REVIEW ARTICLE

Myocardial infarction in young people

Ewa Trzos, Barbara Uznańska, Tomasz Rechciński, Maria Krzemińska-Pakuła,
Magdalena Bugała, Małgorzata Kurpesa

2nd Chair and Department of Cardiology, Medical University of Łódź, Poland

Abstract

An estimated 6 to 10% of myocardial infarctions occur in patients under the age of 45. Usually this applies to men, but an increasing prevalence is being observed among women. Atherosclerosis, often one vessel disease, is the main cause. The presence of classic risk factors affects the dynamics of coronary artery disease: the strongest risk factor is smoking, regardless of gender. Environmental influence is also possible. No atherosclerosis is found in 20% of young patients. In such cases, the most frequent mechanisms of ischemia are: coronary artery embolism (5%), thrombosis (5%), anomalies (4%) and inflammation or spasm of the vessel. Age is an independent prognostic factor. Thus the clinical outcome after myocardial infarction is better in younger than in older patients. (Cardiol J 2009; 16, 4: 307–311)

Key words: myocardial infarction, young patients, risk factors

It is 60 years since the publication of Yater's study of myocardial infarctions (MI) in 866 young war invalids [1]. Since then, there have been many studies regarding myocardial infarctions in young people. The borderline differentiating younger from older patients is the age of 40. However, many authors treat cases of MI in individuals under the age of 45 as being MI in the young.

Myocardial infarctions in patients below the age of 40 constitute about 10% of all cases [2]. The majority of sufferers are men, but an increasing prevalence among women has been observed; nowadays one in four patients with MI younger than 45 years are women [3].

Epidemiological studies conducted in Poland (POL-MONICA 1994, NATPOL PLUS 2002, WOBASZ 2005) indicate a decrease in mortality from cardiovascular diseases. Nevertheless, in western Europe these mortality indexes (standardised to age) are 2.5 times lower than in Poland [4]. This explains the importance of cardiovascular disease prevention in under-40 year-olds. In this paper we discuss present knowledge regarding the clinical course of acute coronary syndromes and prognosis in patients below the age of 45.

The main cause of MI in young people is coronary atherosclerosis (about 80% of cases), usually one vessel disease [5]. Atherosclerotic process begins at birth and significant lesions in coronary arteries may be present as early as age 25 or 30 [2, 6]. After the age of 40, the first symptoms of exercise-induced ischaemia are not uncommon. The reasons for such rapid progression of atherosclerosis, causing MI at the age of about 40, are still being investigated. Beręsewicz et al. [7] indicate that the process may even begin in foetus. The authors emphasize that although the dynamics of atherosclerosis are determined by classic risk factors, the susceptibility to proatherosclerotic factors is programmed by external influences during intrauterine growth, for example mother's hypercholesterolaemia. Recent studies prove that environmental influence on

Table 1. Risk factors of myocardial infarction and their prevalence among Poles aged 18–30.

Risk factor	Prevalence
Smoking	Women: 23%; men: 41%
Hypercholesterolemia	Women: 23%; men: 25%
Hypertriglicerydemia	17%
Arterial hypertension	5%
Overweight	19%
Obesity	5%

genotype may promote the development of coronary artery disease in young age.

There is no doubt that the presence of classic risk factors is strongly causatively related to atherosclerosis and myocardial infarction in young people. Based on post-mortem examinations of children and young adults, the progression and range of atherosclerosis in this population is proven to have strong connection to a number of risk factors. In more than 90% of 40 year-old patients having a first myocardial infarction, more than one risk factor is found (Table 1) [6, 8].

Most recent studies have identified smoking as the strongest risk factor in both men and women under 40 suffering from acute coronary syndrome [9]. Religa et al. [10] found that of 100 women admitted with first myocardial infarction, 45% were smokers, while in the subset of patients below 45 years of age, the figure was 95%. In the epidemiological studies WOBASZ and NATPOL PLUS, in the general population about 25% women and 42% men were smokers, many of them aged 18–31 [11, 12].

