Non-pharmacological management after acute coronary syndromes

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Abstract

Acute coronary syndromes (ACS) are one of the most common causes of hospitalizations in developed countries. Implementation of optimal treatment in these patients is a significant clinical and social problem. Clinical practice guidelines published by the European Society of Cardiology (ESC) are focused on crucial tasks such as regular physical activity sufficient to increase exercise capacity, smoking cessation, a Mediterranean diet, intensive control of risk factors for atherosclerosis (hypertension, diabetes, platelet hyperactivity and hyperlipidaemia) and, in selected cases, coronary revascularization. This review considers non-pharmacological management after ACS, focussing on rehabilitation, appropriate diet and healthy lifestyle.

Key words: acute coronary syndromes, guidelines, prognosis, secondary prevention.

Introduction

Acute coronary syndromes (ACS) are the most common cause of hospitalization of adults in developed countries [1]. Unstable angina, ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) are the clinical types of ACS.

Numerous sources can be helpful in making appropriate medical decisions. Among these sources, diagnostic and treatment guidelines are becoming more popular. These guidelines are developed by scientific societies and based on properly interpreted current evidence.

Guidelines for the treatment of patients after myocardial infarction (MI) were published by the following institutions:

1) European Society of Cardiology (ESC), including guidelines of 2003 (STEMI) [2], of 2007 (NSTEMI) [3] and also of 2005 (percutaneous coronary interventions) [4],
2) American College of Cardiology/American Heart Association (ACC/AHA) in 2006 and 2007 [5, 6],
3) National Institute for Health and Clinical Excellence (NICE) in 2007 [7].

It should, however, be noted that the guidelines for STEMI treatment were developed in Europe more than 4 years ago [2]. Since then, numerous

MI treatment reports and recommendations issued by other societies have been published.

The aim of this article is to present new views and controversies, as well as the resulting clinical implications in the non-pharmacological treatment of patients after STEMI or NSTEMI.

Guidelines for treatment of patients after myocardial infarction – priorities

1. Each patient should receive recommendations concerning taking regular physical activity. The recommendations should apply to introduction of exercise, for at least 20–30 min/day, until one feels a little tired [5]. Exercise should be started gradually, not leading to exhaustion, and aiming at improvement of physical fitness [5]. Cardiological rehabilitation should be recommended and available to all patients after MI [7].

2. Patients should be encouraged to stop smoking and should be provided with appropriate help.

3. Patients should receive instructions concerning their diet. Currently, a Mediterranean-type diet is recommended. It includes more vegetables, fruit, fish and bread and less meat. The diet replaces butter and full-fat cheese with vegetable fat-based products [7].

4. An essential component of treatment of patients after acute MI should be intensive control of atherosclerosis risk factors, especially blood pressure, diabetes and hyperlipidaemia [7].

5. In all patients after acute MI, proper pharmacological treatment according to the guidelines should be introduced [5-7].

Cardiac rehabilitation following myocardial infarction

Evidence shows that exercise-based cardiac rehabilitation after cardiac events positively affects the extent of disability and quality of life, and also has an important beneficial effect on morbidity and mortality [8]. It is an integral component of the care for patients after an MI, invasive coronary procedures or those with chronic stable angina. Although in the last 4 decades physical training has assumed a major role in the health care of coronary artery disease patients, cardiac rehabilitation does not consist exclusively of regular exercise.

According to the 1964 World Health Organization definition, cardiac rehabilitation includes all actions undertaken to provide an optimal physical, mental and social environment for the cardiac patient to let him or her regain maximal functional capacity in society [8]. Thus, cardiac rehabilitation should be multifaceted and comprehensive. It should be initiated with the first symptoms of cardiac disease, immediately following the life-threatening phase of an acute coronary event, or in the early period following invasive treatment. No temporal limits should be imposed on cardiac rehabilitation.

Modern cardiac rehabilitation should be [9]:
- comprehensive,
- initiated as early as possible,
- continuous,
- staged,
- individualized depending on the clinical state,
- acceptable by the patient.

In addition, comprehensive cardiac rehabilitation should include the following components: clinical evaluation, optimization of pharmacotherapy, physical training, psychosocial rehabilitation, evaluation and reduction of coronary disease risk factors, lifestyle modification and patient and family education [9].

These comprehensive goals require involvement of a multidisciplinary team that includes not only the physician but also a physiotherapist, psychologist, social worker and dietician. The primary goal of the care team is to develop an individualized therapeutic plan with the aim of regaining and maintaining optimal clinical status, as well as physical, mental and social capacity of the patient [9].

Physical rehabilitation is a major component of comprehensive cardiac rehabilitation. During the last 30 years, a major breakthrough has occurred in our thinking regarding the role of physical activity in patients with cardiovascular disease. Until the 1960s, bed rest or major limitation of exercise was considered beneficial for the majority of patients. In contrast, moderate or even intense exercise training is currently used not only in the prevention of coronary heart disease, but also as a therapeutic measure following MI, percutaneous coronary intervention (PCI), cardiac surgery, and permanent pacemaker or cardioverter-defibrillator implantations [10]. For some years now, physical rehabilitation has also been undertaken in patients with heart failure regardless of its aetiology [10-12].

Stages of cardiac rehabilitation

Comprehensive cardiac rehabilitation consists of an early phase (stages I and II) and a late phase (stage III) (Figure 1) [9].

Early cardiac rehabilitation includes 2 stages and is undertaken in all patients following ACS or exacerbation of chronic angina pectoris regardless of the treatment strategy (conservative or invasive).

Stage I

Stage I rehabilitation (early in-hospital rehabilitation) is initiated immediately following an acute, life-threatening period of cardiac disease.

