

# PARTICULARITIES REGARDING THE COMPREHENSIVE REHABILITATION OF THE REVASCULARIZED DIABETIC PATIENTS

## Part I

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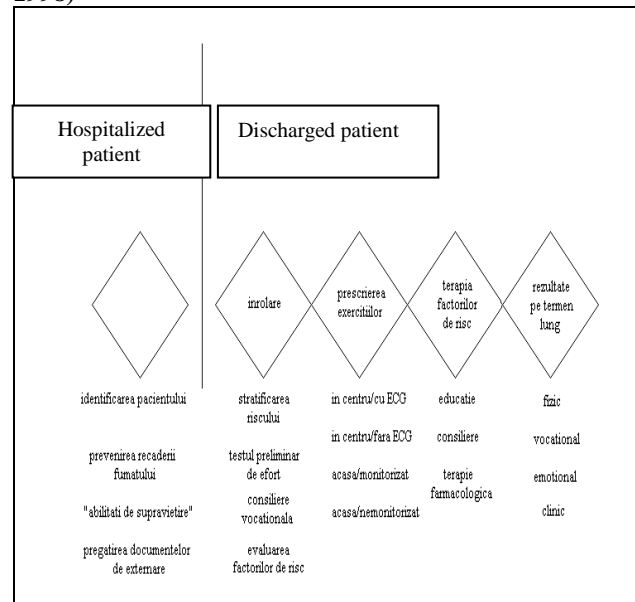
**Abstract:** Comprehensive rehabilitation is a concept developed in order to limit the physiopathologic and psychosocial consequences of the cardiac events and aims at limiting the risk of infarct and of sudden death, at improving the cardiac symptomatology, at delaying or determining the reversion of the atherosclerotic process and at reintegrating the cardiac patients within their family and professional activity with a proper functional status.

**Keywords:** rehabilitation, diabetic patients

**Rezumat:** Reabilitarea comprehensivă este un concept dezvoltat pentru a limita consecințele fiziopatologice și psihosociale ale evenimentelor cardiace și are ca obiective limitarea riscului de reinfarctizare și moarte subită, de ameliorare a simptomatologiei cardiace, de întârziere sau de determinare a reversiei procesului aterosclerotic și de a duce la reintegrarea pacientului cu boală cardiovasculară în familie și activitate profesională cu un status funcțional adecvat.

**Cuvinte cheie:** reabilitare, pacienți diabetici

**Picture no. 1. The component parts of the comprehensive rehabilitation and their development in time (According to Braunwald - Heart Disease, 1998)**



### 1. GENERALITIES. ELEMENTS OF THE COMPREHENSIVE REHABILITATION.

Comprehensive rehabilitation is a concept developed in order to limit the physiopathologic and psychosocial consequences of the cardiac events and aims at limiting the risk of infarct and of sudden death, at improving the cardiac symptomatology, at delaying or determining the reversion of the atherosclerotic process and at reintegrating the cardiac patients within their family and professional activity with a proper functional status.

Generally speaking, its component parts are the physical training, education, counselling and correction of the risk factors.

The period of time for the development of the rehabilitation process is from the coronary event up to an indefinite moment in time, when it becomes part of a lifestyle.

Clinical practice revealed a series of principles of the behavioural change process and there was shaped a number of recommendations for the risk factors management:

### 2. PHYSICAL TRAINING

The aggressive approach of the coronary disease which is possible due to the progress made in the interventional cardiology, as well as the new techniques of surgical revascularization brought about changes in the classical rehabilitation. Thrombolytic treatment, although it reduces the infarcted myocardial mass, most of the times, do not solve definitely the problem of the coronary flux of the involved artery, following the interventional rehabilitation techniques.

