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Hospitalization phase of cardiac rehabilitation. Protocol for cardiac surgery

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SICU: Surgical Intensive Care Unit

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ABSTRACT
Cardiac rehabilitation in the hospitalization phase, in patients scheduled for surgery, has progressed over the years. Based on the knowledge and scientific evidence that a more dynamic physiotherapy intervention favors a quicker recovery from surgery, and reduces postoperative complications and hospital stay, it is the aim of this paper to update the physiotherapy intervention protocol of our hospital. Educational and informational aspects were established in the preoperative stage, as well as the teaching of techniques and breathing exercises, and a psychological intervention. Also, an exercise routine is presented according to the different stages, and the use of variables to control the physical fitness session. Updating the action protocol from the preoperative stage to the moment of hospital discharge will help unify work strategies and criteria in the hospital phase of the national rehabilitation program for cardiac surgery.
Key words: Cardiac rehabilitation, Hospitalization phase, Cardiac surgery, Early mobilization, Hospital physiotherapy

Fase hospitalaria de la rehabilitación cardíaca. Protocolo para la cirugía cardíaca

RESUMEN
La rehabilitación cardíaca en la fase hospitalaria, en pacientes programados para cirugía, ha progresado con el transcurso de los años. Beneficiada por el conocimiento y la evidencia científica de que intervenciones fisioterapéuticas más dinámicas favorecen una recuperación más rápida de la cirugía, disminuyen las complicaciones postoperatorias y la estadía hospitalaria. Se establecieron desde el preoperatorio, aspectos educativos, informativos y de enseñanza en técnicas y ejercicios respiratorios, así como de intervención psicológica, además se presenta una tabla de ejercicios según los diferentes estadios y el uso de variables para el control de la sesión de acondicionamiento físico. La actualización del protocolo de actuación desde la etapa preoperatoria hasta el egreso hospitalario, contribuirá a unificar criterios y estrategias de trabajo en la fase hospitalaria del programa nacional de rehabilitación para la cirugía cardíaca.
Palabras clave: Rehabilitación cardíaca, Fase hospitalaria, Cirugía cardíaca, Movilización precoz, Fisioterapia hospitalaria

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INTRODUCTION

Different stages that potentiated the use of physical exercise as therapy for patients with coronary heart disease have been described, from William Heberden in 1802[1], to the creation, in the early fifties of last century, of special units for the treatment of acute myocardial infarction[2]. These stages were sustained on the basis of the results of research by different authors and periods[3,4] that favored the gradual development of the concept of early mobilization, early ambulation, and then the prescription of physical training. These aspects facilitated the assessment of residual functional capacity of the myocardium few weeks after the acute episode; besides being the first elements taken into consideration since cardiac rehabilitation was identified as a form of treatment, to which, psychological and social care were subsequently incorporated, which required a little more time to progress[5].

Cardiac rehabilitation originated and developed from the '50s - '60s, from the techniques and principles initially implemented in short and long-term monitoring of individuals who survived a myocardial infarction. Then, favored by the rapid development of coronary surgery in the late seventies, cardiac rehabilitation continued to show its advantages with the inclusion of patients with aorto-coronary, valvular, congenital, and heart transplantation surgeries[5-8]. The incorporation of these patients to rehabilitation programs in the hospital phase, at the Institute of Cardiology and Cardiovascular Surgery of Havana[5], and institutions in other countries[6], would begin with a hospitalization of one to two weeks prior to surgery with the purpose of teaching respiratory therapy, specifically diaphragmatic breathing. Exercises for upper and lower limbs were also performed and they would receive emotional support. Postoperatively, there was an emphasis on mobilizing the patient as soon as possible, performing breathing exercises, calisthenics and walking, with protocols ranging between 15 and 21 days, with 14 stages of exercises initially, which later were reduced to 9[2,6,9].

Today more dynamic protocols are conceived, with much less hospitalization time after surgery. It is considered that a proper previous preparation decreases the incidence of postoperative complications, reduces hospital stay and facilitates reintegration to family and social environment[10-14]. The concept of early mobilization remains essential in the first 24-48 hours[12,15-18], and respiratory therapy not only includes diaphragmatic breathing, but other techniques and equipment to attenuate respiratory abnormalities that may occur after chest surgery have been added[19-21].