The management goals in this stage include [9]:
- optimization of pharmacotherapy of the underlying cardiac disease;
- prevention of the sequelae of immobilization;
- improvement in exercise capacity;
- evaluation of the mental state of patients, anxiety reduction, and mental support;

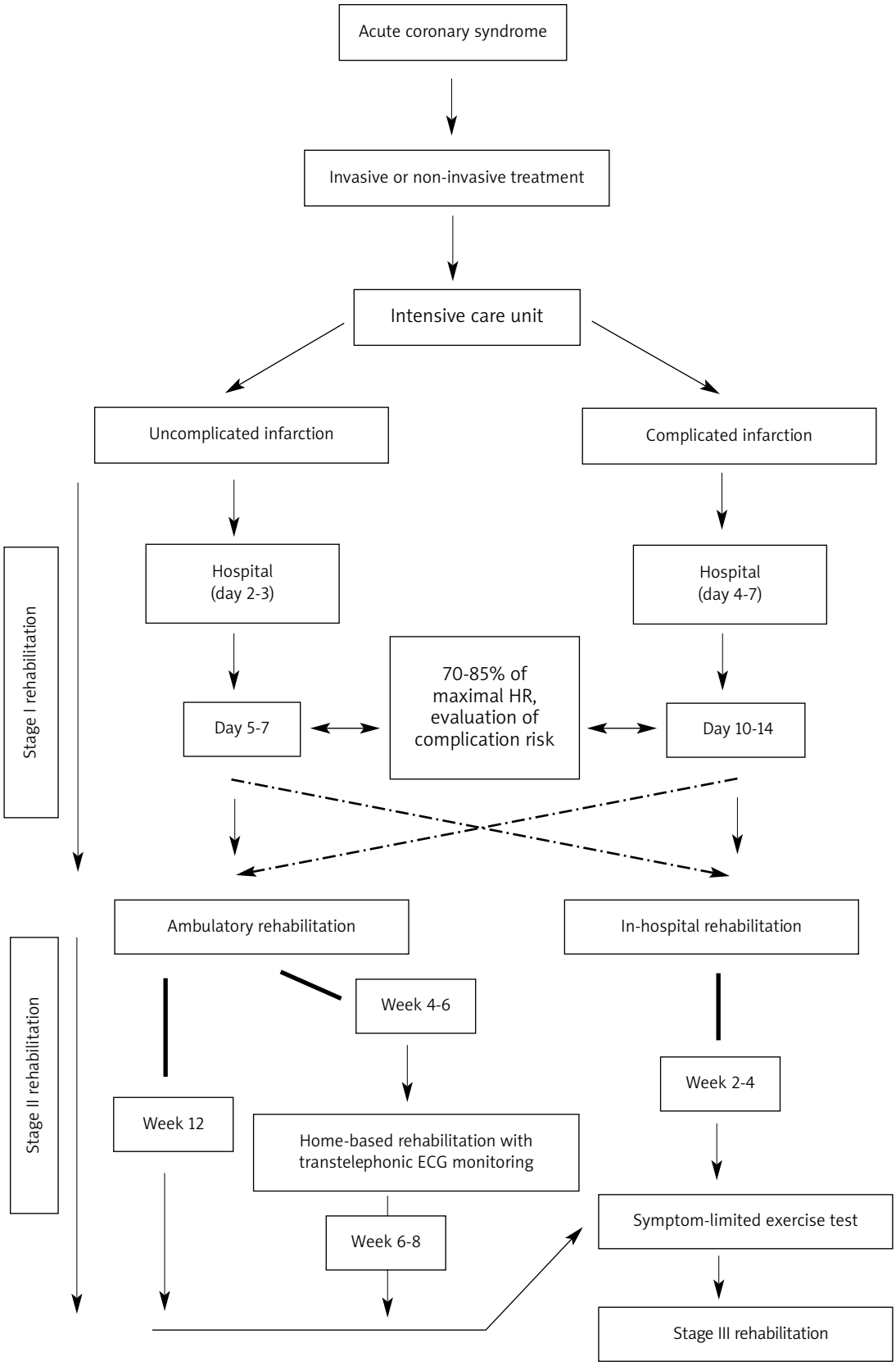

Figure 1. Schematic overview of cardiac rehabilitation following myocardial infarction

Table I. Exercise-induced cardiac event risk stratification model [13]

Risk factor	Risk		
	Low	Moderate	High
Left ventricular systolic function	No significant dysfunction EF > 50%	Moderate dysfunction EF = 40-49%	Significant dysfunction EF < 40%
Complex ventricular arrhythmia	Absent et rest and during exercise		Resting and exercise-induced
Exercise-induced cardiac ischemia	No	Yes	Yes
Exercise capacity	≥ 7 METs	5-6.9 METs	< 5 METs
Hemodynamic response to exercise	Normal		No increase or decrease in SBP or HR with increasing load
Clinical data	Uncomplicated infarction/CABG/ /PTCA NYHA class I	NYHA class II	Infarction or invasive procedure complicated by cardiogenic shock and/or pulmonary edema. Persistent ischemia following invasive treatment. NYHA class III-IV

Categorization to low risk group requires all low-risk features to be present. Categorization to high risk group requires only 1 high-risk feature to be present. Risk can by categorized as moderate if a given parameter indicates neither high nor low risk or can be explicitly assigned moderate risk category
CABG – coronary artery bypass grafting, EF – ejection fraction, HR – heart rate, MET – metabolic equivalent, NYHA – New York Heart Association, PTCA – percutaneous transluminal coronary angioplasty, SBP – systolic blood pressure

Table II. Absolute contraindications to initiation of physical training in patients after a myocardial infarction [12, 13]

Unstable angina
Decompensated heart failure
Resting systolic blood pressure > 200 mm Hg, diastolic blood pressure > 100 mm Hg
Severe symptomatic valvular heart disease
Complex ventricular arrhythmia
Resting paroxysmal supraventricular tachycardia
Complex arrhythmia induced by exercise
III degree atrioventricular block in a patient without permanent pacemaker
Endocarditis
Arterial embolism
Thrombophlebitis
Other disease that might worsen due to physical exercise

- patient education, including:
  - basic information regarding the disease, treatment modalities, and organization of care,
  - information regarding coronary heart disease risk factors and the possible strategies to reduce them;
- evaluation of the clinical status of the patient (see risk groups as shown in Table I and assigning an appropriate stage II rehabilitation schedule.

