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SOUTH AMERICAN GUIDELINES FOR CARDIOVASCULAR DISEASE PREVENTION AND REHABILITATION

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South American Guidelines for Cardiovascular Disease Prevention and Rehabilitation

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Summary

South American Guidelines for Cardiovascular Disease Prevention and Rehabilitation

Realization

Joint position of the South American Society of Cardiology and Interamerican Commitee of Cardiovascular Prevention and Rehabilitation - portuguese version reviewed by the Brasilian Society of Cardiology

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South American Guidelines for Cardiovascular Disease Prevention and Rehabilitation
the last three years the author / developer of the Guidelines:

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Background

In this document, the Inter-American Committee of Cardiovascular Prevention and Rehabilitation, together with the South American Society of Cardiology, aimed to formulate strategies, measures, and actions for cardiovascular disease prevention and rehabilitation (CVDPR). In the context of the implementation of a regional and national health policy in Latin American countries, the goal is to promote cardiovascular health and thereby decrease morbidity and mortality. The study group on Cardiopulmonary and Metabolic Rehabilitation from the Department of Exercise, Ergometry, and Cardiovascular Rehabilitation of the Brazilian Society of Cardiology has created a committee of experts to review the Portuguese version of the guideline and adapt it to the national reality.

The mission of this document is to help health professionals to adopt effective measures of CVDPR in the routine clinical practice. The publication of this document and its broad implementation will contribute to the goal of the World Health Organization (WHO), which is the reduction of worldwide cardiovascular mortality by 25% until 2025.

The study group's priorities are the following:

- Emphasize the important role of CVDPR as an instrument of secondary prevention with significant impact on cardiovascular morbidity and mortality;
- Join efforts for the knowledge on CVDPR, its dissemination, and adoption in most cardiovascular centers and institutes in South America, prioritizing the adoption of cardiovascular prevention methods that are comprehensive, practical, simple and which have a good cost/benefit ratio;
- Improve the education of health professionals and patients with education programs on the importance of CVDPR services, which are directly targeted at the health system, clinical staff, patients, and community leaders, with the aim of decreasing the barriers to CVDPR implementation.

Guidelines

I. INTRODUCTION

In the last 4 decades, CVDPR has been recognized as an important tool in the care of patients with cardiovascular disease (CVD). The role of the CVDPR services in the secondary prevention of cardiovascular events is recognized and accepted by all health organizations; however, the guidelines for CVDPR implementation have not yet been adapted to the needs and resources of Latin America. Therefore, the South American Society of Cardiology took the initiative of developing this guideline.

Justification for cardiovascular rehabilitation/secondary prevention

A preventive strategy for clinical practice should be developed on the basis of cardiovascular rehabilitation for the following reasons:

1. CVDs are the leading cause of death in most countries. They are an important cause of physical incapacity and disability and contribute significantly to the increase in health costs;
2. Atherosclerosis can develop insidiously over decades and its clinical manifestations are only observed in advanced stages of the disease;
3. Most CVDs are closely associated with lifestyle as well as with physiological and biochemical factors;
4. CVDPR-promoted changes in the risk factors decrease the morbidity and mortality due to CVD, especially in individuals classified as high risk;
5. The prevalence of CVD and of risk factors, such as obesity, smoking, diabetes mellitus (DM), and systemic arterial hypertension has increased in the last decades;
6. Despite the known beneficial effect of CVDPR on patients with CVD, only 5%–30% patients eligible to participate in rehabilitation programs are referred to such programs. The percentage in Brazil is probably even lower;
7. Relatively few patients are referred to cardiovascular rehabilitation programs by physicians worldwide;
8. There are no specific CVDPR guidelines that contemplate the particularities of Latin American countries;
9. No certification programs for CVDPR services are available in Latin America till date.

The development of this guideline includes a detailed review of the various topics presented as well as a classification of the recommendations and evidence levels used (Table 1).

Drafting committee

The drafting committee was nominated in March 2010 by the South American Society of Cardiology, in a joint work with the Mayo Clinic of Rochester, Minnesota, United States of America. This committee comprises 1 member from each of the following Societies of Cardiology in Latin America: Venezuela, Brazil, Argentina, Chile, Peru, Colombia, Uruguay, and Paraguay. In addition to these members, the committee relied on the cooperation of a group of specialists from the Mayo Clinic.

II. METHODOLOGY

Definition of cardiovascular rehabilitation/secondary prevention

According to WHO, cardiovascular rehabilitation is "the sum of the actions required to guarantee the best physical, psychological, and social conditions so that patients with CVD may maintain their role in society by their own efforts"[1].

Eligibility criteria of patients for cardiovascular rehabilitation/secondary prevention

There is evidence that both formal exercise programs and increase in the levels of physical activity are associated with a marked reduction in mortality in individuals with and without coronary artery disease[2-6]. In a study conducted in Olmsted, Minnesota, with patients who participated in CVDPR programs, Roger et al.[7] observed a reduction of 25% in the rate of cardiovascular events for each metabolic equivalent (MET) increase in functional capacity. An increase of 1 $mL \cdot kg^{-1} \cdot min^{-1}$ in maximum oxygen consumption leads to a decrease in mortality of approximately 10% during an RCV program[8,9]. The patients eligible for cardiovascular rehabilitation in the context of secondary prevention exhibited at least one of the following cardiovascular events in the past year:

Table 1 – Classification of recommendations and levels of evidence

Recommendation classes
Class I: There is a general agreement that the method or procedure is beneficial, useful, and effective. A class I indication does not mean that the procedure is the only one acceptable
Class II: There is difference of opinion regarding the justification and usefulness of the method or procedure. It is acceptable, but may be controversial Class IIa: The weight of evidence indicates usefulness or effectiveness Class IIb: The weight of evidence is not very well established regarding the usefulness or efficacy
Class III: There is general agreement that the method or procedure is not indicated or justified. In some cases, it may even be dangerous
Levels of evidence
A: Solid evidence, from multiple randomized clinical trials or meta-analyses with adequate design to reach statistically significant conclusions
B: Weak evidence, derived from a simple nonrandomized study or from several nonrandomized studies
C: Expert opinion, small studies, or registries

- Acute myocardial infarction (AMI)/acute coronary syndrome (ACS)
- Coronary artery bypass grafting (CABG)
- Coronary angioplasty
- Stable angina
- Valve repair or replacement
- Heart or heart–lung transplantation
- Chronic heart failure
- Peripheral vascular disease
- Asymptomatic coronary artery disease
- Patients at high CVD risk

O'Connor et al. performed a meta-analysis of 22 studies of CVDPR in post-AMI patients and observed a reduction in total mortality, cardiovascular mortality, and fatal AMI of 20%, 22%, and 25%, respectively[10]. In a study that involved 600,000 beneficiaries of the American Medicare system, Suaya et al.[11] observed that those who participated in a CVDPR program exhibited a reduction in mortality of 34% after a 5-year follow-up.

Patients ineligible for out-of-hospital cardiovascular rehabilitation

The contraindications for physical exercise in a cardiovascular rehabilitation program have been modified and are becoming increasingly complex. Although listed as absolute contraindications (Table 2), several of these conditions may be deemed as temporary because after the stabilization of the acute phase, patients can initiate or resume regular exercise programs.

Objectives of cardiovascular rehabilitation

The pillars of cardiovascular rehabilitation and secondary prevention are as follows: lifestyle modifications with an emphasis on regular physical activity, adoption of healthy feeding habits, smoking and drug use cessation, and stress managing strategies. A CVDPR program should aim to improve the physiological and psychological status of cardiac patients and should be based on a multidisciplinary intervention (exercise program, education, clinical evaluation, nutritional evaluation, etc.).

Therefore, the objectives of cardiovascular rehabilitation are the following:

1) Assist patients with known CVDs or at high risk of developing them;
2) Rehabilitate patients in a comprehensive manner by offering physical, mental, social, vocational, and spiritual support;
3) Educate patients to adopt and maintain healthy habits through lifestyle modifications with or without pharmacological and/or surgical treatment;
4) Decrease disability and promote lifestyle modifications through the proactive engagement of patients in health promotion;
5) Improve quality of life;
6) Prevent new cardiovascular events;
7) Strictly control of risk factors.

Table 2 – Absolute contraindications to physical exercise in out-of-hospital cardiac rehabilitation programs (Phases 2, 3, and 4)

1. Very recent acute myocardial infarction (< 72 h)
2. Unstable angina (< 72 h after stabilization)
3. Severe symptomatic valvular heart diseases requiring surgery — Rehabilitate only after surgery
4. Uncontrolled hypertension: SBP > 190 mmHg and/or DBP > 120 mmHg
5. Uncompensated cardiac failure
6. Serious, complex ventricular arrhythmias
7. Suspected lesion of the left main coronary artery, unstable or severe
8. Infectious endocarditis, myocarditis, pericarditis
9. Severe untreated symptomatic congenital heart diseases
10. Thrombophlebitis and pulmonary embolism — acute phase
11. Aortic dissection — type A or acute phase type B
12. Symptomatic and severe left ventricular outflow tract obstruction with low effort-induced output
13. Uncontrolled diabetes mellitus
14. All acute systemic infections

SBP: systolic blood pressure; DBP: diastolic blood pressure.

For a CVDPR program to be successful, the interventions should be made in agreement with the health provider, the cardiologist, and/or family physician, to optimize and monitor long-term interventions.

III. DEVELOPMENT OF A CARDIOVASCULAR REHABILITATION PROGRAM

Risk stratification of patients referred to a cardiovascular rehabilitation program

To assess the potentials risks complications of exercise, patients should be stratified according to the classification proposed by the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR)[12] (Table 3).

Patients in the low-risk category can be monitored using electrocardiography (ECG) or Heart rate monitor during the first 6–18 sessions, preferably under clinical supervision. A gradual reduction in supervision between sessions 8 and 12 is desirable. Low-risk patients could also be referred to semi-supervised CVDPR programs or distance supervision, depending on their individual assessment.

Patients at intermediate risk should be monitored during the first 12–24 sessions, preferably by continuous ECG monitoring and permanent medical supervision, which should be decreased to intermittent monitoring after the last session. In addition, the monitoring frequency and methods adopted depend on the available resources, capacity of each institution, and patient status and progression[12].

Greater supervision should be used for patients categorized as high risk and when changes in health status, new symptoms, or any other evidence of disease progression are observed.

Table 3 – Stratification for risk of events according to AACVPR

Low risk
1. No significant left ventricular dysfunction (ejection fraction > 50%)
2. No complex arrhythmias, both at rest or exercise induced
3. Uncomplicated myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty
4. Absence of congestive heart failure or signs/symptoms indicating post-event ischemia
5. Asymptomatic, including absence of angina with effort or in the recovery period
6. Functional capacity ≥7 METS (in incremental stress test)*
Moderate risk
1. Moderate left ventricular dysfunction (ejection fraction 40%–49%)
2. Signs/symptoms, including angina, at moderate levels of exercise (5–6.9 METS) or in the recovery period
High risk
1. Severe impairment of left ventricular function (ejection fraction <40%)
2. Survivors of cardiac arrest or sudden death
3. Complex ventricular arrhythmias at rest or with exercise
4. Myocardial infarction or cardiac surgery complicated with cardiogenic shock; congestive heart failure; and/or signs/symptoms of postprocedural ischemia
5. Abnormal hemodynamics with exercise (especially depressed curve or drop in systolic blood pressure, or chronotropic incompetence not related to medication with increasing load)
6. Functional capacity < 5 METS*
7. Symptoms and/or signs, including angina at a low level of exercise (< 5 METS) or in the recovery period
8. Ischemic ST-segment depression during exercise (> 2 mm)
The presence of some of the risk factors included in this category is considered as high risk

**If the measure of functional capacity is not available, this variable should not be used alone in the process of risk stratification. However, it is suggested that, if the patient is able to climb 2 flights of stairs presenting good tolerance, it can be inferred that his/her functional capacity is at least moderate*

Monitoring can also be a useful strategy for assessing response to physical activity, especially when the intensity of aerobic exercise is increased.