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**Table 1: The prevention and rehabilitation objectives**

THE OBJECTIVES OF THE REHABILITATION ARE:
(1) To assist those with low risk cardiovascular diseases in maintaining their status during their entire life and to help those with high risk to reduce it;
(2) To obtain those characteristics that support the health status: The patient: <ul style="list-style-type: none"> <li>○ Should not smoke;</li> <li>○ Should eat healthy;</li> <li>○ Should make 30 minutes/day of moderate physical activity;</li> </ul> Should have: <ul style="list-style-type: none"> <li>○ BMI &lt; 25 kg/m<sup>2</sup> and should avoid central obesity;</li> <li>○ Arterial hypertension &lt; 140/90 mmHg</li> <li>○ Total cholesterol &lt; 190 mg/dl</li> <li>○ LDL-cholesterol &lt; 115 mg/dl</li> <li>○ Glycaemia &lt; 110 mg/dl</li> </ul>
(3) Should obtain a rigorous control of the risk factors in the high risk patients, especially in those with <b>cardiovascular diseases and diabetes</b> , whose: <ul style="list-style-type: none"> <li>○ Arterial hypertension should be &lt; 130/80 mmHg;</li> <li>○ Total cholesterol &lt; 175 mg/dl, aiming at decreasing its level up to &lt; 155 mg/dl;</li> <li>○ LDL-cholesterol &lt; 100 mg/dl, aiming at decreasing it up to &lt; 80mg/dl</li> <li>○ Glycaemia <i>a jeun</i> of 110 mg/dl, while HbA1c &lt; 6.5 %</li> </ul>
(4) To support the cardioprotective therapy in the high risk patients, especially in those with atherosclerotic cardiovascular disease;
According to: <i>European guidelines on cardiovascular disease prevention in clinical practice, 2007.</i>

Covering the above-mentioned therapeutic stages, usually brings about the patient in an acceptable physical condition, by limiting the infraction area and avoiding the prolonged rest. Thus, the length and contents of those three classic stages of the rehabilitation after an infraction are also changed, stage I being avoided or much reduced, stage II being applied immediately after the discharge from the hospital, with good results on the physical activity and stage III that brings the patient in a cardiovascular normal situation or even superior to the condition before the coronary event. In those patients, as well as in those with chronic ischemia but without an infraction, the preliminary effort test, frequently shows a capacity close to the normal limit or even going beyond the inferior limit of 7 METs.

Besides the fact that the coronary disease is potentially evolutive and that the patients are integrated in physical training programmes, they become more adherent to the other elements of the recovery programmes, as well. Physical exercises have benefic effects not only on the increase of the effort capacity. All these represent solid arguments in favour of the comprehensive recovery.

**Table 2: Total cardiovascular risk management – methods for helping the behavioural changes**

TOTAL CARDIOVASCULAR RISK MANAGEMENT METHODS FOR HELPING THE BEHAVIOURAL CHANGES
(1) The development of a relation of sympathy with the patient;
(2) Being sure that the patient understands the relation between disease and lifestyle;
(3) Using this idea in order to modulate the engagement attitude towards the patient;
(4) The involvement of the patients in the identification of the risk factors that must be changed;
(5) Exploring the potential barriers in the process of change;
(6) Facilitating the <i>design</i> of a change plan;
(7) Realism and encouragement - “any improvement in exercise is good and the subsequent evolution is based on this “
(8) Supporting the patients in their efforts;
(9) Monitoring the processes during the supervision visits;
(10) The involvement of other structures of the sanitary system within this process;
According to: <i>European guidelines on cardiovascular disease prevention in clinical practice, 2007.</i>

### Choosing the patients for the physical training programmes

The prescription of the physical training is made based on a preliminary effort. This test is not applied to the patients who are not eligible from the start: those with severe angina, decompensated cardiac insufficiency, uncontrolled arrhythmias. There are also certain limits given by the noncardiac diseases: BPCO, peripheral cardiac disease, cerebral vascular accident, orthopaedic diseases, cases in which special methods of physical training are designed.

Symptom-limited effort test is made immediately after the coronary event, when the medical condition of the patient allows it. Regarding the uncomplicated cases, after a myocardial infraction, the test made be applied 7-21 days after; in case of angioplasty – 3-19 days after and in case of cardiac surgery – 14-28 days after. After the cardiac surgery, the cure of the surgical wounds and the respiratory function will also be taken into consideration when choosing the moment for the effort preliminary effort.

Submaximal test, made immediately before or after the discharge from the hospital is also used. If there is need for the maximal test, this will be done 6-8 weeks after the discharge from the hospital. It has not been proved yet, if the submaximal test is safer than the symptom-limited test. However, making a submaximal test may not reveal important prognostic signs of myocardial ischemia, such as: ventricular dysfunctions,

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arrhythmias, so that most of the present recommendations indicate that the symptom-limited test is more adequate.