Active physical rehabilitation, depending on the severity of the MI (complicated vs. uncomplicated) and possible contraindications (Table II), is initiated after 12-48 h of bed rest. After the clinical condition of the patient is stabilized (usually within 2-3 days in case of uncomplicated MI), exercise of gradually increased intensity is initiated under physiotherapist supervision:

- initial phase – breathing exercise, relaxation exercise, dynamic exercise involving small muscle groups;
- continuation phase – dynamic exercise involving large muscle groups, sitting and standing up, walking;
- at 4-6 days, the patient assisted by the physiotherapist is allowed to try climbing stairs.

Table III. Diagnostic exercise test following a myocardial infarction [12, 13]

Type of exercise test	Termination criteria
Submaximal test	• Heart rate 120/min • 70% of the maximal heart rate • Workload 5 METs
Symptom-limited test	• Chest pain • Increasing dyspnea or cyanosis • Blood pressure fall by > 10 mm Hg • Systolic blood pressure increase to > 250 mm Hg • Diastolic blood pressure increase to > 115 mm Hg • Dizziness, near fainting • Significant exercise-induced arrhythmia • ST segment elevation by ≥ 1 mm in leads without pathologic Q patients request

Dynamic exercise is recommended throughout stage I rehabilitation. In contrast, exercise resulting in Valsalva manoeuvre-like conditions is not advised [10].

During the first days following MI, rehabilitation should be performed under electrocardiographic (ECG) monitoring. Heart rate and blood pressure are measured before exercise, during peak exercise and after exercise. Exercise should be immediately terminated in case of the following: coronary chest pain, dyspnoea, heart rate increase by more than 20 beats/min or decrease by more than 10 beats/min, significant cardiac arrhythmia provoked by exercise, decrease in blood pressure by more than 10-15 mm Hg, or excessive increase in blood pressure (systolic above 200 mm Hg, diastolic above 110 mm Hg).

Evaluation of the clinical status of the patient and assigning an appropriate stage II rehabilitation schedule is a critical component of cardiac rehabilitation (Table I, Figure 1) [11, 12]. Performing an exercise test to determine prognosis (with continued use of current medications) plays a major role in this process. It is planned as a submaximal exercise test but in practice it is usually a symptom-limited one because most patients are treated with β-blockers and are often unable to perform submaximal exercise (Table III). The exercise test is usually performed at 5-7 days in patients with uncomplicated infarction treated with PCI, at 10-14 days in patients with uncomplicated MI treated conservatively, and with a longer delay depending on the clinical situation in patients with complicated infarction.

Stage II – recovery

Stage II rehabilitation may be performed in hospitalized or ambulatory patients [9, 12]. In patients at low risk of exercise-related complications, we can introduce home cardiac rehabilitation monitored using transtelephonic ECG and with regular supervision by a physician and physiotherapist from an ambulatory cardiac rehabilitation unit [12]. Stage II cardiac rehabilitation

Table IV. Practical advice for patients who have suffered a myocardial infarction (according to Fletcher GF *et al*. Circulation 1992; 86: 340-4) [15]

Activities that should not be undertaken:
• Avoid STATIC EXERCISE WITH TEMPORARY BREATHHOL
• Lifting heavy weights
• Pushing a wheelbarrow, car, etc.
• Changing wheel in a car
• Shoveling snow
• Opening windows in a train, car or other similar efforts requiring pulling
• Hanging curtains and other similar efforts
• Digging
Acceptable forms of activity:
• The most available and simple form of exercise is WALKING varying distances at varying pace
• Bicycle riding
• Recreational games: badminton, volleyball, table tennis
• Swimming in a swimming-pool (water temperature 27-30°C)
• Gardening (cutting grass using light lawnmower, raking, weeding)
• Fishing

should be initiated as soon as possible after stage I, optimally at 2-3 weeks following MI. Duration of stage II rehabilitation depends on the clinical condition of the patient and the form of rehabilitation (in-hospital: 2-4 weeks; ambulatory: 4-12 weeks; home rehabilitation monitored using transtelephonic ECG: up to 12 weeks).

In-hospital stage II cardiac rehabilitation is indicated following stage I rehabilitation in case of:

- clinical condition of the patient that precludes ambulatory stage II rehabilitation;
- social and environmental barriers hindering ambulatory stage II rehabilitation (e.g. patients living in bad social conditions or in a remote place that is located far away from an ambulatory cardiac rehabilitation centre).

In-hospital stage II cardiac rehabilitation is particularly indicated in the elderly and patients with coexisting diseases.

Management at this stage is directed at full accomplishment of all major goals of comprehensive cardiac rehabilitation as described above.

Acceptable exercise intensity and rules of loading during training should be defined at this stage, along with information on acceptable and undesirable forms of physical activity during daily life (Table IV), including sexual activity [11, 12].

Appropriate stage II rehabilitation should be planned based on the risk of complications related to exercise training (Table I). Patients at low risk of such complications may be referred for ambulatory rehabilitation, and after they learn (usually within 6-12 training sessions) how to monitor themselves by measuring heart rate and blood pressure and estimating exercise load during training, they may proceed to further home rehabilitation [12]. It would be ideal to monitor the latter using transtelephonic ECG. Patients at moderate risk of complications related to exercise training may undergo conventional ambulatory rehabilitation or in some cases are even referred for in-hospital rehabilitation. Patients at high risk of exercise-related complications should undergo in-hospital rehabilitation and only exceptionally they may be allowed ambulatory cardiac rehabilitation. Physical activity in patients at moderate or high risk of exercise-related complications should be individualized. Close medical supervision as well as ECG and blood pressure monitoring are essential. Patients at moderate risk of complications related to exercise training may proceed to further home rehabilitation after an initial course of training sessions (2 months) if they tolerate exercise well and are able to monitor themselves [12].

In-hospital and ambulatory stage II cardiac rehabilitation includes [9, 11]:

- general fitness training (breathing gymnastics, stretching and relaxation exercise, water-based exercise – considered more attractive by patients than other forms of rehabilitation, safe and resulting in similar improvement in fitness compared with bicycle ergometer training [14]);
- endurance training:
  - interval training using a bicycle ergometer or treadmill, lasting for 15-30 min with 3 min load periods alternating with 2-3 min periods of rest,
  - continuous training lasting for 15-30 min (bicycle ergometer or walking);
- resistance exercise performed as part of stationary training (e.g. interval training using bicycle ergometer exercise alternating with rowing, stepping, and treadmill exercise) to supplement uniform bicycle ergometer exercise.