Patient safety and monitoring

Potential cardiac complications during cardiovascular rehabilitation programs are as follows: cardiac arrest, arrhythmias, and AMI, among others (Table 4). The incidence of cardiac arrest is relatively low. According to studies conducted by Van Camp and Peterson[13], with data from 167 American CVDPR programs involving 51,303 patients, more than 2 million hours of exercise were performed between 1980 and 1984. In this period, 21 patients sustained cardiac arrest, among which 18 patients were resuscitated and survived (only 3 cases were fatal)[13]. It is estimated that the rate of a major complication, such as cardiac arrest, death, or AMI, is 1 for every 60,000–80,000 h of supervised exercise[14].

To achieve increased safety during physical exercise in a rehabilitation session, a comprehensive assessment of the patient is advised with the aim to define the level of CVD risk, individualized exercise programs, and adequate monitoring. Clinical supervision is the most important safety factor in CVDPR. A CVDPR specialist with experience in the management of complications should be present during each exercise session. In the absence of such specialist, the presence of staff qualified in emergency cardiopulmonary resuscitation is indicated. Of note, patients should be educated on self-assessment involving the presence of symptoms, perception of effort during exercise, well-being, risk limits, and immediate measures that should be adopted, such as informing the rehabilitation team about their symptoms, and stopping exercise[15,16].

The guidelines on clinical supervision of patients during secondary prevention programs remain to be a debated topic[12]. The level of clinical supervision is related to age, diagnosis, comorbidities in participants of rehabilitation programs, duration of recovery after the cardiovascular event, and the progression achieved during each session.

The number of sessions under ECG monitoring is not a measure of quality of the exercise program. This type of monitoring is a strategy adopted by each team according to a local protocol[12,15].

Components of the cardiovascular rehabilitation program

According to the guidelines of the American Heart Association (AHA), AACVPR, and the American College of Cardiology (AHA/AACVPR/ACC)[12], a CVDPR program includes the comprehensive care of patients with CVD and chronic heart failure (class I evidence). CVDPR should include a consistent multidisciplinary approach, not only with regard to exercise but also to educational work aimed to control

Table 4 – Event rate in cardiac rehabilitation[3]

In patients with heart disease who perform regular physical activity, the following has been described:
Event rate of 1:112,000 patients/h Myocardial infarction rate of 1 per 300,000 patient hours Mortality rate of 1:790,000 patients/h
The risk of death is approximately 1:60,000 participants/h during programs with supervised cardiac rehabilitation exercise and physician on site

risk factors through lifestyle changes. The components of the CVDPR program are shown in Table 5.

Competencies of the Rehabilitation Staff

A CVDPR program is integrated by a multidisciplinary team (Table 6), which requires the following competencies: basic knowledge in the cardiovascular, pulmonary, and musculoskeletal areas, ECG analysis, medical emergency management, and theoretical and practical knowledge regarding physical exercise. The core team is composed by physicians, nurses, and exercise specialists, with the option of including specialists from other disciplines to provide complete health care and education (nutritionists and psychologists, among others). The core team should have experience in the management of CVD risk factors, psychosocial assessment and intervention, and lifestyle changes.

Phases of cardiovascular rehabilitation

Numerous investigations have demonstrated the importance of early and progressive physical activity within a CVDPR program after an AMI or CABG. The program consists of 3 or 4 phases (Table 7), depending on the different schools[12,17].

Initial patient evaluation

At the start of a rehabilitation program, the initial assessment of the patient must include obtaining an exhaustive and thorough medical history, which includes details regarding previous surgical procedures and comorbidities, such as cardiovascular, renal, pulmonary, and musculoskeletal diseases, as well as depression and other relevant information. During the initial evaluation, it is paramount to identify CVD risk factors, such as smoking, poor feeding habits, blood pressure (BP), Diabetes, dyslipidemia, obesity, physical inactivity, and stress. In addition to the information regarding medication use, it is important to assess the social, educational, and economic situation of the patient.

The physical examination will comprise a thorough assessment of the cardiovascular system, including BP, heart rate (HR), heart sounds and murmurs, palpation of peripheral pulses, and alterations in skin color; it will also identify musculoskeletal changes that may prevent inclusion in the program or restrict the execution of some exercises. The respiratory system examination will assess respiratory rate and presence or absence of abnormal sounds, which are characteristic of pulmonary pathologies[16,18].

A "center" is considered to be a rehabilitation center when it features an area for physical activity, competent and trained staff, adequate equipment for physical exercises, equipment for emergency situations (basic and advanced life support equipment, with a defibrillator), and medical staff to address emergency situations. The center should also consider implementing management protocols for the rehabilitation of patients according to pathology.

Exercise prescription

Exercise prescription should always be considered individually in accordance with each phase, taking into account individual limitations and comorbidities (musculoskeletal, neurological, respiratory, renal, and among others).

Phase 1

During phase 1, in hospital, is a moment when patients are very receptive. In most cases, they are very vulnerable and open to new proposals for lifestyle changes. In addition to the exercises, which are always of low intensity and aiming for early movement, there is also an opportunity to educate the patients, by explaining about the disease and the importance of controlling the risk factors[19]. Exercises can be started immediately after disease stabilization:

- In cases of ACS, after the first 24–48 h, in the absence of symptoms;
- In cases of heart failure, after dyspnea improvement, gentle stretching and movement exercises can also be started as soon as the patient can ambulate;
- In cases of cardiac surgery, especially in the days prior to the intervention, a program comprising breathing exercises, stretching, and progressive movement, followed by physical therapy after surgery, provides a significant reduction in respiratory complications, arrhythmias, and length of hospitalization[19-21].

Although it is difficult to generalize the recommendation, the patient should be assessed at the start of the exercise program at the hospital, to determine the best exercises for that phase, from passive to active exercises and low-intensity walking, which will be increased individually until hospital discharge.

Phase 2

In this phase, the patient needs supervision and individualized care, because this is the convalescence phase and the patient often has not had any previous contact with formal physical activities. Exercise prescription must include the type, intensity, duration, and frequency of exercises[22]. The duration of phase 2 varies between patients, lasting an average of 1–3 months[23]. Exercises should be initiated at a low intensity and low impact during the first few weeks, for initial adaptation and prevention of musculoskeletal injuries[24,25].

Aerobic exercise: Aerobic exercise intensity must fit the clinical picture, risk stratification, and patient's goals. Ideally, a stress test (treadmill test or cardiopulmonary exercise test) should be conducted to evaluate the ECG response, physical

Table 5 – Components of a cardiac rehabilitation program

	Interventions	Class (Level of Evidence)	Goals/results
Patient evaluation	• Clinical history • Physical examination	I (A)	• In the short term, document the evidence of patient care to guide the development of prevention strategies • Avoid complications during the CVDPR sessions • Achieve patient adherence to CVDPR program
	• Complementary tests: • ECG, stress test*	I (A)	
	• 6-min walk test* • Laboratory exams** and others*** • Psychological report of depression and quality of life • Exercise prescription	II (B)	
Education	• Nutritional advice to the family and the patient, comprising:		• Weight control and modification of risk factors • Abstinence from long-term smoking • Achieve a BP < 130/80 • Control fasting glucose < 100 mg/dl • In case of obesity, develop a strategy for weight reduction by at least 5%–10% of initial weight
	• Diabetes control	I (A)	
	• Weight control • Control of smoking • Blood pressure control • Psychological management	I (B)	
	• Diet	I (C)	
Human Resources:			
Qualified cardiologist or exercise physician	• Directs the program and prescribes the safety limits of the exercise; assesses the patient and obtains the clinical history. Conducts the stress test.		• It is important that each CVDPR program has a specialized and committed staff • The physician in charge of rehabilitation should preferably be present during the exercise sessions or be available on call
Nurse	• Performs medical duties according to the physician's instructions • Contributes to patient education in relation to the knowledge of the disease itself, signs and symptoms, correct use of medications, adoption of healthy lifestyle habits, and importance of regular physical activity, always with the multidisciplinary team		
Exercise specialist (physical education professional and/or physiotherapist)	• Must have knowledge in basic and advanced cardiopulmonary resuscitation • Educates patients in relation to exercises and healthy lifestyle habits • Applies the aerobic, muscular strength, and flexibility exercises • Prescribes the performance of exercises according to the safety limits set by the physician, the patient's clinical state, individual preferences, previous experiences with exercise, and any neuromusculoskeletal limitations		
Nutritionist	• Evaluates and provides the patient with customized diets to control risk factors, in addition to addressing educational aspects of the subject		
Psychologist	• Conducts the examination of quality of life and depression, and provides psychological support and relaxation therapies as needed		

Continued

Social assistant	• Educates and advises the patient and the family to cope with the disease • Coordinates with the patient and the family regarding the problems related to hospitalization or work, in addition to assessing smoking cessation
Material resources	CVDPR gym: • Treadmills • Stationary bicycles • Hiking simulator • Stretchers • Free weights • Hand ergometer • Elastic bands • Chronometers • Fully equipped crash cart • Sphygmomanometers • Stethoscopes • Electrocardiogram • Others

** Stress test (ergometry, cardiopulmonary test, or 6-min walk test): although it is not necessary to start CVDPR, it is strongly recommended, because it aids the prescription of optimized exercise and helps to highlight the changes in the patient's functional capacity. The ideal time to conduct the test is at the beginning and at the end of phase 2. It's clearly more useful in some pathologies, such as post-myocardial infarction syndrome, heart failure, after transplantation, and less useful in patients who have undergone recent coronary artery bypass grafting.*

***Hemoglobin, glucose, lipid profile, creatine phosphokinase, uric acid, glycated hemoglobin, hepatic transaminases, and other biochemical tests as appropriate.*

****Echocardiogram, including the assessment of ejection fraction if possible.*

capacity, HR and BP response to stress, thus allowing for a better individualized prescription of physical exercise intensity. In order to avoid delaying of rehabilitation program, just after the medical release, the initial assessment can be made by the physical therapist or physical education professional in the first sessions, adapting the exercise prescription until the stress test is avalable[22].

The intensity of aerobic exercises, which aim greater benefits to the cardiovascular system and metabolism, has been the object of investigations[26]. High-intensity exercises are more effective in improving insulin resistance, BP reduction, and promoting a greater weight reduction when compared with moderate-intensity exercises[27,28].

If the stress test is available, the target exercise heart rate should be around the anaerobic threshold. In the case of stress test without expired gas analysis, the target is 60%–80% of maximum HR (MHR), or 50%–70% of resting HR (RHR). In the first sessions, exercises are suggested to be performed in the lower limit of the prescription, progressively increasing according to the individuals' response and progress. Moreover, exercises should be performed below the ischemic threshold, i.e., below HR and load that induce clinical and ECG signs of myocardial ischemia during stress.

The exercise duration must be of at least 30 min, progressing to 1 h of continuous or intermittent exercise. The frequency can be 2–5 times/week, with an average of 3 times.

Resistance exercises: Muscle strengthening exercises should be started gradually with light loads, progressing throughout the sessions[12,22]. At this stage, the objective is to familiarize the patients with the exercises, ensuring that they are executed with correct posture and gradual progression of the load. They can be performed 2–3 times/week, with 6–15 repetitions per muscle group, at intervals of 30 s to 1 min.

Flexibility exercises: They are also known as stretching. They must be carried out progressively and without discomfort, always respecting musculoskeletal limitations. They can be performed at the beginning and, especially, at the end of rehabilitation sessions[29].