The standard protocols used are changed due to the exercise capacity, which during the recovery after a coronary event is reduced.

Bruce protocol increased 2 up to 3 METs in every stage, quickly exceeding the effort capacity of the patients in convalescence. Naughton protocol starts from a small value of the basal effort and increases with one MET in each stage. This gradual progression is better tolerated and allows a better evaluation of the effort capacity. End-points are considered to be: fatigue, dyspnoea, mild angina symptoms, dizziness, claudication, that occur rarely. Signs that represent important end-points are: severe ventricular arrhythmias (such as: ventricular triplets), decrease of the systolic arterial hypertension with more than 20 mHg and the expressed electric ischemia.

In special cases, the effort capacity may be evaluated with great accuracy by the cardiopulmonary functional exploration (*CPX testing*). Unfortunately, there is a reduced number of medical centres that have the necessary equipment for making the effort test with the respiratory gases analysis. The exploration will be done with the Naughton protocol, which will be modified in cycloergometre. CO<sub>2</sub>, consumption and release analysis will be made every minute, necessary for the establishment of VO<sub>2</sub>, up to the occurrence of dyspnoea or fatigue.

### Prescription of the training programmes

Individualized prescription in uncomplicated cases. The prescription of the physical rehabilitation is made individually and is based on the limited-symptom preliminary effort test. The component parts of the prescription are summarized by the acronym FIT (frequency, intensity, time). The minimum frequency for a favourable result regarding the cardiac capacity is of three sessions per week. The intensity is established based on the cardiac frequency and the time for the training sessions is of 30-60 minutes, the length being prescribed individually. Usually, there are precise indications in the national practice guide.

The effect of physical conditioning is obtained from the balance between the intensity and the length of the exercise session. The intensity of the exercise is based on the maximum frequency attained at the preliminary effort test. A reduced intensity is prescribed initially when one-hour session does not make the patient tired. Around 65% of the maximum frequency attained at the preliminary test may be the start limit at the first session. After the cardiac surgery, when the rest frequency may be increased and close to 65% of the frequency achieved upon the preliminary test, it may be started from a frequency of 75%.

The importance of the regular physical exercise from the sanogene perspective is well illustrated and established in the table below:

**Table 3: Clinical benefices of the physical training and the pleiotropic effects**

CLINICAL BENEFICES OF THE PHYSICAL TRAINING AND THE PLEIOTROPIC EFFECTS		
PHYSIOLOGICALLY/ HEALTH AND DISEASE	ON	PSYCHOLOGICALLY/ ON THE QUALITY OF LIFE
Improves the cardiorespiratory and musculoskeletal fitness	the and	Improves the quality of sleep
Improves the metabolic, endocrine and immunologic functions		Reduces depression and anxiety
Reduces the general mortality		Improves the sanogene behaviour
Reduces the risk of cardiovascular disease		Improves the psychological condition
Reduces the risk of cancer (colon, breast)		Improves the quality of life, in general
Reduces the risk of osteoporosis and osteoarthritis		Reduces the risk of falling
Reduces the risk of NID diabetes		
Reduces the risk of obesity		
Increases the fibrinogen activity		
Decreases the blood viscosity		
Decreases the body weight		
Decreases the level of catecholamine		
Increases the fibrillation level		
Improves the endothelial function		
Increases the number of endothelial progenitors cells		
According to: <i>Zdrenghia, Gaita, Dana Pop</i> -Recuperarea moderna a cardiopatiei ischemice-Progrese in cardiologie, 2007, modificat (Modern recovery of the ischemic cardiopathy. Progress in cardiology, 2007, altered).		

Establishing the level of the optimum cardiac frequency – Monitoring through a permanent training programme by VO<sub>2</sub> is impossible. It is known that between 50% and 90% of the top VO<sub>2</sub>, the relation with the cardiac frequency (CVF) is linear. This allows the cardiac frequency to be an excellent guide in establishing the training level.

