coronary angiography and intervention should be assessed [14,10].

Patients with cocaine induced persistent ST elevation not resolved by nitrates, should be offered thrombolytic therapy. Younger patients seem to tolerate the thrombolytic agents better with a good ST segment resolution in the ECG. In patients with non-ST segment elevation MI, the initial management should be followed by risk stratification based on persistent or dynamic ECG changes, higher degree of cardiac enzyme rise, and presence of other risk factors like diabetes mellitus. Higher risk patients should be referred to the specialists to assess the need for early coronary

Angiography and intervention. Coronary angiography is not routinely offered in all the younger patients as a significant number tend to have normal coronary arteries. In patients with established MI, exercise stress testing could well be a useful tool for risk stratification. Most of the younger patients who managed stage 3 of the Bruce protocol (nine minutes or more) were found to have normal coronary arteries. Echocardiographic assessment of left ventricular function should be done in all patients [3, 15,10].

## **Conclusions**

This article explained some general aspects related to MI including its prevalence, risk factors, clinical presentation of young patients presenting with MI. We also talked about its treatment and management. The main conclusion that we ended up with was that although MI in young people under age of 45 years is not common, its incidence is substantial and causes a problem for both of patients and physician. Young patients with MI have a different risk factor profile, clinical presentation, and prognosis in comparison with older patients, which has to be taken into consideration when treating these young adults presenting with MI. Smoking is considered as the main coronary risk factor, while the prevalence of other conventional risk factors is relatively low. Thus, we should keep in mind that smoking remains one of the most important risk factors and should be the target of any program aimed to reduce the frequency of MI in young patients.

## **Recommendations**

In general, cardiologists recommend a systematic approach to arriving at a correct diagnosis. Any young patient with confirmed MI should undergo coronary angiography to identify the atherothrombotic culprit. If risk factors (smoking, diabetes mellitus, hyperlipidemia, hypertension, peripheral arterial disease) and angiographic features (thrombus, presence of atherosclerotic disease elsewhere in the coronary vascular bed) favor atherothrombotic disease, then it is highly recommended to follow the American Heart Association/American College of Cardiology guidelines for medical management and/or coronary revascularization with either percutaneous coronary intervention or surgery. Regarding MI in young population, it is highly recommended that risk factor, smoking in particular should be considered in the treatment of MI.

## References

- [1] K. Thygesen *et al.*, “Universal Definition of Myocardial Infarction,” pp. 2634–2653, 2007.
- [2] A. E. Azab, S. Universty, and A. Elsayed, “Acute Myocardial Infarction Risk Factors and Correlation of its Markers with Serum Lipids,” no. February 2019, 2017.
- [3] A. Aggarwal and S. Aggarwal, “A retrospective case-control study of modifiable risk factors and cutaneous markers in Indian patients with young coronary artery disease,” pp. 1–8, 2012.
- [4] F. Wiesbauer *et al.*, “Coronary heart disease Familial-combined hyperlipidaemia in very young myocardial infarction survivors ( 40 years of age ),” pp. 1073–1079, 2009.
- [5] B. D. Hoit *et al.*, “PATHOPHYSIOLOGY AND NATURAL HISTORY Myocardial infarction in young patients : an analysis by age subsets,” 1983.
- [6] A. Oliveira, “Impact of risk factors for non-fatal acute myocardial infarction,” pp. 1–11, 2021.
- [7] W. B. Kannel, R. D. Abbott, and R. Articles, “Incidence and Prognosis of Unrecognized Myocardial Infarction — An Update on the Framingham Study Author A liations,” pp. 9–10, 2021.
- [8] J. Y. David D. McManus , Stephen M. Piacentine , Darleen Lessard MS , Joel M. Gore and R. J. G. , Frederick A. Spencer, “Thirty-Year ( 1975 to 2005 ) Trends in the Incidence Rates , Clinical Features , Treatment Practices , and Short-Term Outcomes of Patients < 55 Years of Age Hospitalized With an Initial Acute Myocardial Infarction,” vol. 66, pp. 1–2, 2021.
- [9] N. Shah and A. Kelly, “Myocardial Infarction in the ““ Young ””: Risk Factors , Presentation , Management and Prognosis,” *Hear. Lung Circ.*, vol. 25, no. 10, pp. 955–960, 2016.
- [10] M. Egred, G. Viswanathan, and G. K. Davis, “Myocardial infarction in young adults,” pp. 741–745, 2005.
- [11] R. Gulati *et al.*, “Acute Myocardial Infarction in Young,” *Mayo Clin. Proc.*, vol. 95, no. 1, pp. 136–156, 2020.
- [12] D. D. S. L. Cara B Ebbeling , Dorota B Pawlak, “Childhood obesity : public-health crisis , common sense cure,” no. 2080, pp. 1–2, 2021.
- [13] M. D. Ranjana Sinha, M.D., Gene Fisch, Ph.D., Barbara Teague, R.N.,

- William V. Tamborlane, Bruna, and S. C. Banyas, R.N., Karin Allen, R.N., Mary Savoye, R.D., Vera Rieger, M.D., Sara Taksali, M.P.H., Gina Barbetta, R.D., Robert S. Sherwin, M.D., “Prevalence of Impaired Glucose Tolerance among Children and Adolescents with Marked Obesity,” pp. 1–16, 2021.
- [14] M. D. RICHARD A. LANGE, M.D., AND L. DAVID HILLIS, “CARDIOVASCULAR COMPLICATIONS OF COCAINE USE,” vol. 345, no. 5, pp. 351–358, 2001.
- [15] Lalit Chouhan and • Juan Carlos Pomposiello Hajar A. Hajar, “Comparison of thrombolytic therapy for acute myocardial infarction in patients aged <35 and >55 years,” vol. 71, no. 2, pp. 1–7, 2021.