Phases 3 and 4

These phases have an indefinite duration[23]. The main difference between them is that phase 4 is performed by long-distance supervision, also known as rehabilitation without supervision. In essence, the prescription of these 2 phases is very similar, because the prescribed exercises are part of daily life. The prescription must be updated periodically and adapted to the profile and comorbidities of each patient. A reassessment, which can be repeated every 6–12 months, is preferred when initiating the third phase.

Aerobic exercise: In asymptomatic patients, training HR should be 70%–90% of MHR achieved in the stress test, or 50%–80% of RHR, or between the first and the second threshold obtained during the cardiopulmonary test.

These exercises are also performed below the ischemic threshold, i.e., below HR and load that induce clinical and ECG signs of myocardial ischemia during stress. In selected cases of patients with symptoms, such as stable angina, MHR can be just below that at which symptoms appear, even if ECG shows indirect signs of ischemia.

Table 6 – Human resources competences in a cardiovascular rehabilitation program

Human resources	Competence
Medical director	• Main function: head of the multidisciplinary team • Should be a physician with experience in exercise medicine, preferably a cardiologist. If no such professional is available, he/she should be a physician with experience in exercise and secondary prevention, and familiar with CVD management • Should have management experience, training, and skills • Has the specific responsibility for the evaluation and management of patients who join the program • Trained in advanced cardiopulmonary resuscitation
Nurse	• Demonstrates competence and experience in cardiovascular rehabilitation • Trained in cardiopulmonary resuscitation • Collaborates with the stress tests by preparing the skin for the adhesion of electrodes • Although preferably performed by a physician, the nurse can, in some specific cases, educate the patient in relation to the knowledge of the disease, signs and symptoms, correct use of medications, adoption of healthy lifestyle habits, and the importance of regular physical activity, together with the multidisciplinary team, either in individual or group meetings • Demonstrates basic knowledge of exercise and fitness training • Fills the medical prescription (only at hospital level)
Exercise specialist (physiotherapist and physical education professional)	• Knowledge of the cardiovascular system and its diseases • Knows primary and secondary cardiopulmonary prevention • Capable of basic and advanced cardiopulmonary resuscitation techniques • Can recognize signs and symptoms of cardiovascular instability • Conducts the exercise routine • Provides information to the patient regarding the problems and benefits of physical activity • Educates the patient regarding the adoption of healthy lifestyle habits • Responsible for the coordination and conduct of the supervised exercise program • Prescribes the exercises according to the safety limits set by the physician, the patient's clinical picture, individual preferences, previous experiences with exercise, and any musculoskeletal limitations
Nutritionist	• Knowledge of the cardiovascular system and its diseases, as well as of the physical exercise • Familiar with the CVDPR program and its goals • Assesses the patient and identifies the risk factors • Provides information to the patient regarding the modification of risk factors and outlines goals to achieve a healthy diet
Social Assistant	• Knowledge of the cardiovascular system and its diseases • Familiar with the CVDPR program and its goals • Performs the coordination with the patient and the family, to maintain the necessary conditions for the patient's rehabilitation • Works with the psychologist in supporting the patient • Gives information to the patient regarding his/her obligations and social benefits

Resistance exercises: They should be performed in sets of 8–15 repetitions, with progressive loads sufficient to cause fatigue in the last 3 repetitions, but without causing physical breakdown. Ideally, they should be performed 3 times/week. As an alternative to conventional exercise with free weights or weight machines, the Pilates method with practical resistance can be used in combination with flexibility and breathing exercises[12,30].

Flexibility exercises should be a part of gym classes, either at the beginning and/or, preferably, at the end of each session. A combination of practices, such as yoga, tai chi, can be adopted; these practices help decrease BP[31] and increase maximum oxygen consumption[32].

Balance exercises: They are essential; they should be performed 2–3 times/week, especially by the elderly population, to maintain self-sufficiency in this age group and help prevent fractures due to falls[13].

Components of the exercise

The training program should take into account the following points:

- *Training frequency*: It should be at least 3 times/week. Ideally, the patient should be encouraged to perform daily physical activity (walking, climbing stairs, cycling)[12,22].
- *Duration of each session*: The recommended duration is 40–60 min/day.
- *Training intensity*: This can be controlled by the training HR (THR). In this strategy, the goal is to perform the prescribed exercises at the heart rate between the two respiratory thresholds or 70%–90% of MHR obtained during the stress test. Another common practice is the use of RHR by applying the Karvonen formula (50%–80% of RHR)[33,34].

Karvonen formula: $THR = RHR + (0.5-0.8) \times (MHR - RHR)$

The patient's subjective perception of exertion should always be assessed, using the Borg scale of perceived exertion[35] [*Rating Perceived Exertion* (RPE)] (Table 8).

Subjectively, the speech test can also be used, in which patients are aware of their own respiratory movements, i.e., the exercises are performed at an intensity that leads to a heavier breathing, without reaching a degree of tachypnea that prevents the patient from completing a sentence.

- *Specificity of training*: in some cases, the patients' training should consider the muscle groups that they usually use in

Table 7 – Phases of a CVDPR program[12]

Step	Duration	Objectives	Recommendations	Reach
Phase 1: Hospitalized after a cardiovascular event: acute coronary syndrome or after intervention (PTCA), coronary artery bypass grafting, valvular prosthesis, or correction of congenital heart disease	Starts 48 h after the acute event until hospital discharge	• Prevent loss of physical capacity • Avoid effects of prolonged bed rest • Avoid depression • Avoid respiratory and thromboembolic complications • Facilitate early discharge • Give information to the patient and family about the disease and basic care	• Takes place in the patient's bed, room, or hospital corridor • Monitoring can be used • A preliminary assessment is made • Multiple sessions can be conducted per day, but they must be short • Initially, the exercises will be passive, progressing gradually, with active exercises, walks, and others, until discharge	• Achieving the ability to initiate Step 2 of cardiac rehabilitation
Phase 2: Cardiac rehabilitation after discharge Performed in a gym or rehab center	Average duration of 3 months, with 3–5 weekly sessions	• Improve the patient's functional capacity • Achieve changes in risk factors • Restore patients' self-confidence after the cardiac event	• Achieve adequate physical and psychological conditions to start Step 3 of rehabilitation	
Phase 3: Early maintenance	3–5 weekly sessions, during 3–6 months (could be extended in some cases)	• Increase or maintain functional capacity • Continue with the exercise plan • Blood pressure control • Control of blood glucose and cholesterol • Weight and adequate nutrition control • Seeks and ensures psychological well-being	• The patient enters this stage when he/she reaches stabilization in his/her clinical picture and evolution in the exercises • Patient controls the intensity of the exercise performed according to the Borg scale (Table 10) and by controlling heart rate • It is necessary to assess and monitor adherence to drug therapy and nonpharmacological measures	• Performing physical activity safely with basic standards of self-care
Phase 4: Late maintenance Starts after completion of Phases 2 and 3	Its termination is undefined, and its frequency depends on the clinical state, the disease, and the evolution of each patient, as well as the components of the follow-up	• Help the patient maintain a healthy lifestyle	• Strengthen the education given • Assist the patient in overcoming difficulties to disengage themselves from bad habits • Motivate and generate strategies to maintain healthy lifestyle	• Achieving permanent changes toward a healthy lifestyle, physical activity, and adequate control of risk factors

their day-to-day activities, thus generating greater muscle strength for daily work[12,25].

Components of each session

a) Warm-up period: a moment in which muscle groups are incorporated gradually; starting with small groups and then progressing to larger muscle groups. Initially, the exercises are performed slowly; the repetitions and the speed increase progressively. After approximately 5 min, a more intense warm-up session starts, including jogging or another higher-intensity exercise (lasting 1–3 min). In general, when a patient begins rehabilitation, the warm-up period is longer. Before the first session, it is desirable that some testing is performed. The aim of the examination (such as the 6-min walk test) is to enable an objective analysis of the current state of the patient[12,29,36,37].

b) Exercise training: It can be performed with a bicycle ergometer, treadmill, climber, or simply consist of a walk/jog guided by trained personnel. Usually, the duration of training is short (15 min) in the first session, with weekly or per-session

Table 8 – Borg scale of perceived exertion[35]

6	No effort
7	Very, very light
8	Very light
9	Very light
10	
11	
12	Moderate
13	
14	Intense or hard
15	
16	Too intense or too hard
17	
18	
19	Very, very intense
20	Total exhaustion

Equivalences between the subjective perception of exertion (Borg) and the intensity of exercise can be summarized in: < 12: mild = 40%–60% of the maximum; 12–14: moderate, slightly more intense = 60%–75% of the maximum; > 14: intense, strong = 75%–90% of the maximum.

progression, depending on the case. This phase should be connected with the time and intensity of exercise.

THR is determined according to the prescription method and/or results of the stress test, as previously discussed. The goal is to achieve and maintain this HR during the execution of continuous or interval aerobic exercise. Furthermore, it is convenient to add resistance exercises to every session[12].

c) Cool-down period: All sessions must take into account that the patient should return to the initial HR and BP levels in the last minutes of the session. The methods used to achieve this goal are varied, but some elements must be present, such as gradually decreasing the load of aerobic exercise, stretching, resting on a chair or mattress, and using breathing techniques (abdominal breathing)[12,29].

Types of exercise

The exercises can be divided into **isotonic or dynamic** and **isometric or static**:

- **Isotonic or dynamic** exercises change muscle length with rhythmic contractions, joint movements, and limited strength development. These exercises cause a significant increase in oxygen consumption, systolic volume, and HR. The systolic BP (SBP) increases and the diastolic BP (DBP) may decrease as a consequence of the reduction in total peripheral resistance[16].
- **Isometric or static** exercises cause an increase in muscle strength with little change in muscle length. During these exercises, SBP increases significantly, and HR and systolic volume increase less than during dynamic exercise[16].

However, the majority of activities present a combination of these 2 types of exercises in varying magnitudes; the hemodynamic response depends on which is performed with greater intensity.

With regard to the types of training: the most relevant are continuous and

- ***Continuous training***: It relies on a steady exertion over a given time. Preferably, it is of moderate intensity, to last longer. It usually comprises a walk or run at a moderate and constant intensity, and the speed of execution and the behavior of cardiopulmonary variables depend on the clinical presentation and individual physical capacity. The minimum suggested time to maintain this type of effort is 20–30 min/session[38,39]. It may be performed at different intensities (Table 9).
- ***Interval training***: it is defined as an exercise or a series of exercises composed of periods of exertion that alternate with periods of active or passive recovery. When the exercise is of high or moderate intensity, active intervals are used, using either the same or different exercises, but of lower intensity[40]. If the patient's functional capacity is low, passive recovery intervals can be used. In such patients, this training method with alternating loads may be the only way to start an exercise program, because of the low tolerance to continuous loads. The progression is made by gradually increasing the periods of activity and decreasing the resting periods, or by replacing them with lower-intensity activity (active recovery). Before starting this activity, a longer warm-up session is needed, as well as a low-intensity recovery at the end of the session[38].

Education

As previously mentioned, a multidisciplinary CVDPR program includes not only the scheduled exercise plan but also the education provide to the patient, about CVD and the appropriate management of risk factors[12].

Obesity and overweight

Definition and facts

The incidence and prevalence of overweight and obesity have increased globally to alarming levels. Obesity is considered a worldwide epidemic, both in children and in adults, affecting nearly one-third of the world's population. According to the INTERHEART study, the most prevalent CVD risk factor is abdominal obesity, whose prevalence is 48.6% in Latin America, compared with 31.2% in other participating countries[41]. The consumption of high-calorie foods, rich in simple carbohydrates and saturated fats, associated with physical inactivity, are responsible for this worldwide epidemic.