There are a few methods for the establishment of the cardiac frequency level at the moment of the exercise. As the real maximum cardiac frequency (CF max) remains unknown, F<sub>cm</sub> is estimated based on the following formulae:

$$CF \text{ max estimated} = 220 - \text{age}$$

or

$$CF \text{ max estimated} = 210 - (0,5 \times \text{age})$$

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One of the disadvantages is related to the beta-blocker treatment, when the following formula should be used:

$$CF \text{ max estimated} = 162 - (0.7 \times \text{age})$$

The level of the cardiac frequency at the moment of the exercise (LCFME) may be established by many methods:

- percentage:  $LCFME = CF \text{ max} \times \text{percentage of the CF wished to be attained}$  (requiring corrections when this percentage is below 50% or above 90%)
- reserve cardiac frequency:

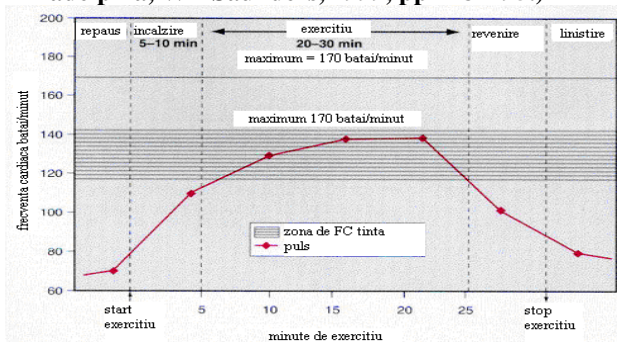
$$\text{Reserve CF (RCF)} = CF \text{ max} - CF \text{ rest}$$

$$LCFME = (\text{RCF} \times \text{VO}_2 \text{ wished to be attained}) + FC \text{ rest}$$

### Component parts of the training session

Physical training sessions may be made individually or in groups and will last one hour at least. Each session comprises a period of warm-up, a period of aerobic muscular effort and a period of recovery.

**Picture no. 2. The pattern of a physical training session, which illustrates the periods of warm-up, exercise and recovery with a representative curve of the cardiac frequency. According to Franklin BA, McCullough PA, Timmis GC: Exercise. In Hennekens CH [ed]: Clinical Trials in Cardiovascular Disease. Philadelphia, WB Saunders, 1999, pp 278–295.)**



Selection of the patients and safety of the training programmes. The safety of the training programmes is the best imposed through the careful selection of the patients and during the effort test. The characteristics of the high risk patients for the cardiovascular complications are presented in table 4.

For these patients, there will be always the tendency to adjust the high-risk favouring conditions, before the recommendations made for the physical training. Those patients, whose risk exceeds the foreseen benefice are advised to refrain from physical training and effort.

The maximum supervision level is necessary in almost 15-25 % of those patients and supposes electrocardiographic permanent monitoring during the training session<sup>5,6,7</sup>. The next level of supervision supposes the assistance made by a personnel with resuscitation qualification. The patients without high risk will participate in supervised training programmes and will be electrically monitored. Very low risk patients will

be able to made the physical sessions individually and safely, after having learnt the way in which the cardiac frequency is monitored and the symptoms occurrence. These patients belong to the group with an effort capacity of 8 or more METs.

**Table 4: Indications for EKG permanent monitoring during the physical training sessions.**

CLINICAL INDICATIONS	OBJECTIVES SIGNS
Severe ventricular dysfunction Congestive cardiac insufficiency Cardiogene shock history	Fraction of ejection < 30 %
Effort-induced severe ischemia	
Complex ventricular arrhythmias (at rest or during the exercices) Cardiac arrest in antecedents	Unsupported ventricular tachycardia
Response with hypotension during the exercise	Decrease of systolic hypertension with 20 mm Hg or more when increasing the charge
Low functional capacity	Maximum effort < 5 METs
Inability of supervising the cardiac frequency by himself	
According to: <i>Braunwald</i> , Heart Disease, 1998.	

All patients should be capable of monitoring their pulse and to recognize the symptoms during the exercise. The concept of target frequency should always be reminded, both in groups and individually; those who cannot understand these criteria should be addressed to the type of training strictly supervised.

Despite the cardiovascular complications potential presented during the training sessions, the training sessions register a larger rate of safety. In 167 supervised programmes, the incidence of the fatal complications was of 1.3 to a million, regarding the myocardial infraction - 3,4 and of cardiac arrests resuscitated 8.9 times. There were no significant differences between the programmes monitored permanently and those intermittently monitored<sup>8</sup>.