Similar to stage I rehabilitation, stage II and III exercise should be terminated or modified if the following occur: coronary chest pain, dyspnoea, heart rate increase to values exceeding maximum heart rate or decrease by more than 10 beats/min despite increasing load, significant cardiac arrhythmia provoked by exercise, decrease in blood pressure by more than 10-15 mm Hg, or excessive increase in blood pressure (systolic above 200 mm Hg, diastolic above 110 mm Hg) [9].

Stage III – secondary prevention and healthy lifestyle

Stage III cardiac rehabilitation may be performed on an outpatient basis in patients living in their homes or takes place in specialized rehabilitation facilities. This may be either individual or group activity that is periodically supervised by primary care physicians and/or physicians and physiotherapists based at cardiac rehabilitation units [15].

The goals of stage III rehabilitation include:

- control of pharmacotherapy,
- maintaining optimal mental and physical condition of the patient,
- reduction of coronary artery disease risk factors,
- promotion of a healthy lifestyle.

Stage III cardiac rehabilitation usually begins at 2-4 months after the onset of disease and is continued lifelong. Patients usually do not require constant medical supervision and monitoring of exercise training [10-12].

In some patients, high risk of physical training-related complications may continue for years. These patients would be candidates for ambulatory rehabilitation but due to logistic, financial and personal problems home-based rehabilitation often remains the only feasible option. Appropriate patient education is critical in this group, and attention should be given to such issues as prescribing appropriately intense exercise, the ability of the patient to identify worrisome symptoms, and patient self-monitoring during the training. In addition, easy telephone contact with the physician is extremely important, in particular if transtelephonic ECG monitoring is also possible [12].

Table V. Subjective scale of exercise intensity. 20-grade Borg scale for subjective evaluation of exercise intensity

6 7 8	Minimal exercise
9	Very light exercise
10 11 12	Light exercise
13	Moderately intense exercise
14 15 16	Intense exercise
17	Very intense exercise
18 19 20	Maximal exercise

Stage III cardiac rehabilitation may include various forms of physical activity (Table IV). Exercise intensity should be individualized. Recommended activities include walking, cycling, general fitness training, and team games (without competitive sports). Training sessions should be performed at least twice a week and last 45-60 min.

Forms of physical exercise used in cardiac rehabilitation

Physical exercise used in cardiac rehabilitation includes isotonic (dynamic) exercise, isometric (static) exercise, and resistance training that combines isometric and isotonic exercise [12].

Isotonic exercise results in the muscle movement without increasing its tension. This leads to increased left ventricular preload. Response to exercise depends on the amount of muscle involved and exercise intensity. In isometric exercise the muscles contract without the movement of the affected joints. This leads to increased left ventricular afterload, related to faster increase in blood pressure and heart rate compared with dynamic exercise. While dynamic exercise has a more beneficial effect on the control of metabolic coronary risk factors, resistance training is more beneficial for patients in terms of improving fitness during their everyday activity [12].

Regardless of the form of physical activity, stage II and III training should be preceded by a 5-min warm-up followed by the main training session, and finished with a 5-min period of cool-down exercise [9, 11].

Monitoring of exercise training

During all stages of cardiac rehabilitation, exercise training should be initiated according to guidelines regarding acceptable workload. Exercise intensity is set based on the results of initial stress testing [12].

The following approaches to set an acceptable workload have been used in cardiac rehabilitation [12]:

Target heart rate (HR) during training is set based on the exercise test result: resting HR + (maximum HR – resting HR) × (40-80)%.

As may be seen above, a wide range of target heart rate is acceptable (40-80% of the functional reserve) depending on the training stage and the form of exercise. Lower target heart rate values are used during initial or continuous training. Exercise may be more intense (up to 80% of the heart rate functional reserve) with good exercise tolerance in fitter patients, and during interval training.

Target workload resulting in the achievement of target heart rate during training. Workload may be set in Watts or metabolic equivalents (METs) based on the stress test result (maximum training workload equals the workload during the exercise test that resulted in the achievement of the target training heart rate). Thus, maximum acceptable workload during ergometer or treadmill training is set and compared with the workload during everyday activities of the patient.

Exercise intensity may be measured subjectively using the Borg scale (Table V). This is used to gauge training intensity in patients who are unable to perform an exercise test [12]. The recommended training intensity is a score of 12-13, while a score of 14-16 is acceptable during short periods of training in patients at low risk of exercise-related complications who tolerate the training well.

Regardless of the approach used to evaluate and set workload during training, less intense exercise is always associated with a lower risk of complications, while more intense exercise is associated with a higher risk of complications but leads to faster improvement of cardiorespiratory fitness. Training workload and frequency to achieve desired improvement in physical capacity and fitness should be set individually [12].

Recommended exercise training frequency

Similarly to exercise intensity, training frequency should also be set individually. In addition to initial fitness of the patient, factors that should be taken into account include physical activity related to the profession of the patient and his or her daily life activity. Epidemiological data suggest that the minimal training frequency/intensity required to obtain benefits from physical activity is 30 min

3 times/week, equal to the energy expenditure of 700 kcal/week, and optimal moderate physical activity is 30 min 5-7 times a week with the energy expenditure of 2000-3500 kcal/week [12, 16, 17].

Omega-3 acids and their ethyl esters

Guidelines of the ESC recommend supplementation with omega-3 polyunsaturated fatty acids (n-3 PUFA) administered 1 g/24 h in all patients after MI [2]. This recommendation was assigned a class I and level of evidence B [2]. Use of omega-3 acids was also included in secondary prevention in the recent guidelines on treatment of patients with stable coronary disease [18].