The increase in adiposity is associated with the increase in free fatty acids, hyperinsulinemia, insulin resistance,

Table 9 – Examples of continuous training

Type of activity	Speed	Behavior
Slow walk	4–5 km/h	Can talk
Moderate walk	5–6 km/h	Maintains a conversation with difficulty
Fast walk	>6 km/h	Maintains a conversation with short phrases
Light jog	6–7 km/h	Can talk
More intense jog	7–9 km/h	Maintains a conversation with short phrases

DM, systemic arterial hypertension, and dyslipidemia. The effects of obesity on global CVD risk are pronounced. Obese individuals have higher frequency and incidence of other risk factors. However, the risk is also direct, because adipose tissue, particularly intra-abdominal visceral adipose tissue, is a metabolically active endocrine organ that synthesizes and releases into the bloodstream different peptides and other nonpeptidic compounds that participate in cardiovascular homeostasis. Obese individuals have a disturbance in this balance, to a greater or lesser degree, increasing the CV risk.

The calculation of body mass index (BMI) has been proposed by the United States National Institutes of Health (NHLBI)[42] and by WHO[43] as the conventional method for diagnosing overweight and obesity. In adults, overweight is defined as a BMI from 25–29.9 kg/m^2, and obesity is defined as BMI ≥ 30 kg/m^2 [42,43].

Although BMI is a simple method to detect individuals with considerably increased body fat, particularly in population studies, recent studies have questioned its validity in diagnosing individual obesity[44-46]. Numerous studies have demonstrated that central obesity measures correlate better with CVD risk than BMI[47]. Therefore, it is more important to determine whether there is an increase in abdominal fat than to define body weight in relation to height. A simple way to determine this is by measuring the perimeter of the waist with a tape measure, either at the navel level or 2.5 cm above the iliac crest. The cutoff points recommended for diagnosing central obesity, using waist circumference, are ≥ 94 cm for men and ≥ 80 cm for women. If the waist–hip ratio values are used for diagnosing central obesity, the cutoff points are as follows: ≥ 0.9 for men and ≥ 0.85 for women. All these calculations have been established for Caucasian individuals. Other parameters and other determinations are necessary for the various Latin American ethnic groups[48,49].

Other methods used to measure body fat are computed tomography, ultrasonography, magnetic resonance imaging, and whole-body air displacement plethysmography. Waist circumference measurement has the advantage of being a simple method and of being superior to BMI; however, it should be noted that this method is prone to measurement errors[48-50].

Challenges and goals

Weight reduction is recommended in patients with obesity (BMI ≥ 30 kg/m^2) or overweight (25 ≤ BMI < 30 kg/m^2).

Values between 94 and 101 cm for men and between 80 and 87 cm for women should be considered as an alert; they represent a threshold from which one should not gain more weight. Restriction of total caloric intake and regular exercise are the cornerstones of weight control. It is likely that exercise will produce improvements in the metabolism of central adiposity, even before weight reduction is noticed.

Special recommendations

Feeding habits education is paramount, with emphasis on decreasing caloric intake and drastically decreasing the intake of fats and simple carbohydrates. The patient should be encouraged to consume more fruit, vegetables, whole-grain foods, and monounsaturated and polyunsaturated fats. The habit of mild-to-moderate alcohol consumption should not be discouraged; however, this area of knowledge still requires further studies to define the best conduct.

The frequency, duration, intensity, and volume of exercise performed must be adapted to the physical fitness level of the individual. Prolonged exercises at a moderate intensity are preferred, although the program should be initiated at a light intensity and progress as results are achieved. The best exercises are dynamic exercises, which employ large muscle groups and are predominantly aerobic.

Sedentary lifestyle

Definition and facts

The percentage of sedentary population in Latin America oscillates between 25% and 75%; this very wide range is because of the differences between the studies carried out in each region. Individuals who remain sedentary are at a higher risk of death and at a 2-fold higher CVD risk when compared with their physically active peers[51].

Challenges and goals

- To initiate, recondition, and educate the patient regarding exercise prescription;
- To motivate the patient to continue the practice of physical activity indefinitely (30–60 min of moderate exercise, 5–7 days/week) (class I, level of evidence B);
- To ensure that all members of the CVDPR programs know, educate, and motivate patients to perform physical activities according to the prescription.

Special recommendations

- To collect a complete medical history;
- To determine the CVD risk individually;
- To prescribe physical activity (aerobic, resistance, and flexibility);
- To supervise the physical activity practice according to the risks and prescriptions.

(Refer to the section Exercise for more details regarding the recommendations and exercise prescriptions.)

Psychosocial stress and depression

Definition and facts

Stress has been defined as a "situation of an individual or of any of his/her organs or systems that, by requiring a greater performance than normal, places the individual at risk of becoming ill." It is a body's response or reaction that requires adaptations, which may be acute or chronic[52]. These adaptations are not always well tolerated or accepted. All these adaptations include anxiety, emotional exhaustion, depersonalization, emotional insecurity, fear of failure, chronic job stress, personality traits, character, and social isolation, which lead to depression. Elevated stress is clearly associated with AMI. Nowadays, stress is considered a risk factor as important as hypertension, smoking, and dyslipidemia.

Unfortunately, there are not enough data to know with certainty the prevalence of increased stress, depression, and other psychosocial problems in Latin America. Data from the INTERHEART study demonstrate that in Latin America the prevalence of chronic stress and depression is, respectively, 6.8% and 36.7%[41].

Stress responses produce increased autonomic activity by the activation of the sympathetic nervous system and catecholamine release, causing an increase in HR, contractility, minute volume, and peripheral vascular resistance, as well as inhibiting insulin secretion and increasing the release of hepatic glucose and fatty acids into the blood stream. Concurrently, there is an increase in platelet aggregation and a decrease in the ventricular fibrillation threshold[52].

Challenges and goals

It is important to know the degree of stress and depression of patients seeking a CVDPR program; the use of standardized questionnaires is recommended, such as the PHQ-9 depression questionnaire, which is free and available online. Once the patient's condition is known, he/she should be severity of the emotional problem.

Special recommendations

The recommendations focus on the identification of these groups of patients to allow early intervention, through psychotherapy and lifestyle changes, not only aimed specifically at the individual but also at the family members. These measures may include group therapy, specific medication, physical activity, and social support, which are all administered by specialized professionals[53] (class I, level of evidence B).

Smoking

Definition and facts

Smoking is a chronic addiction caused by the excessive tobacco smoking, which is triggered by its main component, nicotine. It is an independent risk factor for CVD[54], and is regarded as a leading cause of preventable deaths worldwide[55].

According to WHO, a smoker is a person who has had this habit daily for the previous month, regardless of the number of cigarettes smoked. A passive smoker is defined as a person who is exposed to tobacco smoke in its different forms, such as pipes and cigarettes. There is no minimum innocuous exposure to cigarette smoke: passive smoking increases the CVD risk by 25%–30%[56].

There have been significant changes in the implementation of smoke-free areas, through a historic partnership between WHO and Latin America and Caribbean countries[57]. The prevalence of smoking in this region is approximately 31% in men and 17% in women, which motivates physicians to work toward improving this situation[58].

Challenges and goals

The overall goal is to achieve complete cessation of cigarette smoking[59,60]. For achieving such a goal, CVDPR and secondary prevention programs should include comprehensive smoking cessation measures; they should also educate the smoker by promoting and implementing public health measures related to the suppression of the habit[56] (IB).

Specific recommendations

Every clinical history must include questions regarding smoking history, so as to diagnose smokers according to the above definition. It is also necessary to check whether there is environmental exposure and whether the patient wants to quit smoking, as well as measure physical dependence, and prepare a smoking cessation plan that includes follow-up and feedback[59,60].

Some useful recommendations regarding smoking are as follows:

- To routinely apply questionnaires on smoking habits;
- To indicate the amount of tobacco consumed and attempts to stop smoking;
- To assess the patient according to physical, psychological, social, and gestural addiction, as well as nicotine dependence (Fagerstrom test, Glover and Nilson test)[61];
- To identify the phase of interest in smoking cessation according to the criteria by Prochazka and DiClemente (Precontemplation, Contemplation, Preparation, Action, Maintenance)[62];
- To establish a conversation to generate awareness (IA);

- To follow the smoking cessation process ("5As"): **Ask** about smoking status; **Advise** to quit; **Assess** willingness to stop smoking; **Assist** in smoking cessation; and **Arrange** follow-up consultation[63];
- To offer help regardless of patient motivation[64];
- To create interventions that enables the patient to advance in the stages of interest in smoking cessation;
- To offer and refer to pharmacological therapies for smoking cessation (nicotine replacement, bupropion, varenicline, and/or combinations thereof)[65]. Although the use of medications to help in smoking cessation has been used in cardiovascular patients, their prescription should be left to the cardiologist;
- To perform nonpharmacological therapies, such as:
  - Practical advice (problem solving/skills training);
  - Psychological and social support as a part of treatment;
  - Group therapy is approximately 2 times more efficient than self-help therapy[64];
  - Establishing a comprehensive monitoring and follow-up strategy for the patient.

The scope of smoking cessation management in CVDPR programs is an opportunity for the other the members of the household. Thus, this approach can prevent the onset of cigarette smoking (children, grandchildren, siblings, other family members) and/or its complete eradication in the nuclear family (IB).

Dyslipidemia

Definitions and facts

Dyslipidemia is a major risk factor for developing atherosclerosis. Every 1% reduction in low-density lipoprotein cholesterol levels (LDL-C) translates into a reduction of 1% in the risk of future cardiovascular events. A 1% increase in high-density lipoprotein cholesterol levels (HDL-C) is associated with a risk reduction of 2%–4%[41]. The prevalence of dyslipidemia in Latin America is 42%, according to the INTERHEART study, compared with a 32% prevalence in other countries participating in that study[41].

Challenges and goals

Risk stratification:

The *Adult Treatment Panel* III (ATP III)[66] guidelines for dyslipidemia treatment in adults defines the classification of LDL-C, HDL-C, and total cholesterol levels according to their plasma levels (Table 10). That document also identified LDL-C as the main treatment target (class I, level of evidence A).

The ATP III established risk categories according to the presence or absence of other risk factors. The presence of CVD or other clinical forms of atherosclerosis, the so-called risk categories, determine the LDL-C target (Table 11).

It remains to be determined whether the LDL-C targets in primary prevention will remain the same, given the results of the Jupiter study[67], which randomized to treatment with rosuvastatin or placebo patients without coronary artery

Table 10 – HDL-C, LDL-C, and total cholesterol classification according to ATP III[66]

Total cholesterol (mg/dl)
< 200 Desirable
200–240 Borderline high
≥ 240 High
LDL-C (mg/dl)
< 100 Optimal
100–130 Near optimal
130–160 Borderline high
> 160 High
> 190 Very high
HDL-C (mg/dl)
< 40 Low
≥ 60 High

HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; ATP III: Adult Treatment Panel III guidelines for the treatment of dyslipidemia in adults.

Table 11 – Objectives, levels, changes in lifestyle, and treatment of LDL-C in different categories, according to ATP III[66]

Risk category	LDL-C target (mg/dl)	LDL-C at which to initiate therapeutic lifestyle changes (mg/dl)	LDL-C at which to initiate LDL-lowering drugs (mg/dl)
CAD risk or equivalent (10-year risk > 20%)	< 100	≥ 100	≥ 130 (100–129: optional)
+2 risk factors (10-year risk ≤ 20%)	< 130	≥ 130	10-year risk 10%–20%: ≥ 130
			10-year risk < 10%: ≥ 160
0–1 risk factors	< 160	≥ 160	≥ 190 (160–189: optional

LDL-C: low-density lipoprotein cholesterol; CAD: coronary artery disease.

disease who had LDL-C < 130 mg/dl and high-sensitivity C-reactive protein levels > 2 mg/l. The study was completed ahead of time, having shown a clear benefit in favor of the group treated with rosuvastatin, which exhibited a 44% reduction in the primary outcome (combined endpoint) of cardiovascular death, nonfatal stroke, nonfatal AMI, unstable angina, or CABG.