### Physical recovery of the patients with acute, revascularized myocardial infraction

*Stage I* of the recovery has suffered a substantial reduction, first of all due to the good hemodynamic remaining performance and due to the reduction of the hospitalization period of time. Physical activity will be resumed immediately after the disappearance of pains and after hemodynamic stabilization, maximum 12 hours after the intervention, when the patients may rise from the bed

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or lay on the edge of this. On the second day, it is allowed to wash themselves or to move around the room, then gradually, during those 4-5 days of hospitalization, the patients may move outside their hospital room and at the end of the hospitalization period of time, the climbing of 1-2 floors will be possible. The assistant or the kinetotherapeut will supervise the patient mainly in order to detect an increase of the cardiac frequency with more than 10-20 beats/minute, when passing in orthostatic position or the decrease of the arterial hypertension. Symptoms-limited preliminary effort test will be made 1-2 weeks after, before the inclusion in a programme of institutionalized recovery. The other rehabilitation measures refer to informing the patients on the disease and its causes, on the evolutive possibilities and on the therapeutic and preventive measures, insisting on the risk factors, especially regarding the diabetes complications, the importance of the glycaemia control. Psychological assistance, specialized or not, may be important in order to accept the idea of the disease and the rules imposed by its subsequent evolution. The idea of changing the lifestyle is stressed, emphasising the importance of the supported physical activity, but ensuring that this activity is not harmful.

**Stage II** follows the intermediary period of time of 1-2 weeks, when the patient is at home and advised to practice easy physical exercises and only if these were prescribed during the hospitalization period of time, or the exercise the patient used to make before the coronary event. The patient will take repeated walks of 2-30 minutes. Much interest will be paid on the food diet and smoking quitting, while the sexual activity will be resumed with precautions. The patient will be re-evaluated from the metabolic point of view and glycaemia will be strictly controlled. Subsequently, the patient will address to an institutionalized recovery setting or will establish a recovery programme at home.

A large number of patients will have the capacity of effort between 5 and 7 METs, which represents a mild risk; an intense physical training programme may be initiated for these patients (the value of 7 METs was previously considered the target of the patients' recovery after the effort!).

A reduced number of patients will have their effort capacity below 5 METs, representing a mild or increased risk; regarding these patients, the intensity of the training will be monitored through EKG in certain situations during the training. They will be divided in two subgroups: with and without cardiovascular complications. Those with cardiovascular complications will be submitted to special programmes.

Recently, there have been described two risk categories:

**Table 5: CLASS B – Stabilized ischemic cardiopathy, with low risk for the occurrence of certain complications during rigorous physical efforts. Slightly increased risk in comparison with the healthy looking individuals.**

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The classification comprises persons with one of the following diagnoses:

1. ischemic cardiopathy (myocardial infraction, aorto-coronary by-pass, postangioplasty condition, pectoral angina, abnormal effort test, abnormal coronography) stabilized with the following clinical characteristics (any of the following):

- a. class NYHA I or II;
  - b. effort capacity  $\geq$  6 METs;
  - c. without signs of congestive cardiac insufficiency;
  - d. without signs of myocardial ischemia or angina at rest or during the exercises  $<$  6 METs;
  - e. corresponding increase of the systolic arterial hypertension during the effort;
  - f. absence of ventricular tachycardia, supported or unsupported at rest or during the effort test;
  - g. the patients capable of adapting the intensity of the activity;
2. changes during the effort test that do not belong to the high risk criteria contained in class C;

According to: *Zdrengheta, Gaita, Dana Pop-Recuperarea moderna a cardiopatiei ischemice - Progrese in cardiologie, 2007. (Modern recovery of the ischemic cardiopathy. Progress in cardiology, 2007).*

**Stage III** of recovery may last indefinitely, the physical training being about to turn into a lifestyle. Certain authors insert a IVth stage of recovery, corresponding to the present third stage, which would become a limited stage 6-12 months after and in which the physical training is still made under supervision in recovery centres. The observation that the patients who make the physical training in recovery centres are more responsive to the other methods of recovery is extremely useful in the diabetic patients, because in such cases, reocclusion is more frequent, their monitoring and metabolic control being extremely necessary. 6-12 months after, secondary prevention is well implemented, the patient being physically trained. The weight, glycaemia, medication are under the control, as well as the risk factors in case of reverting to the old lifestyle.