Dyslipidemia occurs in about 29% of patients with myocardial infarction below the age of 40. In the Polish population hypercholesterolemia affects 23% of women and 25% of men while 17% of people aged 18–29 have hypertriglicerydemia [12]. Premature coronary artery disease is most common in patients with familial hypercholesterolemia, less often in familial mixed dyslipidemia. The results of many studies indicate significantly higher levels of triglicerydes and total cholesterol and lower concentration of HDL-cholesterol (especially HDL2) in patients with coronary artery disease under 40, compared with those in whom the disease occurred after 60 [13, 14]. The GRIPS study [15] of over 5,000 patients confirms that a high level of LDL-cholesterol is a significant risk factor of myocardial infarction in men under 45. The elevation of total cholesterol and LDL-cholesterol concentrations is strongly connected to the increase of ischemic heart disease risk. In patients with hypertriglicerydemia the highest risk of ischemic heart disease occurs when the triglicerydes level is moderately increased, but often accompanied by severe increase of highly atherogenic VLDL.

Premature ischemic heart disease in first-degree relatives is recognized as an independent risk factor for this disease under the age of 40 [14]. This long-known relationship [14, 16], and ethnic differences in susceptibility to atherosclerosis, are being explained as DNA structure research continues. Many proatherogenic genetic factors were discovered. Apolipoprotein E is a good example of gene polimorphism modifying atherosclerotic process [17]. It comes in three main variants: E2, E3 and E4. Large metaanalysis conducted in 2004 identified the presence of allel E4 as an important risk factor for atherosclerosis and ischemic heart disease.

Arterial hypertension is less common in young patients [8]. Recently in Poland arterial hypertension was diagnosed in 5% of the 18–31 year-old population; it affects 12% of young patients after myocardial infarction [18].

Type 2 diabetes mellitus affects only 3–5% of patients after myocardial infarction under the age of 45 [18].

On the other hand, obesity is quite common in this group of young adults. Between 35% and 58% of patients after myocardial infarction under the age of 45 are obese [18]. Obesity doubles the risk of myocardial infarction in men and increases the risk in women by 2.5 times. The molecular mechanism explaining the pathogenesis of many cardiovascular diseases in obese people is unclear. Disorder of the intracellular lipid metabolism is an important issue in metabolic syndrome pathogenesis. Excessive accumulation of triglicerydes impairs the function of cardiomyocytes, liver and pancreas.

The risk factors presented above concern mainly myocardial infarction caused by coronary artery atherosclerosis. Still, in the population younger than 40 years, myocardial infarction in patients without coronary artery stenosis is not uncommon. The main causes of those are: coronary artery embolism (5% of cases), thrombosis (5%), anomaly (4%) and vessel inflammation or spasm [19].

Cocaine and amphetamine use is a factor in an increasing number of MIs. Dangerous complications of such 'hard' drugs are more frequently being described in the literature. Myocardial infarction after cocaine abuse was first reported in 1982 [20]. This drug causes heart rate and systolic blood pressure increase with artery spasm followed by

reduced coronary flow, which results in imbalance between oxygen consumption and supply. Increase in thrombocytes aggregation stimulated by cocaine may be a direct factor triggering coronary artery thrombosis. Another factor possibly leading to myocardial infarction after cocaine or amphetamine use is the blocking of sodium channels and the presynaptic part of the neuron, resulting in excessive release of neurotransmitters like norepinephrine and dopamine. Authors describing MI after intravenous drug injection emphasize the presence of unchanged coronary arteries in coronary angiography conducted after acute phase [21, 22]. On the other hand, transient impairment of blood flow was observed in the case of a young woman with MI after amphetamine use, in whom coronary angiography was performed within several hours of the onset of chest pain [23]. Moreover, cocaine may cause direct toxic lesion of myocardium, resulting in focal necrosis [24]. Infarctions in marihuana smokers are also reported [25].