Special considerations

As previously mentioned, the overall risk stratification defines each patient's LDL-C targets according to the risk category. To achieve these goals, treatment must often be aggressive. The therapeutic options are as follows:

- Nonpharmacological measures: decreased intake of simple carbohydrates and of saturated and trans fats in general; weight loss in individuals with obesity; and increased physical activity (class I, level of evidence B). Aerobic exercise of moderate intensity is considered to have the greatest impact on triglyceride levels and to have less impact on HDL-C, and even less impact on LDL-C[66].
- Pharmacological measures: the primary goal in dyslipidemia management is to achieve a reduction in LDL-C in accordance with the goals described in Table 11. Statins are the most commonly used drugs because of their impact on risk reduction. In addition to these drugs, niacin, fibrates, resins, and ezetimibe may be used[66].

Other treatment goals:

- If triglyceride levels are between 200–499 mg/dl after the LDL-C target has been reached, medication can be used to achieve the non-HDL-C target (class I, level of evidence B), which must be less than the LDL-C + 30. This can be achieved by intensifying statin therapy and adding nicotinic acid or fibrates[66]. If triglyceride levels are > 500 mg/dl, the priority should be to decrease this level to decrease pancreatitis risk (class I, level of evidence C).
- Another important goal is to increase HDL-C, particularly in patients with extremely low HDL-C and atherosclerotic CVD. Niacin can be used; it should be started at a low dose (500 mg) and increased according to tolerance (up to a maximum dose of 2 g). Statins also increase HDL-C, but to a lesser extent[66]. The evidence supporting the use of drugs to increase HDL-C is not strong, and recent studies have questioned the use of niacin for this purpose, whereas others have demonstrated that the use of cholesteryl ester transfer protein inhibitors to increase HDL-C may increase cardiovascular mortality[68].

Arterial hypertension

Definitions and facts

One of the most common problems in primary care is the lack of detection, treatment, and control of hypertension, which is undoubtedly a risk factor with the highest impact in CVD.

The worldwide prevalence is approximately 1 billion individuals, causing approximately 7.1 million deaths per year[69]. In Latin America, 13% deaths can be attributed to systemic arterial hypertension. According to the Interheart[41] study, the prevalence of systemic arterial hypertension in Latin America is 29.1%, higher than the 20.8% observed in other participating countries. Another problem is that approximately 30% adults are unaware that they have this disease. More than 40% hypertensive patients are untreated, and two-thirds do not have controlled BP (> 140/90 mmHg).

Classification of BP

Table 12 presents the classification of systemic arterial hypertension according to the guidelines of the Seventh Report of the Joint National Committee (JNC VII) for adults[69]. The classification is based on the average of ≥ 2 BP measurements, performed in the sitting position in ≥ 2 visits.

Challenges and goals

The treatment goal for hypertensive patients without other disorders is BP < 140/90 mmHg (class I, level of evidence A). In hypertensive patients with renal disease or DM, the BP target is < 130/80 mmHg; however, recent studies have shown that it is probably not crucial to achieve such levels to decrease the CVD risk, particularly in patients with DM[70].

Specific recommendations

To achieve the treatment goals, it is crucial to implement lifestyle changes (Table 13). Such approaches should also be recommended to normotensive patients with genetic predisposition for hypertension (e.g., both parents aged < 60 years medicated for systemic arterial hypertension).

With regard to physical activities, those with a predominance of dynamic components are ideal. Their benefits become apparent after the third week after exercise initiation. Muscle strength exercises have not shown benefits in hypertension as an isolated method, because they must be performed together with dynamic exercises (class I, level of evidence B)[69].

With regard to drug treatment, a reduction in BP should be considered as the target of the pharmacological treatment, regardless of the medication used. As is usual in cardiovascular prevention, the decision to start the drug treatment depends on the patient's overall risk. Because the majority of hypertensive

Table 12 – Classification of hypertension in adults according to JNC VII[69]

BP rating	SBP (mmHg)	DBP (mmHg)
Normal	< 120	< 80
Prehypertension	120–139	80–89
Hypertension stage 1	140–159	90–99
Hypertension stage 2	≥ 160	> 100

BP: blood pressure; SBP: systolic blood pressure; DBP: diastolic blood pressure; mmHg: millimeters of mercury.

Table 13 – Lifestyle modifications to prevent and manage hypertension[69]

Measure	Purpose	BP reduction
Weight reduction	Maintain BMI < 24.9	5–20 mmHg/10kg
Adoption of the DASH* diet	A diet rich in fruits, vegetables, and low in total and saturated fats.	8–14 mmHg
Decrease sodium consumption	Consume < 2.4 g/day of sodium**	2–8 mmHg
Aerobic physical activity	30–45 min/day (the highest number of days/week)	4–9 mmHg
Moderation of alcohol consumption***	No more than 2 servings of alcohol per day (30 ml) in men. Ex.: 700 ml of beer, 300 ml of wine, or 60–90 ml whisky Not more than 1 serving (15 ml) in women and subjects with lower weight	2–4 mmHg

** DASH diet: dietary approaches to stop hypertension.*
*** The American Heart Association recommends a daily intake of < 1,500 mg of sodium.*
****It is not recommended that a person who does not consume alcohol start doing so as a way to control hypertension.*
BP: blood pressure; BMI: body mass index; kg: kilogram; mmHg: millimeters of mercury; g: gram.

patients require ≥ 2 antihypertensive drugs to achieve BP control, the addition of a second drug from a different class should be indicated when BP is > 20 mmHg above the target SBP or > 10 mmHg above the DBP target despite the use of a single agent at suitable doses[69].

Diabetes

Definition and facts

DM is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances in the metabolism of carbohydrates, fats, and proteins, which results in defects in insulin secretion and/or action.

The main cause of death in individuals with type 2 DM is cardiovascular; therefore, preventing CVD involves an integrated management of all risk factors. All CVD risk factors (except smoking) are more common in individuals with diabetes, and their impact on CVD is also higher[72]. Approximately 25.1 million individuals have type 2 DM, representing 8.7% adult population in Latin America, according to the 2011 census. It is estimated that this figure will reach approximately 40 million people (60% of the adult population) in the next 20 years. Moreover, it is important to mention that currently 15.1 million people (5.2% of the adult population) suffer from glucose intolerance, a situation that should be considered as a warning and trigger more efficient measures for DM prevention (*International Diabetes Federation*).

For the diagnosis of DM, according to the American Diabetes Association (ADA)[73], any of the following criteria can be used:

1. Glycated hemoglobin levels (HbA1c) ≥ 6.5.
2. DM symptoms combined with blood glucose levels, measured in venous plasma, ≥ 200 mg/dl (11.1 mmol/l).
3. Fasting glucose ≥ 126 mg/dl (7 mmol/l).
4. Glucose levels, measured in venous plasma, ≥ 200 mg/dl (11.1 mmol/l) 2 h after a glucose load, during an oral glucose tolerance test (OGTT).

For diagnosis in an asymptomatic individual, it is essential to have at least 1 positive blood glucose result equal to or greater than the levels in items 3 and 4.

Challenges and goals

Strict glycemic control (class I, level of evidence A) (Table 14) is recommended. The United Kingdom Prospective DM Study[74] and the Diabetes Control and Complications Study (DCCT)[75] demonstrated a linear relationship between stable HbA1c and the risk of complications, although the level at which the risk disappears was not identified. Currently, the therapeutic goal of HbA1c is < 8%, and < 7% in young CVD patients. The ACCORD study demonstrated that, in patients with type 2 DM, there is no additional benefit in decreasing HbA1c to strict low levels (< 6.5%) and that, on the contrary, this reduction could increase mortality[76].

Specific recommendations

DM treatment includes pharmacological and nonpharmacological measures. Nonpharmacological measures include 3 basic aspects: diet strategies, exercise, and healthy habits[12]. Weight reduction in obese patients with DM remains the only comprehensive treatment that can simultaneously control most metabolic problems from type 2 DM (class I, level of evidence C). Pharmacological treatment should be initiated in every person with type 2 DM who has not achieved control of blood glucose levels through therapeutic lifestyle changes.

Refer to the Special Populations section for additional recommendations for cardiac rehabilitation in individuals with diabetes.

Table 14 – Targets for glycemic control parameters[77]

Level	Normal	Adequate	Inadequate
Risk of chronic complications		Low	High
Fasting blood glucose	< 100 (1)	70-100	≥ 120
Postprandial blood glucose (1–2 h)	< 140	70-140 (2)	≥ 180
HbA1c (%)	< 6 (3)	<6,5 (4)	≥ 7 (4)

(1) The risk of hypoglycemia increases significantly when levels are maintained within the range of a person without diabetes through the use of medications. The risk must be avoided in the elderly, and less stringent goals should be adopted.
(2) A reduction into normal ranges of postprandial blood glucose usually presents lower risk of hypoglycemia. For this reason, it is also an appropriate goal.
(3) Normal HbA1c can also be defined as the average value for the population without diabetes + 2 standard deviations, using the DCCT reference method, which is 6.1%. The normal range is not the therapeutic goal in patients with DM.
(4) With the new treatments, it is possible to attain and perhaps maintain an almost normal HbA1c. Although all international DM associations agree the treatment should aim to achieve this goal, the majority propose a reduction < 7%; a higher value requires therapy initiation or change.
Blood glucose levels are expressed in mg/dl (to convert to mmol/l, divide by 18)
HbA1c: glycated hemoglobin

Metabolic syndrome

Definition and facts

Metabolic syndrome is a cluster of risk factors that include central obesity, elevated BP, elevated levels of triglycerides and blood glucose, and low HDL-C (Table 15). The pathophysiology of this syndrome is insulin resistance. This means that glucose metabolism at the cellular level is altered, and a higher amount of insulin becomes necessary to metabolize the same amount of glucose. That is, there is a decreased sensitivity of the peripheral tissues, particularly skeletal muscle, to insulin action, thus producing secondary hyperinsulinemia. Patients with this syndrome are at twice the risk of suffering a cardiovascular event and at 5 times DM risk[78,79]. In addition to the described metabolic abnormalities, it has been demonstrated that this syndrome is accompanied by an increase in plasminogen activator inhibitor (PAI-1), which potentially increases thrombogenesis, and is therefore another element that adds to AMI risk[66,80].

Challenges and goals

- To achieve the proposed goals for each component of the syndrome;
- To measure waist circumference in all patients;
- To educate the patient about the strong influence that a lifestyle change can have on this syndrome.

Special recommendations

- To decrease body weight;
- To decrease waist circumference;
- To perform predominantly aerobic exercise of moderate intensity, aiming to reach 80 to 90% of MHR (stress test), as well as resistance exercise with frequent repetitions and sets that exercise various muscle groups;
- To decreased added sugar intake, as well as sweetened beverages, and simple carbohydrates.