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**Table 6: CLASS C – Patients with moderate-high risk for the cardiac complications during the effort and/or patients unable of self-adapting the activity or of understating the recommendations at effort level.**

<p><b>CLASS C – CLASS C – Patients with moderate-high risk for the cardiac complications during the effort and/or patients unable of self-adapting the activity or of understating the recommendations at effort level.</b></p>
<p>The classification comprises the persons with one of the following diagnoses:</p> <ol style="list-style-type: none"> <li>1. ischemic cardiopathy with the following clinical characteristics (any of the following): <ol style="list-style-type: none"> <li>a. class NYHA II or III;</li> <li>b. effort test with the following results: <ul style="list-style-type: none"> <li>• effort capacity &lt; 6 METs;</li> <li>• angina or segment subdenivelation occurred at 6 METs;</li> <li>• Decrease of the systolic arterial hypertension below the values at rest;</li> <li>• Unsupported ventricular tachycardia during the effort test;</li> </ul> </li> <li>c. cardiac arrest in antecedents (that did not occur within the context of an acute myocardial infraction or of certain procedures);</li> <li>d. the existence of a medical problem the physician considers threatening the patients' life;</li> </ol> </li> <li>2. insufficiently controlled ventricular arrhythmia.</li> </ol>
<p>According to: <i>Zdrenghea, Gaita, Dana Pop-Recuperarea moderna a cardiopatiei ischemice - Progrese in cardiologie, 2007</i> (Modern recovery of the ischemic cardiopathy. Progress in cardiology).</p>

### Particularities of the physical rehabilitation in the diabetic patients

Each diabetic patient will be evaluated before the physical training programme, either if he participates in moderate physical exercises programmes (40-60% of  $VO_{2max}$ ) or intense ones (> 60%  $VO_{2max}$ ). When the patient's history is analysed, it is important to emphasize the following aspects:

1. presence and absence of certain acute or chronic complications and for those chronic – their stage;
2. laboratory value of  $HbA_{1c}$ , plasmatic glucose and proteinuria;
3. hypertension;
4. results of glycaemia self-monitoring;
5. body weight and body mass index;
6. medication and administration way;
7. history of other training programmes;
8. diet and the type of food previously to the coronary event;
9. other clinical entities besides diabetes.

**Table 7: Absolute counter indications of the effort test**

<p style="text-align: center;"><b>ABSOLUTE COUNTER INDICATIONS OF THE EFFORT TEST</b></p> <ol style="list-style-type: none"> <li>1. acute myocardial infraction or other acute coronary event in the first 2 days;</li> <li>2. electric alterations suggestive for ischemia, myocardial infraction or other acute coronary event;</li> <li>3. instable angina that could not be stabilized through therapy;</li> <li>4. uncontrolled cardiac arrhythmias that bring about symptoms or hemodynamic compromising;</li> <li>5. severe symptomatic aortic stenosis;</li> <li>6. uncontrolled symptomatic cardiac insufficiency;</li> <li>7. acute pulmonary emboly and pulmonary infraction;</li> <li>8. endocarditis and acute myocarditis;</li> <li>9. aortic or ventricle dissection aneurysm, suspected or recognized;</li> <li>10. acute infectious diseases (flu, rinofaringitis)</li> </ol>
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**Table 8: Potential side effects in the patients with diabetes mellitus**

<p style="text-align: center;"><b>POTENTIAL SIDE EFFECTS IN THE PATIENTS WITH DIABETES MELLITUS</b></p>
<p><b>CARDIOVASCULAR</b></p> <p>Cardiac dysfunctions and arrhythmias attributable to the myocardial ischemia (frequently silent); Excessive increase of the hypertension during the exercises; Hypotension in orthostatic position after the exercises.</p>
<p><b>MICROVASCULAR</b></p> <p>Retina bleedings; Proteinuria increase; Acceleration of the microvascular lesions;</p>
<p><b>METABOLIC</b></p> <p>Worsening of the hyperglycemia and ketosis control; Hypoglycaemia in the insulin-treated patients.</p>
<p><b>MUSCULOSKELETAL AND TRAUMATIC</b></p> <p>Perforating ulcer of the foot (especially in the presence of neuropathy); Orthopaedic lesions related to neuropathy; Acceleration of the articular degenerative disease; Ocular lesions and retina bleedings.</p>
<p>According to: <i>American Diabetes Association, 1993, "Exercise and NIDDM (Tehcnical Review)", Diabetes care 16:54-58.</i></p>

Recommended exercises – endurance and resistance training and a series of easy exercises may be recommended in the majority diabetic patients. For those patients who are also recommended to loose weight (especially for the patients with diabetes type 2) are recommended to loose a total of minimum 1000 kcal/week in aerobic activities and to participate in resistance physical training<sup>10,11</sup>.