Omega-3 polyunsaturated fatty acids – eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), α-linolenic acid (ALA) – show a favourable effect on the human cardiovascular system. Among other effects, are lowering the blood pressure, reducing triglyceride levels and increasing high-density lipoprotein (HDL) levels. They also have an anti-arrhythmic effect by increasing polarization of the myocardial cell membrane and increasing the sensitivity threshold, especially in ischaemic myocardium, where life-threatening ventricular fibrillation may occur. Due to these effects omega-3 acids reduce total mortality and risk of sudden death, particularly in patients with recent MI. Other properties of omega-3 acids with possible significance for patients after MI may include an antidepressant effect [19]. Depression is an unfavourable prognostic factor, especially after MI [20]. A recent meta-analysis of randomized double-blind studies [21] reported a substantial antidepressant effect of omega-3 polyunsaturated fatty acids.

In the Diet and Reinfarction Trial (DART) study, patients after MI were randomly assigned to a group in which fish consumption was increased (200-400 g of fatty fish per week, correlating with 500-800 mg/24 h of omega-3 fatty acids) or to a group with standard fish consumption, and a 29% reduction in mortality due to all causes was demonstrated (Figure 2) [20]. The greatest benefits were seen in the prevention of MI complicated by death; therefore, a hypothesis was proposed that omega-3 acids protect the myocardium against unfavourable effects of ischaemia [20].

In accordance with the results of the DART study and similar ones, the European and American societies of cardiology recommend an increase in fish consumption, especially in secondary prevention of coronary disease [5, 18]. The only controversy is maximum acceptable fish consumption, associated with the presence of mercury, dioxins and polychlorinated biphenyls (Figure 3) [22].

In order to achieve the desired supply of 1000 mg/24 h EPA/DHA in a patient after MI, consumption per week should be as follows:

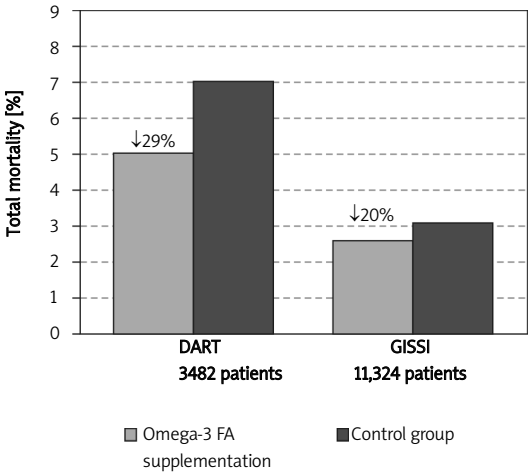

Figure 2. Impact of omega-3 fatty acids on total mortality in patients after recent myocardial infarction (according to Domingo JL. Environ Int 2007; 33: 993-8 [22]). For details see text

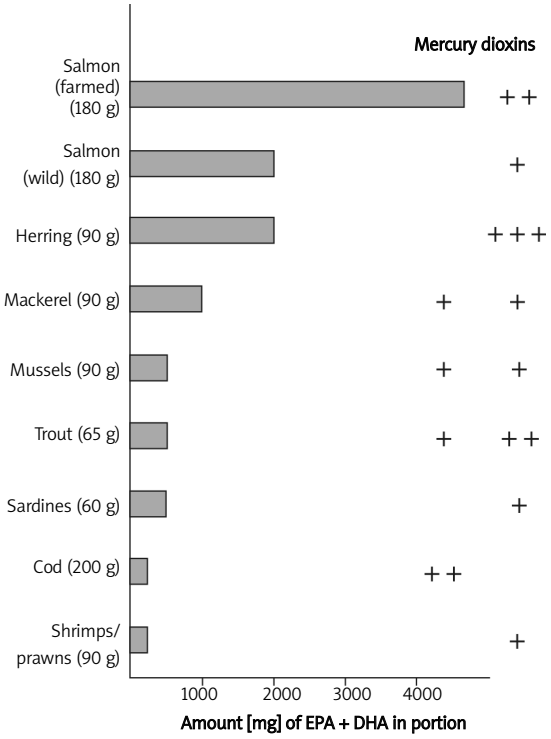

Figure 3. Content of omega-3 fatty acids and harmful substances in some fish/seafood. DHA-doco-sahexaenoic acid, EPA-eicosapentaenoic acid (according to Domingo JL. Environ Int 2007; 33: 993-8 [22])

- 2400 g of canned tuna, or
- 400-1400 g (depending on fishery location) of fresh tuna, or
- 420 g of herring, or
- 400-1700 g of mackerel, or
- 700 g of trout, or
- 500 g of salmon.

Table VI. Unsaturated fatty acid content in some fats and oils (according to The USDA National Nutrient Database for Standard Reference)

Fat/oil	Unsaturated/ /saturated fatty acid ratio	Content of some fatty acids [%]		
		Monounsaturated	Polyunsaturated	
		Oleic acid C18 : 1	Linoleic acid (omega-6) C18 : 2	α-Linolenoic acid (omega-3) C18 : 3
Butter	0.5	29	2	1
Lard	1.2	44	10	–
Train oil	2.9	22	5	–
Peanut oil	4.0	48	32	–
Olive oil	4.6	71	10	1
Walnut oil	5.3	28	51	5
Soybean oil	5.7	24	54	7
Corn oil	6.7	28	58	1
Grapeseed oil	7.3	15	73	–
Sunflower oil	7.3	19	68	1
Flaxseed oil	9.0	21	16	53
Almond oil	9.7	69	17	–
Canola oil (Canadian rapeseed oil)	15.7	62	22	10