Recommendations on restarting sexual activity after cardiovascular events

Lack of confidence to perform sexual activity, decreased libido, erectile dysfunction, and ejaculation disorders are important points to consider after a cardiovascular event. Orientation and therapeutic management should begin from the earliest stages of CVDPR programs[81]. Some practical recommendations[82]:

- If the patient is able to achieve 6 METs of physical exertion in a stress test, or the equivalent in daily life tasks, sexual activity should not be restricted, because neither the duration nor the intensity of physical effort during sexual activity are risky enough to cause cardiovascular complications.
- It is advisable to prevent excessive consumption of food and alcohol a few hours prior to sexual activity.
- It is recommended to indulge in sexual activity in an appropriate manner, in which the patient feels relaxed and willing to indulge in the activity. Moreover, it is advisable to adopt positions that do not demand an excessive effort from the patient. The patient needs to be aware that the majority of MIs related to sexual activity appear to occur in situations of infidelity and/or in concomitant use of drugs, or when patients are experiencing high stress.
- Counseling is key in restoring the patient's confidence.
- The use of sildenafil and other phosphodiesterase inhibitors is not contraindicated in CVD patients, unless they have class IV angina, severe valvular stenosis, or persistent ventricular arrhythmias. Such drugs are also contraindicated when the patient uses nitroglycerin or other nitrates regularly.

Table 15 – Definition of metabolic syndrome according to ATP III[66]

At least 3 of the following 5 components must be met:
• Central obesity: waist circumference > 102 cm in men and >88 cm in women
• High triglycerides: ≥ 150 mg/dl or patient under pharmacological treatment
• Low HDL-C: < 40 mg/dl in men and < 50 mg/dl in women or in patients under pharmacological treatment
• Increased blood pressure: systolic BP ≥ 130 mmHg and/or diastolic BP ≥ 85 mmHg or previously diagnosed hypertension under treatment
• Change in fasting glucose: fasting plasma glucose 110 mg/dl [≥ 100 mg/dl] or previously diagnosed type 2 DM

ATP III: guidelines for the treatment of dyslipidemias in adults, Adult Treatment Panel III; BP: blood pressure; HDL-C: high-density lipoprotein; DM: diabetes mellitus.

IV. CARDIOVASCULAR REHABILITATION IN SPECIAL POPULATIONS

Rehabilitation in adults aged <55 years

Definition and facts

The pathologies that lead to CVDPR indication in this group of patients comprise, mostly, coronary artery disease (after AMI, CABG, angioplasty, medical management of coronary artery disease, followed by valvular heart disease, heart failure, and congenital heart disease).

This age group has its own characteristics, which require additional specific recommendations, together with those described for each of the abovementioned conditions. Such characteristics include the fact that this group is more likely to be economically active, performing activities that may require significant physical effort; more likely to have children at home, with the responsibilities that this entails; and a high probability that income is decreased during the acute episode. All these factors create major barriers to both access to and permanence in a CVDPR program, as well as difficulties in adhering to healthy habits and pharmacotherapy in general[83].

Challenges and goals

- Decrease the access barriers to CVDPR programs;
- Promote and encourage strategies that improve CVDPR program adherence;
- Implement strategies that educate the patients regarding healthy habits, exercise prescription, and the importance of medication[12,25].

Specific recommendations

The recommendations within the CVDPR program are the same as those for every pathology[12].

Rehabilitation in the elderly

Definition and facts

The elderly, defined as those aged >65 years, are often excluded from CVDPR programs; however, there are known benefits from the improvement in functional capacity, quality of life, and modification of risk factors in this age group[84]. This population has a decreased level of physical capacity, decreased flexibility, and exhibits alteration of the senses and impaired balance. In this scenario, the implementation of specific recommendations has a fundamental role[85,86].

Challenges and goals

- Encourage the referral of the elderly to CVDPR programs;
- Minimize barriers to inclusion and adherence to the program;
- Manage comorbidities in a comprehensive manner;
- Achieve a higher level of independence, self-care, and social adaptation;
- Stimulate the practice of resistance exercises to prevent or reverse sarcopenia;
- Consider the possibility of some cognitive deterioration that can represent a challenge in learning exercise techniques, diet, and other principles included in the CVDPR program.

Specific recommendations

- Encourage learning motivation, not only in the context of exercise but also regarding information related to their illness;
- Consider whether orders, indications, and precautions should be repeated;
- Include exercises that promote self-care;
- Combine aerobic exercise with individualized exercise program and stretching, flexibility, coordination, and balance exercises. Prescribe resistance exercises with low load[87] and multiple repetitions, covering various muscle groups.

Rehabilitation in children and adolescents

Definitions and facts

Pathologies with CVDPR indication in this population derive from congenital heart disease, with or without heart failure, as well as neurocardiogenic syncope. There is evidence that regular physical activity can be beneficial, even

in children with complex congenital heart disease, resulting in significant changes in functional ability, behavior, self-care, and emotional state[87,88].

Challenges and goals

- Minimize barriers to inclusion for this group of patients;
- Consider the educational component related to healthy habits;
- Achieve the highest level of patient's self-care and adaptation to the family and social context.

Specific recommendations

- Guide and motivate patients to perform their preferred recreational physical activity that meets the specific recommendations for each pathology and clinical status;
- Dietary recommendations should consider the patient's age and developmental stage, as well as the underlying disease; thus, it is very important to include consulting and monitoring by nutrition experts.

Rehabilitation in women

Definition and facts

There is limited specific information on women, because they are under-represented in clinical trials.

The current CVDPR recommendation for women in secondary prevention is class I, level of evidence A (women with recent acute coronary event, coronary intervention, or CVD)[89].

In most Latin American countries, CVD is a major cause of morbidity; however, it is recognized that, on average, < 10% of the total participants in CVDPR programs are women[90,91].

With regard to risk factors for coronary artery disease, there are some characteristics that can differ according to gender, such as physical inactivity, stress, and diabetes. It is known that women initiate CVDPR programs at an older age (an average of 10 years more), present higher anxiety than men, and are physically less fit; they also have more comorbidities and worse quality of life. In general, the benefits of CVDPR programs for women are the same as those for men, although some studies suggest that the former benefit from a greater impact of quality of life functional class. Despite this fact, women are less likely to stay in the program than men[92].

Challenges and goals

- Increase the participation of women with CVD in CVDPR programs;
- Increase the permanence of women in CVDPR programs;
- Maintain healthy habits after the end of the CVDPR program.

Specific recommendations

The current recommendation for physical activity for women is 30 min/day, 5–7 days/week, increasing to 60–90 min of moderate activity in most days of the week. The exercise program should include strength, balance, coordination, flexibility, and stretching activities (class I, level of evidence B).

Furthermore, it is important to:

- Adjust the exercise prescription to the comorbidities of the patient;
- Include the patient in a compatible physical activity group;
- Consider the atypical symptoms that may be present;
- During the sessions, determine the patient's preferred type of aerobic exercise (walking, dancing, cycling, swimming, or other), thereby favoring its performance as a part of the patient's routine, independently of the program[87].

Rehabilitation in patients with DM

Definition and facts

Proper diagnosis and treatment of DM are associated with decreased mortality. Part of the treatment is physical exercise, which should be adequately performed, with the attention that these patients require. Therefore, the interdisciplinary group in a CVDPR program must be aware of the correct approach in patients with this disease[93,94].

Challenges and goals

These are the goals of CVDPR staff:

- Know the medical history of the patient with diabetes, considering the following:
  - The presence of CVD;
  - The presence of comorbidities, retinopathy, neuropathy, and nephropathy;
  - The results of recent tests (fasting glucose level, OGTT, HbA1c, ophthalmic examination, lipid profile, etc.);
  - The patient's current medication, with special attention to medications that cause hypoglycemia[95] (Table 16). If the patient is being treated with insulin, the staff should know the type, dose, and route of administration.
- Know the patient's history of hypoglycemia: frequency, associated circumstances that may contribute to its onset, symptoms, prior hypoglycemia (use of carbohydrates)[95,96]. Each center should create their own protocols for glucose monitoring and develop appropriate policies and procedures, tailored to their institution;
- Know the use of glycemic self-monitoring: frequency and time of day, interpretation of results, and treatment if necessary[95];
- Educate patients regarding foot care: the patient must be advised on proper feet hygiene and on the importance of using comfortable shoes to avoid friction, wounds, burns, and injuries that may complicate his/her condition[96].

Table 16 – Hypoglycemic medication and risk of hypoglycemia[93]

Neutral	Low	Moderate	High
• Biguanides • Thiazolidinediones • Acarbose • GLP-1 analogs and gliptins	Mitiglinides	Sulphonylureas	Insulin

GLP-1: a peptide similar to glucagon type 1 DDP4.

Special recommendations

Exercise prescription:

The exercise must comply with the following goals:

- Short term: change the sedentary habits through daily walks at the patient's pace.
- Medium term: the minimum frequency should be 3 times/week on alternate days, with a minimum duration of 30 min/session.
- Long term: increase the frequency, if possible daily, and with moderate intensity, 45–60 min in duration, following the warm-up, exercise, and cool-down stages. Aerobic exercise (walking, jogging, swimming, cycling, among others) is recommended[92].

The practice of high-intensity exercise or competitive sports requires preventive measures, such as:

- Assessment of cardiovascular status in patients aged >30 years or who have had DM for > 10 years (there is a greater risk in case of proliferative retinopathy, autonomic neuropathy, and others).
- Avoid high-intensity exercise if there is evidence of proliferative retinopathy.
- Insulin-dependent patients should consume a meal or a snack rich in complex carbohydrates before starting physical activity, and they should have a sugary drink at their disposal because of the risk of hypoglycemia. Eventually, the physician will indicate an adjustment of the insulin dose for exercise days.
- High-risk exercises, in which the patient cannot receive immediate aid (climbing, hang gliding, scuba diving, among others), are not recommended.

Controlling glucose levels during CVDPR sessions

There is no consensus regarding the frequency or the indication of glucose monitoring prior, during, or after a CVDPR session. However, glycemic control is useful during the first sessions to determine the glycemic response to exercise. Thus, it is possible to successfully prevent hypoglycemia and properly adjust the exercise prescription to each patient, by defining whether prior or subsequent self-monitoring in each session is required. If the monitoring of post-exercise glucose is necessary, it should be performed 15 min after the end of the session. If the blood glucose level obtained in the first sessions is < 100 mg/dl or > 300 mg/dl, the physician should be informed, so that he/she can prescribe the treatment deemed appropriate for the patient. Patients who use insulin or oral hypoglycemic agents that may cause hypoglycemia should maintain blood glucose levels >100 mg/dl prior to exercise.

In case of hypoglycemia:

- Administer 15 g of carbohydrates to the patient (e.g., a fruit, a glass of sugary drink, sweetened juice, or a cup of milk). Assess the patient 15 min after carbohydrate ingestion.

In case of hyperglycemia:

- Type 1 DM patients with fasting blood glucose >300 mg/dl and ketosis should discontinue exercise, because it can aggravate ketosis. It is not necessary to suspend exercise, based simply on hyperglycemia, in cases of negative ketosis.
- Type 2 DM patients with fasting blood glucose >300 mg/dl can perform physical activities, but with caution.

Table 17 presents the recommendations and key points for the management of patients with diabetes.

Rehabilitation in patients with heart failure

Definition and facts

Heart failure is a major health problem, especially in the elderly population[85]. Although the primary pathology of heart failure results from abnormalities in cardiovascular function, changes in peripheral blood flow, metabolism, and skeletal muscle morphology (in its strength and endurance) contribute largely to the symptoms (peripheral flow).

The results of systematic studies indicate that regular exercise in patients with heart failure is safe and is associated with an increase in peak oxygen consumption by 16%. With regard to central hemodynamic mechanisms, patients who enter a CVDPR program present an increase in peak cardiac output and MHR.

Physical training induces a series of adaptations in skeletal muscle, including increased muscle mass, increased content of mitochondria, increased activity of oxidative enzymes, greater oxygen extraction from the blood, and change in fiber type distribution.

Inflammatory and immune responses play a central role in the development and progression of heart failure. Increased circulating levels of specific cytokines have been detected in these patients. Exercise positively affects such inflammatory markers by improving tolerance to physical activity and attenuating the inflammatory process. Thus, it produces a release of endothelium-derived relaxing factors, whose main representative is nitric oxide, which allows greater vasodilation[103].