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There are general prescriptions contained in guides, but the circumstances of each patient should determine the individualized adaptation of the training programmes.

It was proved that the inclusion of the non diabetic patients in a resistance training programme improves the tolerance to glucose and insulin sensitivity.

**Table 9: Summary of the recommendations of the diabetic patients' physical training**

Type: aerobic <ul style="list-style-type: none"><li>- Manner: walking, riding a bike, swimming;</li><li>- Frequency: 3-5 times per week or most of the week days;</li><li>- Length: 20-60 minutes;</li><li>- Intensity: 50-75 % of the maximum aerobic capacity;</li><li>- Energy spent: an average is estimated between the manner, frequency, length and intensity, so that a quantity of 700-2000 kcal/week should be obtained;</li><li>- Schedule: time of physical training should correspond to the top hour of insulin action;</li></ul>
Type: resistance training <ul style="list-style-type: none"><li>- Manner: lifting loads, walking on elastic strip;</li><li>- Frequency: 2 times per week at least, never on consecutive days;</li><li>- Length: sessions of 10-15 rehearsals; 1-2 sessions for each type of the exercise;</li><li>- Intensity: around 60 % of the aerobic capacity;</li></ul>
Type: free movements <ul style="list-style-type: none"><li>- Manner: static stretching;</li><li>- Frequency: after the aerobic sessions;</li><li>- Length: 10-30 seconds for each exercise for each muscle groups;</li></ul>
<b>SPECIAL CONSIDERATIONS</b> <ul style="list-style-type: none"><li>- Special attention will be paid for the vascular and neurological complications, including silent ischemia that may lead to the change of the training prescriptions or to counter indicate the physical effort;</li><li>- EKG in the patients with recognized or suspected coronary disease, in those with diabetes type 1 above the age of 30, in those who have been suffering from diabetes type 1 more than 15 years or in those with diabetes types II above the age of 35;</li><li>- Training the patients for the warm up period of time;</li><li>- Carefully choosing the type and the intensity of the exercises;</li><li>- Promoting the patient's education;</li><li>- Encouraging the patients to wear suitable shoes;</li><li>- Preventing the patients against making efforts in conditions of extreme temperatures;</li><li>- Teaching the patients to avoid the physical effort in case of deficient metabolic control;</li><li>- Maintaining a proper hydration of the patient;</li><li>- Encouraging the patient to monitor the glycaemia and to prevent hypoglycaemia.</li></ul>
According to: American Diabetes Association, 2002, <i>Handbook of Exercise in Diabetes</i> .

### Considerations on the physical training of the revascularized patients

The graduated effort test is made for the patients who have suffered a revascularized procedure in order to establish the cardiovascular functional status. The moment in which this test may be made remains controversial.

All patients who have successfully benefited from an aortocoronary *by-pass* will be make an effort test before the prescription of a monitored training programme, this evaluation having a proved clinical benefice and a possible reduction of the subsequent financial burden <sup>12</sup>. A proper moment for making the effort test is the moment in which the pain from the incision area has been solved, the blood value and the haemoglobin level normalized and the muscular force has been partially recovered through low effort exercises and active mobilization.

3-4 weeks are needed after the surgery, in order that the patient should be able to make an effort close to the minimum physiological effort, so that the test should be accurate in assessing the cardiovascular functional capacity; this test may appreciate whether the patient may return to work or resume sports activity with large energy consumption. The patients whose results after the surgery are not satisfactory, or who have symptoms suggestive for the myocardial ischemia will make the test effort and will make the physical training according to their functional capacity.

There are also a lot of discussions regarding the optimum moment for making the test effort after the coronary angioplasty. The effort test in the patients with incomplete PTCA is accepted as a standard practice. *Gruentzig and co* <sup>13</sup> made effort tests in the first 2 days after the procedure without complications. There is enough evidence that in the first 2 days after PTCA, the effort test may be made in order to assess the functional status of the revascularized patient. Like in the case of CABG, the effort test for the stent patients with a view to prescribe the physical training is still under debate. The patients who have recurrent angina symptomatology are recommended to make a diagnosis effort test.