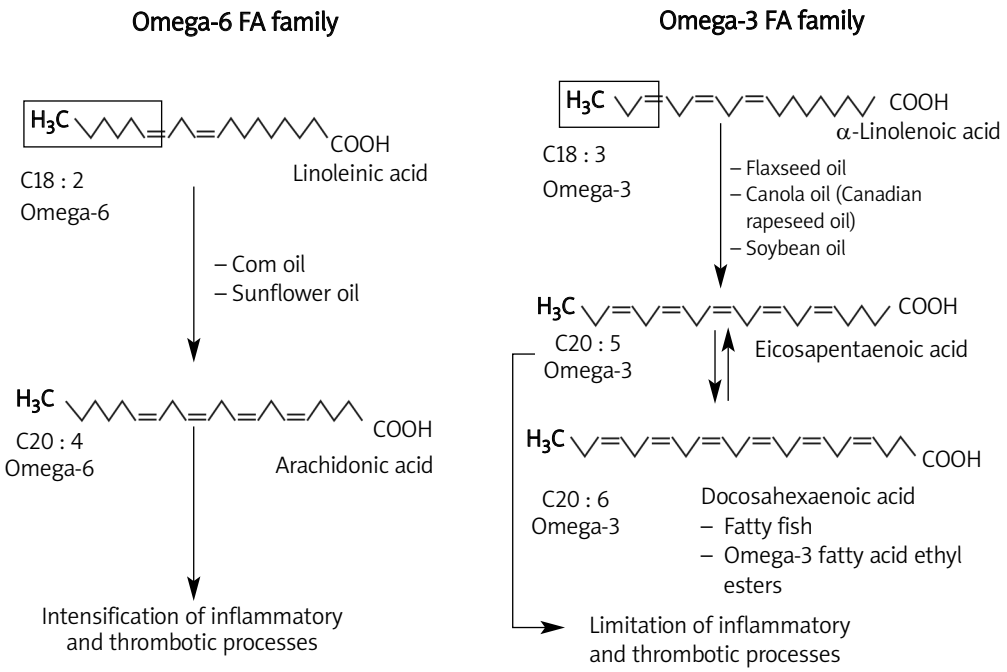

Figure 4. Different roles of omega-3 and omega-6 fatty acids in pathogenesis of atherosclerosis

This may result in excessive consumption of harmful substances. This strongly depends on fish farming conditions and location of fisheries. Recently, the results of detailed analyses of harmful substance content in some fish species, e.g. in omega-3 acid rich salmon, were published [22]. They may imply that in accordance with the recommendations of the US Environmental Protection Agency, due to carcinogenic substance content, salmon from northern Europe should not be consumed more than 5 meals per month [22]. However, consumption of wild Pacific salmon would be allowed 1-5 times a month [22]. Similar relations could be provided for other fish species.

It should also be noted that apart from fish, there are other natural sources of mono- and polyunsaturated fatty acids (Table VI). Fats and oils with high unsaturated/saturated fatty acid ratio and low omega-6/omega-3 acid ratio are preferred.

Attention should be paid to the fact that while omega-3 α-linolenic acid undergoes favourable transformation into EPA and DHA, omega-6 linoleic (linolein) acid is metabolized to arachidonic acid and then to eicosanoids and its excess may have an unfavourable effect (Figure 4) [22].

Unfortunately, the ability of the human body to transform α-linolenic acid into EPA and DHA is limited.

In such a complex situation, administration of highly purified omega-3 acid ethyl esters may be an alternative in secondary prevention after MI. In the GISSI-Prevenzione study (Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto miocardico), the impact of addition of highly purified omega-3 acid ethyl esters to standard treatment after MI was assessed in 11,324 patients [23]. After 3.5 years of follow-up, there was a relative decrease in mortality by 21% and sudden cardiac death by 44% [21]. A significant decrease in total mortality by 41% was observed in the first 3 months of follow-up [24] (Figure 2). Recently, it was also demonstrated in a double-blind randomized study involving over 18,000 Japanese that even with initially high level of fish consumption and administration of statin, adding omega-3 acid ethyl esters reduces the occurrence of serious coronary events in primary and secondary prevention by 19% [24]. In the aforementioned study, the decrease in risk of all types of ACS by approximately 25% deserves attention.

Considering the significance of an appropriate supply of omega-3 acids after MI, the British National Institute for Health and Clinical Excellence (NICE) [7] recently included omega-3 acid ethyl ester (approved for secondary prevention after MI) supplementation as one of the priorities in the UK for the next 3 years [7]. Detailed analysis performed by NICE showed that introduction of omega-3 acid ethyl ester therapy in only 20% of patients after recent MI should allow 2700 British patients to be protected against a second MI within 3 years from implementation of this priority [7].

The NICE guidelines unambiguously recommend use of omega-3 acid ethyl esters, which are approved for secondary prevention after MI [7]. The recommendations of the ESC concerning omega-3 acids are less precise. It should be emphasized that large randomized trials, like GISSI and JELIS, were carried out using omega-3 acid ethyl esters [23, 24].

A simple and safe treatment with n-3 PUFA can also provide a small beneficial advantage in terms of mortality and admission to hospital for cardiovascular reasons in patients with heart failure in a context of usual care. The GISSI-HF investigators undertook a randomised, double-blind, placebo-controlled trial to check whether *n*-3 PUFA could improve morbidity and mortality in a large population of patients with symptomatic heart failure of any cause. Patients given a supplement of *n*-3 PUFA (1 g daily) had a relative risk reduction of 8% of mortality and admissions to hospital for cardiovascular reasons. The benefit was moderate and smaller than expected, however, it was achieved in a population which was already well treated with recommended therapies [25]. According to these findings an increased intake of EPA and DHA represents a valuable tool for vascular disease prevention and should be recommended in patients with chronic heart disease and heart failure [26].

Smoking cessation

Quitting smoking is difficult and this process requires supervision and support. Many placebo-controlled trials have demonstrated the efficacy of individual pharmacotherapies approved for smoking cessation. However, few direct or indirect comparisons of such interventions have been conducted.

Eisenberg *et al*. performed a meta-analysis of randomized controlled trials to compare the treatment effects of 7 approved pharmacologic interventions for smoking cessation (varenicline, nicotine nasal spray, bupropion, transdermal nicotine, nicotine tablet, nicotine gum and nicotine inhaler) [27]. They found that varenicline, bupropion and the 5 nicotine replacement therapies were all more efficacious than placebo at promoting smoking abstinence at 6 and 12 months with ORs of about 2. In the direct comparison of varenicline and bupropion using data from trials with both varenicline and bupropion arms, varenicline was about twice as efficacious as bupropion (OR 2.18, 95% CI 1.09-4.08).