Patients with heart failure also present multiple changes in respiratory function, which may occur as a result of decreased muscle strength secondary to inactivity, causing an increase in respiratory work, both at rest and during exercise. Hence the need for training the respiratory muscles and improve their strength and endurance, which in turn increases exercise tolerance[104].

Table 17 – Summary of recommendations/key points in the management of patients with diabetes in cardiovascular rehabilitation[94]

Objectives	• One of the key recommendations for patients with type 1 or type 2 diabetes is the optimal control of blood glucose, which has been shown to decrease the incidence of diabetes-related microvascular complications[97]
Cardiovascular rehabilitation	• Regular exercise helps to maintain appropriate levels of blood glucose and is a class I indication in the management of patients with diabetes mellitus[73] • The environment of cardiovascular rehabilitation is an excellent opportunity for the medical staff to monitor and manage diabetes mellitus, because of the frequent and close contact developed between the medical personnel and the patient • Aerobic and strength exercises may cause hypoglycemia in patients with diabetes, particularly in those individuals with strict blood glucose control. This provides a positive feedback regarding the effects of exercise on blood glucose control[98] • Education and guidance are given to patients identified at risk of hypoglycemia and hyperglycemia; hypoglycemia should be properly treated to avoid unnecessary consumption of calories and weight gain
Complications	• Diabetes is a major risk factor for cardiovascular disease (CVD). Individuals with diabetes are 2–4 times more likely to have a CVD than those without. In addition, CVD occurs at a younger age in individuals with diabetes, who tend to develop more diffuse lesions. Individuals with diabetes have a high prevalence of hypertension (approximately 50%) and dyslipidemia, which contributes to the increase in their CVD risk • Individuals with diabetes, particularly those with long-standing disease, are susceptible to autonomic neuropathies and are less likely to have symptoms, such as angina, while developing myocardial infarction. Therefore, tailoring training exercises that allow the recognition of symptoms of myocardial infarction in this type of patients is not easy. Some patients may have extensive areas of myocardial ischemia before developing any chest pain or the equivalent of angina • Some individuals with diabetes can develop long-term complications, which make cardiovascular rehabilitation even more challenging. Some examples comprise blindness, kidney disease, peripheral neuropathy with decreased sensitivity, peripheral vascular disease with significant claudication or amputation of finger(s)/limb(s), inability to decrease the heart rate response to exercise, and orthostatic hypotension[100-102]

Challenges and goals

Despite the known benefits derived from physical exercise, few patients with heart failure enter CVDPR programs. These patients have poor adherence to these programs, given the physical limitations they present. Therefore, it is important to increase participation and permanence in the program. Moreover, for a more accurate prognostic assessment, as well as for optimal exercise prescription, it is important to perform a cardiopulmonary test. In the absence of this option, the exercise test can provide useful information, although less robust than the former. The completion of the 6-min walk test with pulse oximetry can also contribute to the evaluation and prescription.

Special recommendations

In this type of patients, predominantly aerobic exercises are recommended; they can be performed either continuously or at intervals, with small and gradual increases in frequency and intensity, returning to the previous level when there is decreased tolerance. Dynamic resistance exercises, with a high number of repetitions and low load, can also be performed[105].

Rehabilitation in patients with valvular heart disease

Definition and facts

The prevalence of valvular heart disease has been changing in our setting in recent decades. Nevertheless, valvular pathology continues to have a significant importance in any cardiology service. It is the most frequent degenerative or nonrheumatic etiology; congenital valvular heart disease has lower incidence[106]. Although valvular heart disease is very common and, in most cases, physical effort is the triggering and limiting factor for symptoms, there are few studies that assess these patients' response and limitations to exercise.

Challenges and goals

Increasing the participation of patients with valvular heart disease in CVDPR programs is challenging. Therefore, it is important to educate referring physicians about the safety of these programs, because fear is the main cause of low indication of physical activity for these patients.

Specific recommendations

The guidelines or recommendations about exercise in this group of patients are directed primarily to lesions that have a moderate or severe degree, because patients with mild and asymptomatic lesions without hemodynamic repercussion have no restriction to the practice of noncompetitive physical activity (Table 18)[29,107].

Valvular diseases may be accompanied by some degree of severity of pulmonary hypertension; although patients benefit from CVDPR programs, there is not enough scientific evidence to recommend their use.

Rehabilitation in patients with peripheral arterial disease

Definition and facts

Atherosclerosis of the lower limbs, also known as peripheral vascular (or arterial) disease, has an annual incidence estimated at 20 per 1,000 individuals aged > 65 years. This pathology generates ischemic pain (intermittent claudication) that may cause physical limitations in affected individuals, with risk of loss of the extremity.

Table 18 – Physical exercise in valvular heart disease

	Aerobic exercise	Isometric exercise	Competitive exercise	Commentaries
Aortic insufficiency	• Asymptomatic with good ventricular function: moderate exercise	• Avoid	• Asymptomatic with good ventricular function: accepted in many cases (prior evaluation)	• Prior evaluation with stress test
Aortic stenosis	• Mild asymptomatic aortic stenosis: no restrictions • Moderate to severe aortic stenosis: moderate exercise	• Mild asymptomatic aortic stenosis: no restrictions • Moderate to severe aortic stenosis: only exercises with very low load	• Mild asymptomatic aortic stenosis: no restrictions • Moderate to severe aortic stenosis: avoid	• The recommendations are based on the hemodynamic severity of stenosis • A stress test must be conducted prior to the activity
Mitral stenosis				• Exercise is very limited by symptoms.
Mitral insufficiency	• Asymptomatic, sinus rhythm, good ventricular function, normal left atrial dimension, and normal pulmonary artery pressure: no restrictions	• Asymptomatic, sinus rhythm, good ventricular function, normal left atrial dimension, and normal pulmonary artery pressure: no restrictions	• Asymptomatic, sinus rhythm, good ventricular function, normal left atrial dimension, and normal pulmonary artery pressure: no restrictions • Left atrial pressure >60 mm, pulmonary hypertension, ventricular dysfunction: avoid	

Intermittent claudication of the lower limbs is defined as a pain of sufficient intensity that requires the patient to stop walking. It is caused by exercise; it is relieved by rest, and is originated by occlusive arterial disease[108].

The incidence of symptoms in the general population ranges between 0.9% and 6.9% in men and 1% in women[109]. The finding of intermittent claudication in a patient should not be considered as an isolated symptom, but rather as a systemic disease that manifests in the lower limbs and has impacted the musculoskeletal system, and that such patients probably have other CVD risks, not necessarily related to this symptom. In fact, 5%–10% patients will have a nonfatal cardiovascular event within 5 years.

Challenges and goals

CVDPR programs are part of the clinical treatment.

At the time of admission, the members of the CVDPR service must:

- Assess the patient to know his/her medical history: the presence of CVD risk factors, coexistence of coronary artery disease, habitual medication, etc.;
- Conduct and/or request a stress test on the treadmill aiming to identify:

a) The threshold for onset of ischemic pain in the extremities;

b) The peripheral hemodynamic response to exercise;

c) The coexistence of coronary artery disease.

It is important to repeat this test to evaluate the patient's improvement. At the same time, questionnaires to assess quality of life and perception of pain can be applied at the time of rehabilitation admission and after its completion.

In general, 75% of individuals present an improvement in intermittent claudication with exercise combined with peripheral vasodilators and antiplatelet drugs, whereas the remaining 25% exhibit worsening of their condition. Of these, 5% require vascular intervention and 2% undergo amputation[110].

Specific recommendations

One of the most frequent mistakes in this group of patients is pushing them to walk at a pace close to the maximum pain of claudication. This causes distress to the patients and the discomfort does not disappear after rest, which discourages them to adhere to the program. The correct recommendations regarding scheduled walks for patients with claudication are as follows[111]:

- Intensity: moderate and gradual. Rest for brief periods until the pain disappears, restart the walk immediately after;
- Duration: start with 5 min of intermittent walk, then progress to 50 min;
- Type of exercise: treadmill and walk without reaching the maximum pain threshold;
- Resistance exercises can be performed in addition to aerobic exercises, but should not replace them;
- Components of each session: warm-up and cool-down periods, lasting 5–10 min each, with a walk in the field or the treadmill;
- Frequency: 3–5 times/week. Ideally, these exercises should be performed daily.

Exercise programs with walks are successful when lasting no less than a few months[22].

Rehabilitation in post-heart transplantation patients

Definition and facts

Despite receiving a heart with normal systolic function, the transplanted patient experiences exercise intolerance after surgery. This intolerance is caused by the absence of sympathetic innervation of the myocardium, skeletal muscle abnormalities (that develop before transplantation for heart failure), and decreased skeletal muscle strength[112].

Patients who undergo transplantation are characterized by the following:

- Differences in cardiopulmonary and neuroendocrine responses;
- High RHR (above 90 beats/min);
- Elevated systemic BP and systemic BP at rest, because of the increased plasma norepinephrine and immunosuppressive drugs, such as cyclosporine, a medication that causes an increase in BP at rest and during submaximal exercise.

Challenges and goals

- Decrease basal HR with training;
- Increase HR during submaximal work;
- Avoid overweight or lose weight, thus balancing the side effects of immunosuppressive therapy;
- Maintain BP < 130/80 mmHg;
- Offer the patient a support for his/her psychosocial management.

Specific recommendations

An echocardiogram can be used by a physician to discard pericardial effusion and evaluate ventricular function, as well as to provide information to the patient and family about changes in vital functions derived because of transplantation.

Regarding physical activity, the ideal is to start with slow walks, between 1.5 and 2 km, slowly increasing the distance, keeping the perception of effort according to the Borg scale between 12 and 14. Aerobic exercise should be performed with an intensity of < 50% of peak VO_2 or 10% below the anaerobic threshold (guided by HR). Training should start immediately after hospital discharge, progressing to phase II between the 2nd and 3rd week after transplantation.

Exercise should be stopped during steroid pulse therapy[112].

Resistance exercises are added at the 6th and 8th week. At first, they should be performed with an elastic band (2–3 sets with 10–12 repetitions, with a recovery period of > 1 min between each set and with intensity between 40% and 70% of maximum voluntary contraction[113]). The goal is to perform 5 sets of 10 repetitions with 70% of maximum voluntary contraction and a full recovery.

The total duration of the exercise should be from 30–40 min/day, combining aerobic and resistance exercises, progressing slowly from warm-up to resistance activities.

It is also important to establish a diet to maintain the ideal weight, as well as to control cholesterol levels, DM, and BP, because these patients are very sensitive to excessive salt intake. It is also necessary to inform the patient regarding the adoption of measures to decrease the risk of infection after the transplantation. Adequate psychosocial support is very helpful to manage depression, which is increased by the use of steroids and the high level of anxiety generated by the transplantation itself[112].

Rehabilitation in patients with pacemakers and cardiac defibrillators

Definitions and facts

The benefit of these devices in decreasing episodes of sudden death and improving quality of life has already been demonstrated; however, a significant incidence of depression, anxiety, and phobias has been described. For this reason, most of the research is in agreement regarding the recommendation of appropriate and ongoing support, as well as psychological and educational counseling[114,115].

Challenges and goals

Because physiological changes of exercise can increase the likelihood of the defibrillator (implantable cardioverter-defibrillator [ICD]) being triggered, both the medical team and the patient fear the practice of physical activities. Thus, overcoming this fear and increasing the number of patients referred to a CVDPR program is challenging[12].