Regarding the successfully revascularized asymptomatic patients, the probability of a negative effort test is very high, immediately after the procedure. The correct attitude is to integrate the patient in a physical training programme of low level and to test the functional capacity.

Regarding the patients with angioplasty, with or without a stent, the first problem that must be taken into consideration is restenosis. On the first meeting, the patient will be questioned about angina symptoms. The educational programme will also comprise the elements related to how to recognize the symptomatology of angina, as well as the way in which the patient should react (nitro-glycerine administration or calling the emergency unit etc.). This category of patients may be included in programmes, either immediately after the procedure, or after their discharge from the hospital.

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The exercise programmes may ameliorate the progression of the coronary atheromatosis after angioplasty, through the inhibition of the proliferation of the muscle cells, decrease of the plasmatic lipids. It was proved that 30-40 minutes of aerobic training, 4-6 times a week for 12 weeks improve the physical performances of the patient, as well as the restenosis rate 3 months after angioplasty. Moreover, this makes the patient feel better, improves depression, reduces the stress and improves the quality of sleep. Due to angioplasty, many patients with low risk profile are referred to rehabilitation programmes (for example: the patients with increased exercise capacity, without ischemia evidence, with ventricular normal function, without arrhythmias). The typical patient is a young person, monovascularized, without a past myocardial infarction. Regarding the physical training programmes, these may be assimilated to apparently healthy persons, but they are included in the educational programmes for recognizing the symptoms of angina, self-care and changing the risk factors. But, why do these patients need rehabilitation? The answer to this question is given by the possibility of restenosis and its early detection, as well as by all the processes of slowing the atherosclerotic process<sup>14,15</sup>.

Recommending the exercises. Over the last decade, the hospitalization period of time has been reduced and is still reducing with almost half a day/year. In the countries where the health systems function well, a case of *by-pass* without complications may be discharged 15 days after the procedure. Even if the hospitalization period is short, the rehabilitation programme should start with easy exercises, mobilization and training the patient regarding the therapeutic plan, activities allowed immediately after the discharge and the objectives aimed at ambulatorily. All efforts will be taken for the patient to be included in a programme of ambulatory rehabilitation.

*Cardiovascular training.* The initial exercises will be guided according to the information obtained on the first interview, before the coronary event. The patient is carefully monitored, in order to detect the possible symptoms and to assess the tolerance correctly. Start programmes will include walking on a rolling carpet (5-10 minutes), ergonomic bike (5-10 minutes), combined ergonomic programmes including the lower and upper limbs (5-10 minutes) with an intensity of 2-3 METs. The cardiac frequency, arterial hypertension, signs and symptoms will be monitored and registered. The programmes will be progressively titrated upon the first session up to the level of 11-14 on the effort scale, in the absence of any sign or symptom. Generally, the intensity of the exercises may increase with 0.5-1 MET, rate based on signs and symptoms, the occurrence of certain abnormalities and starting from the correct assessment of the initial effort capacity.

*Resistance training.* The exercises of muscle force and muscle endurance will be correlated with that of cardiovascular endurance and flexibility even from the early period after hospital discharge. According to the clinical and physical status, 10-12 sessions of walking on

elastic strip, lifting loads etc will be made. The patient will be trained to avoid the irregular breathing and Valsalva-type manoeuvres. By-pass patients will start the resistance training 4 weeks after the procedure, when the sternal stability is safe and the exercise does not produce any discomfort. After angioplasty, the resistance training may start immediately. The exercises will start with the important muscles that are used daily for moving and caring. The loads will be chosen so that to allow 10 rehearsals of movements any only 3 should be felt as being more difficult to lift. 2-3 sessions of 10-12 rehearsals will be tried afterwards.

*Series of movements.* Each session of exercise will start with active movements for the increase of the articular flexibility, in order to improve the movement amplitude in articulations. The exercises may start standing or sitting, bending and turning the head, limbs and arms.

## CONCLUSIONS

The progress made in the revascularized procedures and the increase of the life length of the coronary patients will bring about more and more requests for the rehabilitation programmes. Besides the change of the risk factors, the physical training programmes are essential in preventing the reocclusion.

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## CLINICAL ASPECTS

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