The safety data for the different pharmacotherapies were limited by the inconsistency and quality of reporting in the trials, particularly in the older studies. Most studies reported the number of patients who

stopped treatment because of adverse events as well as the occurrence of nuisance side effects. Recently, the US Food and Drug Administration issued an alert concerning an increase in serious neuropsychiatric symptoms in patients taking varenicline [28]. This alert highlights the need for an in-depth analysis of the safety of these pharmacotherapies. Consequently, there remains a need to develop improved smoking cessation agents and to identify optimal cessation strategies, including alternative ways to use existing agents.

Moderate alcohol consumption

The role played by moderate alcohol consumption remains controversial, especially in secondary prevention. This is demonstrated by editorial articles in leading cardiology journals, such as *European Heart Journal, Journal of the American College of Cardiology, and Circulation* [29]. Reliable epidemiological data show that the relation between the amount of alcohol consumed and total mortality takes the form of a J-curve [29, 30]. It was reported that females consuming 1-2 drinks a day and males consuming 2-4 drinks a day demonstrate lower mortality than teetotallers and persons consuming greater amounts of alcohol [29]. Such a situation may be associated with lower incidence of MI and cardiovascular failure in those persons [29, 30].

The mechanism of protective effect of small amounts of alcohol on the cardiovascular system most probably consists in increase in HDL cholesterol level and insulin sensitivity, as well as in an antiplatelet and anti-inflammatory effect [29]. It is disputable whether alcohol itself, or its combination with polyphenols found in red wine, is responsible for these effects [29, 30]. Currently there is interest in one of those substances, resveratrol. Experiments showed that it reduces angiotensin II activity, increases the nitric oxide level, and reduces platelet aggregation and LDL oxidation [29]. Agonistic effects of resveratrol on sirtuins were also documented. Sirtuins, also referred to as SIRT (silent information regulator two) proteins, are responsible for deacetylation and deactivation of histones, especially factor p53 histone influencing cell ageing [29]. During experiments, its effect resulted among others in life extension of myocytes in the impaired myocardium [29]. Future studies will show whether resveratrol found in red wine is a real longevity factor.

Observational studies on wine consumption in patients after recent MI demonstrated that the risk of cardiovascular complications in persons consuming moderate amounts of alcohol mentioned before, in comparison with teetotallers, was significantly lower, i.e. by 59% [30]. A limitation of the study was the number of patients enrolled (n = 437).

Due to the fact that many questions and doubts concerning the real benefits of moderate alcohol consumption still remain unsolved, we need to be careful with recommendations. In recent ESC guidelines on treatment of patients after MI, the recommendation reads as follows: "Moderate alcohol consumption may be beneficial in those patients" [3].

Influenza vaccination

Both epidemiological data and randomized clinical trials show that influenza vaccination in cardiovascular patients may reduce the frequency of adverse cardiovascular events by as much as 40-50% [5, 31, 32]. In the United States alone, influenza is estimated to cause 91,000 deaths a year, by increasing the incidence of MI [33]. We do not know whether the transient increase in risk is due to a short-term alteration of endothelial function or to other mechanisms, such as changes in plaque composition, white-cell activation, dehydration or bed rest. Clearly, however, it will now be important to establish the mechanisms of and implications for prevention.

The American College of Cardiology (ACC) and the American Heart Association (AHA) recently recommended influenza vaccination in all cardiovascular patients (class I, level B) [5].

Summary

According to the data presented above, there are several non-pharmacological methods of influencing prognosis in coronary patients after MI. The most effective management in patients after MI is multifactor intervention. It should cover not only pharmacotherapy, according to current guidelines, but also aggressive treatment of atherosclerosis risk factors, long-term cardiological rehabilitation, as well as appropriate diet and healthy lifestyle [34-39].

References

1. Opolski G, Filipiak K. Epidemiologia ostrych zespołów wieńcowych. In: Opolski G, Filipiak KJ, Poloński L (eds.). Ostre zespoły wieńcowe [Polish]. Urban & Partner, Wrocław 2002.
2. Van de Werf F, Ardissino D, Betriu A, et al. Management of acute myocardial infarction in patients presenting with ST-segment elevation. ESC Guidelines. Eur Heart J 2003; 24: 28-66.
3. Bassand JP, Hamm CW, Ardissino D, et al. Guidelines for the diagnosis and treatment of non-ST-segment elevation acute coronary syndromes. ESC Guidelines. Eur Heart J 2007; 28: 1598-660.
4. Silber S, Albertsson P, Fernandez-Avilès F, et al. Guidelines for percutaneous coronary interventions. ESC Guidelines. Eur Heart J 2005; 26: 804-47.
5. Smith SC, Allen J, Blair SN, et al. AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 Update. J Am Coll Cardiol 2006; 47: 2130-9.