The following must be known prior to physical activity initiation:

- Patient's pathology;
- Basic information of the pacemaker, such as type of sensor that adjusts HR, as this will determine, in some patients, the HR response to exercise, especially in those without adequate chronotropic response. This factor should be taken into account when prescribing physical activity.
- The device's programming, such as MHR at which it is programmed to send a shock.

It is important to determine the limits of exercise (10–20 bpm below HR at which ICD is programmed to send a shock). A stress test will determine THR; the goal should be to exercise at 75% THR in the first month and at 85% in the second month.

Group work results in great psychological benefits, facilitating the exchange of experiences and feelings, helping patients to lose their fear. Groups are formed in a gradual manner by bringing together old and new patients. The former serve as guides for the latter, demonstrating that it is possible to make major efforts to improve physical capacity without the risk of complications[115].

Special recommendations

They will depend on the type of pacemakers implanted:

- Unicameral (VVI) without adaptive response, but with good chronotropic response: the physician should treat

the patient in a similar way to individuals without CVD. An improvement in the maximum O_2 consumption and anaerobic threshold can be anticipated, with an increase in functional capacity.

- Unicameral VVI without adaptive response and without chronotropic response: it is indicated for physical training without restrictions. However, in these patients, although it improves functional capacity, there is a smaller increase in the consumption of peak O_2 and cardiac output.
- Unicameral VVIR (with adaptive response) will adjust to the exercise HR. However, if the pacemaker sensor is based on an accelerometer that detects axial movement, the adaptation of HR may not be adequate during activities of moderate or high intensity that do not induce axial movement, such as stationary bike.

It is recommended not to perform exercises with weights or to raise the arms excessively until at least 6 weeks after implantation. The patient should always maintain a direct relationship with the arrhythmologist in charge, to define adjustments in the program. In most cases, and especially in patients who survived sudden death, the psychological effects are very important. A specific and individualized treatment by psychologists and psychiatrists is necessary to improve the quality of life and prognosis, as there is evidence of the relationship between psychological impact, ventricular arrhythmias, and ICD shocks[116].

A test run of the pacemaker should be performed on each patient prior to their entry in the CVDPR program, to monitor vital signs, symptoms in response to exercise, and change of pace. In addition to pacemaker programming, age, and level of physical activity of the patient should be taken into account[116].

The percentage of HR achieved, METS, and perceived exertion calculated using the Borg scale, will determine the calculation of exercise intensity. Adequate planning of the training will result in an improvement in functional capacity and morbidity, directly related to the etiology and severity of the underlying CVD. One of the main goals is to give patients in CVDPR programs confidence and security in face of possible shocks or arrhythmias during exercise or during their daily lives, and to help them overcome their fears and anxieties regarding the change in their quality of life[115].

Rehabilitation in patients with chronic obstructive pulmonary disease

Definition and facts

Patients with pulmonary disease associated with stable cardiac disease should not be excluded from a CVDPR program; it is only required that they are stable and properly medicated. These patients develop progressive limitations, often without cardiac involvement. Chronic obstructive pulmonary disease progressively damages the lung tissue and airways, finally resulting in slow deterioration of the respiratory reserve. This picture is complicated with hypoxemia and elevated pulmonary vascular pressures, leading to right ventricular dysfunction.

All these factors contribute to the sensation of dyspnea and worsening of exercise capacity, which lead to a reduction in daily physical activity. The lack of exercise leads to a loss of peripheral physical condition, and ultimately decreases resistance and increases muscle weakness and atrophy, resulting in a greater functional impairment. However, patients with severe respiratory deterioration and respiratory muscle weakness significantly benefit from intensive pulmonary rehabilitation. Similarly, hypoxemia due to physical activity has been considered by some to be a contraindication to an exercise program; this can be a particular case for a patient with aggregated coronary artery disease, but can be performed in a properly monitored and decompensated patient. It is desirable to have a pulse oximeter to measure O_2 saturation during exercise. A decrease in saturation <88% is an indication for a transient break[117] or of the need for supplemental oxygen during physical training, using a nasal catheter or even a Venturi mask.

Challenges and goals

- Get the patient to tolerate the prescribed exercise program;
- Conduct a joint assessment with the pulmonologist to establish an adequate medication regime to allow for the performance of an exercise program; Adequately quantify the level of inability to prescribe the appropriate exercise load;
- Control the CVD risk factors;
- Control the depression and anxiety produced by the sensation of dyspnea;
- Improve muscle strength and decrease muscle atrophy;
- Improve the quality of life of patients by improving their functional capacity with exercise;
- Decrease the rest period between each exercise period.

Specific recommendations

- It is important to evaluate the respiratory and cardiovascular parameters before starting the program. It is advisable to perform a standard chest radiography, spirometry, and echocardiography, in addition to a cardiopulmonary stress test or the 6-min walk test. Conducting a standard stress test with oxygen supplementation may be useful in patients with significant hypoxemia at rest or induced by effort.
- The exercise must be divided into 3 types: flexibility, strength, and aerobic exercises. Stretching is part of a routine of exercises that develop flexibility, improve the range of motion, and help the general warm-up session. Exercises with free weights, at low intensity and high frequency, may be included, as well as walking, rowing, swimming, water aerobics, cycling, climbing stairs, and others, which are capable of producing a significant level of cardiopulmonary stress[118,119].

- The intensity of the prescribed initial load, from the pulmonary standpoint, must be sufficiently low so that the patient does not feel discomfort.
- The proper intensity for these patients should be determined with training, i.e., 70%–80% of MHR, if possible[118].
- In the first weeks, the sessions must not extend beyond 20 min. Therefore, strategies to achieve the highest level of the initial stress test should be the ultimate goal[119,120].
- Patients with obvious obstruction should be advised to use a fast-acting bronchodilator 15 min before starting physical activity.
- When the patient tolerates exercise loads, these can be increased by approximately 12.5 watts for stationary bicycles and by 9 watts for the hand ergometer, increasing every 6 sessions.
- Psychosocial management: because the psychological changes are common in these patients, it is important to have a psychological evaluation prior to entering the CVDPR program.

Rehabilitation in coronary artery disease patients (after MI, percutaneous coronary revascularization, or after CABG)

Definition and facts

After an acute coronary event, patients should start a physical activity that is compatible with their tolerance (walking, cycle ergometer, etc.) and clinical picture severity. Generally, after 1 week, all patients should be developing an activity that is, at first, of light intensity and prescribed by the professional in charge of their program[121].

Challenges and goals

CVDPR-based exercise decreases fatal events 25%–40% in the long term. Despite the indisputable benefit of CVDPR, only 15%–30% patients who have suffered a cardiovascular event participate in this type of programs, in addition to the decreasing adherence observed in patients who choose to participate. Thus, it is important to foster constancy and adherence of such patients to the CVDPR program[12,122].

Special recommendations

- A stress test and a neuromusculoskeletal assessment should be performed when patients start the CVDPR program. If the patient starts the program before the stress test, the test should be conducted within the first 4–7 weeks; the results will be used to adjust the exercise prescription.

All post-ACS or CABG patients should undergo a stress test with ECG analysis (when technically feasible) or an equivalent noninvasive test to assess ischemia in the first 4–7 weeks after hospital discharge (level of evidence IIa-C)[29].

- As a general rule, physical activity (leisure, professional, and sexual activity) should restart at 50% of maximal exercise capacity, expressed in METS, and should be increased gradually.
- Patients who have a preserved left ventricular systolic function and present no inducible ischemia or arrhythmias in a stress test can return to their jobs. If they have an office job, an 8-h daily activity can be restarted. If the work is manual and involves physical activity with moderate or intensive exertion, the workload should not exceed 50% of maximal exercise capacity assessed in the stress test. The workday should not exceed 4 h in the first month, with progressive 2-h increases monthly[29].
- Patients with moderate left ventricular systolic dysfunction or mild ischemia on a stress test can resume office work, but their activity should be limited to stationary desk work.
- A patient with severe left ventricular systolic dysfunction or significant ischemia on a stress test can engage in office work whenever the exercise capacity is > 5 METS without symptoms. If not, the patient should abstain from work[29].

Rehabilitation in patients with vasovagal syndrome

The vagal or vasovagal syncope is a common entity with an estimated prevalence of approximately 35%[123-126].

The use of fluids and salt has been widely recommended for the treatment of this pathology[127,128]. Certain isometric exercises (counter-pressure) have been used as abortive for episodes that are preceded by a prodrome. These exercises are designed to quickly increase peripheral arterial resistance and, therefore, prevent syncope due to a decrease in BP. The main counter-pressure exercises are handgrip, flexing the upper extremities, clasping both hands and trying to separate them, and flexing the lower extremities[129-131]. Another effective method for preventing new episodes is the practice of supervised exercises, in which the patient remains in the standing position, leaning against the wall, with increasing duration, reaching up to 30 min[132]. Regular aerobic exercise should be recommended, because they are almost always effective in decreasing the symptoms by increasing the volume of blood and muscle mass in the lower limbs, as well as enhancing venous return[130]. Evidence has shown that a regular exercise program, comprising aerobic activities and resistance exercises, increases the sensitivity of arterial baroreceptors, when compared with pharmacological treatment[133].

Cost effectiveness of a cardiovascular rehabilitation program

Cost effectiveness measures the years and quality of life gained; it is usually expressed in monetary terms over the years gained. When discussing the cost/benefit ratio or cost effectiveness, the costs of an intervention are also measured, combined with the disease-related costs, including complications or long-term events. The results are expressed in terms of clinical benefit (years of life gained) divided by the monetary value (cost), resulting in cost of every extra year of life in comparison with alternative treatment or no treatment.

Several studies have shown that CVDPR is cost effective and that it can even be cost saving, because it not only increases survival but also decreases costs. Ades et al.[134] analyzed the cost/benefit ratio of 21 months of CVDPR, and found savings of USD 739 compared with the control group; Oldrige et

al.[135] evidenced savings of USD 9,200 in comparison with the control group, over a period of 12 months. To compare the cost effectiveness of CVDPR with that of other interventions we can cite the typical treatment of hypertension, which has a cost effectiveness of USD 9,000. This proves that CVDPR is useful in terms of survival, incidence of cardiovascular events, quality of life, and also from an economic standpoint.

V. CONCLUSIONS

Presently, CVDPR is regarded as safe and effective, decreasing the overall CVD-related mortality and the number of cardiovascular events; it also decreases hospitalizations, improves symptoms and quality of life, and is cost effective. Although it is recommended in all guidelines for clinical practice, its implementation in our environment is suboptimal and frustrating.

Human and material resources to develop these programs in a standardized, accessible, and universal manner should be provided. The attitude and collaboration of physicians in the hospitalization phase is important for the referral of patient to CVDPR programs and the success of such programs. A favorable attitude toward rehabilitation will facilitate modification of the daily routines of a larger number of patients.

Program design and the attitude of the professionals can lead to poor adhesion to the guidelines, if they are not adjusted to the patients' circumstances. Less-intensive and/or semi-supervised home programs should be considered in specific cases. Fewer women enroll in CVDPR programs than men; they also tend to abandon the program earlier. This is attributed to their higher age, increased prevalence of pathologies associated with depression, decreased social support, and increased family obligations. A similar effect occurs in depressed patients and those of low socioeconomic background. Lack of exercise and poor feeding habits are creating a shift in the cardiovascular profile of the population, which implies an earlier appearance of clinical manifestations of CVD and increased prevalence of risk factors, such as physical inactivity and overweight. These circumstances cause serious public health problems, which must be corrected with educational measures aimed at the entire population, fostering mainly primary prevention programs. Therefore, we believe that governments, through their health policies, should become more involved in promoting and performing actions that have a real impact on society.

In a 1993 statement, WHO proposed that CVDPR should not be considered as an isolated therapy, but rather as a treatment integrated in the overall management of CVD and as an active component of secondary prevention.

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Guidelines