There are reports regarding the possibility of myocardial infarction after overdosing on medicines. The case of a 29 year-old male was described, who after attempting suicide by taking a high dose (50 times greater than the therapeutic one) of rifampicine, was observed to have typical severe stenocardia, ST-segment elevation, systolic dysfunction with major decrease of left ventricular ejection fraction as well as elevated levels of markers of myocardial necrosis. In coronary angiography no plaques were found. It is believed that toxic influence on endothelium may be the cause of drug-induced acute coronary syndromes [26].

Myocardial infarctions caused by coagulation disorders constitute 5% of all cases. An imbalance between coagulation and fibrynolysis may increase the risk of thrombus forming in the unchanged artery. Blood platelets play an important role in the development of thrombosis. Weiss et al. [27] emphasize the importance of many polimorphisms of platelet receptors (GP Ib and GP IIb/IIIa). Patients with polimorphism have a six times greater risk of coronary artery thrombosis. Also, an increase in thrombocytes aggregation in response to ADP is more expressed in young patients after myocardial infarction than in the healthy control group. A reduced activity of plasminogen activator inhibitor was reported in many young individuals with a history of MI [28]. Polimorphism of gene Bc11 (coding beta chain of fibrinogen), related to elevated fibrinogen levels, was proved to be more common in young patients after myocardial infarction. Tanis et al. [29] reported a 12 times greater risk of MI in smoking women with prothrombotic mutation than

in the control group and a doubled risk in smoking women with factor V Leiden mutation.

Antiphospholipid syndrome is a rare background of MI in young women. In this disease arterial thromboembolism is likely, which may result in infarction. Antiphospholipid syndrome manifests as venous thromboembolism, thrombosis in arteries (with tendency to locate in cerebral circulation), moderate thrombocytopenia and obstetric complications, mainly habitual miscarriages. The mechanism of thrombotic complications is multi-factorial and not entirely clear. Endothelium damage, excessive platelet activation and imbalance between coagulation and fibrynolysis may play important roles [30].

There are also reports about acute myocarditis with a severe clinical course and clinical symptoms of acute myocardial infarction [31]. In myocarditis, the symptoms mimicking acute MI appear a few days after the onset of the disease when body temperature decreases. Jarisch-Herxheimer reaction is connected with endotoxin release and accompanied by elevation of cytokines levels [32].

In rare cases of MI in young patients, a coronary artery anomaly is diagnosed [33, 34].

Myocardial bridge may cause acute coronary syndrome. This structure is found during 15 to 85% of autopsies, but is seldom diagnosed in coronary angiography: only in 0.5 to 2.5% of cases [35–38].

In conclusion, we must emphasize that most (as many as 80%) of young patients with MI have typical atherosclerotic coronary stenosis, usually one vessel disease [5, 13, 39]. Klein et al. [40] found three vessel disease in 19% of young individuals with myocardial infarction, although multivessel lesions were present mainly in those who had several risk factors, especially diabetes.

What are the differences in the clinical course of ischemic heart disease in young people? What are the most characteristic features in this population?

Young patients with coronary artery disease usually have no concomitant disorders. After myocardial infarction they have higher left ventricular ejection fraction and lower levels of pro-brain natriuretic peptide than older groups [41].

The results of GISSI study [18] indicate that younger age is an independent prognostic factor of a favorable clinical course in myocardial infarction. It is estimated that increased risk of recurrent coronary events concerns only 5% of patients with MI under the age of 40. Nevertheless, the problem of sudden death risk remains, because according to some authors it is significantly higher than in the older group [41, 42].

It should be highlighted that patients younger than 45 years, in whom primary percutaneous transluminal coronary angioplasty was performed, especially benefit from a good prognosis in the early period of hospitalization as well as in long-term follow-up.

Acknowledgements

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