6. Anderson JL, Adams CD, Antman EM, et al. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non-ST-elevation myocardial infarction. J Am Coll Cardiol 2007; 50: e1-157.
7. NICE clinical guideline 48: Secondary prevention in primary and secondary care for patients following a myocardial infarction. National Institute for Health and Clinical Excellence, London. 2007. Available at: www.nice.org.uk.
8. World Health Organization: Rehabilitation of patients with cardiovascular disease: Report of a WHO expert committee. WHO Technical Report Series, 1964; 270.
9. Piotrowicz R, Dylewicz P, Jegier A. Kompleksowa rehabilitacja kardiologiczna [Polish]. Folia Cardiol 2004; 11 (Suppl A): A1-48.
10. Ades PA. Cardiac rehabilitation and secondary prevention of coronary heart disease. N Engl J Med 2001; 345: 892-902.
11. Dylewicz P, Przywarska J, Borowicz-Bieńkowska S, et al. Wybrane problemy rehabilitacji pozawałowej. In: Opolski G, Filipiak KJ, Poloński L (eds.) Ostre zespoły wieńcowe. Chapter 15 [Polish]. Urban & Partner, Wrocław 2002.
12. Fletcher GF, Baldy GJ, Ezra A, et al. Exercise standards for testing and training. A statement for Healthcare professionals from the American Heart Association. Circulation 2001; 104: 1694-740.
13. American Association of Cardiovascular and Pulmonary Rehabilitation. Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs: Promoting Health & Preventing Disease. 3rd ed. Human Kinetics, Champain, Ill 1999.
14. Dobraszkiewicz-Wasilewska B, Baranowski R, Korzeniowska-Kubacka I, Rydzewska E, Osak J, Piotrowicz R. Porównanie efektów treningu interwałowego i treningu w wodzie u pacjentów po zawale serca i operacyjnym leczeniu choroby wieńcowej. Wyniki wstępne [Polish]. Folia Cardiol 2004; 11: 831-7.
15. Fletcher GF, Balair SN, Blumenthal J, et al. Statement on exercise: benefits and recommendation for physical activity programs for all Americans. A statement for health professional the Committee on Exercise and Cardiac Rehabilitation of the Council of Clinical Cardiology. American Heart Association. Circulation 1992; 86: 340-4.
16. Oldridge NB, Guyatt GH, Fischer ME, et al. Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials. JAMA 1988; 260: 945-50.
17. Sesso HD, Paffenbarger RS. Physical activity and coronary heart disease risk in Men. The Harvard Alumni Health Study. Circulation 2000; 102: 975-80.
18. Task Force on the Management of Stable Angina Pectoris of the European Society of Cardiology; ESC Committee for Practice Guidelines (CPG). Guidelines on the management of stable angina pectoris: executive summary: The Task Force on the Management of Stable Angina Pectoris of the European Society of Cardiology. Eur Heart J 2006; 27: 1341-81.
19. Rosendorff C, Black HR, Cannon C, et al. Treatment of hypertension in the prevention and management of ischemic heart disease. Circulation 2007; 115: 2761-88.
20. Maisch B, Oelze R (eds.). Cardiovascular benefits of omega-3 polyunsaturated fatty acids. IOS Press, 2006.
21. Lin PY, Su KP. A meta-analytic review of double-blind, placebo-controlled trials of antidepressant efficacy of omega-3 fatty acids. J Clin Psychiatry 2007; 68: 1056-61.
22. Domingo JL. Omega-3 fatty acids and the benefits of fish consumption: is all that glitters gold? Environ Int 2007; 33: 993-8.
23. Marchioli R, Barzi F, Bomba E, et al. Early protection against sudden death by n-3 polyunsaturated fatty acids after myocardial infarction: time-course analysis of the results of the Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto Miocardico (GISSI) – Prevenzione. Circulation 2002; 105: 1897-903.
24. Yokoyama M, Origasa H, Matsuzaki M, et al. Effects of eicosapentaenoic acid on major coronary events in hypercholesterolaemic patients (JELIS): a randomised open-label, blinded endpoint analysis. Lancet 2007; 369: 1090-8.
25. Gissi-HF Investigators. Effect of n-3 polyunsaturated fatty acids in patients with chronic heart failure (the GISSI-HF trial): a randomised, double-blind, placebo-controlled trial. Lancet 2008.
26. Tziomalos K, Athyros VG, Karagiannis A, Mikhailidis DP. Omega-3 fatty acids: how can they be used in secondary prevention? Curr Atheroscler Rep 2008; 10: 510-7.
27. Eisenberg MJ, Filion KB, Yavin D, et al. Pharmacotherapies for smoking cessation: a meta-analysis of randomized controlled trials. CMAJ 2008; 179: 135-44.
28. US Food and Drig Administration, Center for Drug Evaluation and Research. Varenicline (marketed as Chantix) information. Washington (DC): US Department of Health and Human Services; 2008 Feb 1. Available at: www.fda.gov/CDER/Drug/infopage/varenicline/default.htm (accessed 2008 May 12).
29. Opie LH, Lecour S. The red wine hypothesis: from concepts to protective signalling molecules. Eur Heart J 2007; 28: 1683-93.
30. de Lorgeril M, Salen P, Martin JP, et al. Wine drinking and risks of cardiovascular complications after recent acute myocardial infarction. Circulation 2002; 106: 1465-9.
31. Gurfinkel EP, Fuente L, Mendiz O, et al. Flue vaccination in acute coronary syndromes and planned percutaneous coronary interventions (FLUVACS) Study. Eur Heart J 2004; 25: 25-31.
32. Madjid M, Naghavi M, Litovsky S, et al. Influenza and cardiovascular disease: a new opportunity for prevention and the need for further studies. Circulation 2003; 108: 2730-6.
33. Poloński L, Gąsior M, Gierlotka M, et al. Ogólnopolski Rejestr Ostrych Zespołów Wieńcowych (PL-ACS). Charakterystyka kliniczna, leczenie rokowanie chorych z ostrymi zespołami wieńcowymi w Polsce [Polish]. Kardiol Pol 2007; 65: 861-72.
34. Kontos MC, Jamal SM, Ornato JP, Tatum JL, Jesse RL, Anderson FP. Comparison of the modification of diet in renal disease and the Cockcroft-Gault equations for predicting mortality in patients admitted for exclusion of myocardial ischemia. Am J Cardiol 2008; 102: 140-5.
35. Jensen MK, Chiuve SE, Rimm EB, et al. Obesity, behavioral lifestyle factors, and risk of acute coronary events. Circulation 2008; 117: 3062-9.
36. Kołodziej K, Drożdż J, Kurpesa M, Bednarkiewicz Z, Krzemińska-Pakuła M. Prognosis and long-term observation of a group of patients with acute coronary syndromes without ST-elevation (ACS-NSTEMI). Arch Med Sci 2006; 2: 164-70.
37. Goch A, Misiewicz P, Rysz J, Banach M. The clinical manifestation of myocardial Infarction in elderly patients. Clin Cardiol 2008; 31: (in press).
38. Banach M, Rysz J, Goch A, Mikhailidis DP, Rosano GM. The role of trimetazidine after acute myocardial infarction. Curr Vasc Pharmacol 2008; 6: 282-91.
39. Banach M, Goch JH, Ugurlucan M, Rysz J, Mikhailidis DP. Obesity and postoperative atrial fibrillation. Is there no connection? Comment on: Wanahita et al. "atrial fibrillation and obesity – results of a meta-analysis". Am Heart J 2008; 156: e5.