Educational, nutritional, and smoking cessation programs have been gradually incorporated. Psychological care, recommendations for sexual activity, counseling for job reinstatement and control of cardiovascular risk factors, have been approached with more current and comprehensive perspectives[15,22] aimed at secondary prevention, key and vital element of cardiac rehabilitation programs[23-25].

Through the years, the beneficial results of secondary prevention and rehabilitation programs in reducing cardiac morbidity and mortality have meant that now the American Heart Association, American College of Cardiology and the European Society Cardiology consider them as Class IA indication in accordance with its recommendation, usefulness, effectiveness and level of evidence, in the treatment of patients with acute coronary syndrome, heart failure, percutaneous coronary intervention and coronary artery bypass grafting[12,18,26]. Similarly, these programs are indicated after valve surgery and heart transplantation[26-28].

In order to provide increasingly appropriate and effective services, the inpatient rehabilitation protocol for patients scheduled for cardiac surgery is updated. At the Institute of Cardiology and Cardiovascular Surgery of Havana, all patients requiring surgical procedure, following the guidelines of the World Health Organization[29], begin with the hospital phase, where the heart surgery protocol will be divided into pre and postoperative stages, so the multidisciplinary team (surgeon, anesthesiologist, cardiologist, psychologist, nutritionist, nurse, physiatrist and physiotherapist) should make a proper psychological and physical assessment to undertake a work strategy from the admission of the patient.

STEPS OF PHYSIOTHERAPY INTERVENTION

Stage 0: Preoperative

The main objective in the preoperative stage is the preparation prior to surgery, so that teaching, education and information for the patient are vital elements for him/her to arrive at surgery in the best

possible conditions and thus ensure prompt and adequate recovery[10,12,15,17].

The physiotherapy intervention begins by making an anamnesis to obtain personal and family information. Also a general assessment to determine any osteomioarticular condition, and of the respiratory tract is made.

The opening of the chest causes decreased respiratory function and pulmonary complications such as atelectasis, pneumonia, pleural effusion, respiratory failure, pneumothorax, phrenic paralysis, among others. These are exacerbated in smokers and those with chronic obstructive pulmonary disease. Anesthesia, analgesia and other medications used in the perioperative stage affect the central respiratory control and modify the neurological regulation of upper airway and chest muscles, all of which contributes further to postoperative pulmonary disorders. Surgical trauma is another factor that - by altering the ventilatory mechanism because of the functional disruption of the respiratory muscles by the incision as well as the inhibition of its innervation and postoperative pain - alters the normal activity of the muscles, mainly the diaphragm, so chest physiotherapy is considered one of the most important points of action of pre and post-surgical cardiac rehabilitation [19,21,30].

Aspects to be considered in the preoperative preparation

Respiratory physiotherapy

The main objective is to improve regional ventilation, gas exchange, function of the respiratory muscles, dyspnea, and exercise tolerance, and facilitate the removal of bronchial secretions[10,31].

Out of the existing permeabilization techniques of airways[32,33], in the preoperative stage, those that may be applicable in the postoperative stage of a chest surgery will be used.

Breathing reeducation

- Teaching diaphragmatic breathing (**Figure 1**): The patient takes a slow, deep breath through his nose, trying to rhythmically raise the abdomen; then exhales with parted lips, checking how the abdomen goes down. It will be started with 5-10 diaphragmatic breaths, urging the patient to continue practicing several times a day.
- Breathing with pursed lips: Inhaling through the nose and exhaling slowly and evenly against pursed lips, while the muscles contract. When tightening the lips, intraalveolar pressure is increased, expiratory phase is prolonged and the air is more easily expelled from the lungs, which favors the elimination of carbon dioxide.

Figure 1. The physiotherapist performs respiratory reeducation through teaching and explaining the patient diaphragmatic breathing in the preoperative stage.

Techniques using gas compression

- Forced Expiration: Sequence of 3-4 diaphragmatic breaths at normal volume, followed by 3-4 movements of chest expansion (slow, deep inspiration with passive expiration), repeating again with 1-2 forced expirations with open glottis at average or low lung volume.
- Effective Cough: Detachment of mucus from the bronchial wall usually triggers coughing. It can be caused by applying a gentle pressure on the trachea in the suprasternal fossa, at the end of inspiration. The cough produces mucus expectoration by mouth or its swallowing. The patient will be taught to perform an effective and undisturbing cough. For this purpose, he/she should place one hand on the sternal area where the incision will be made, so that sternal suture will not be compro-

mised by increased pressures, and the other hand on the abdomen, to contribute to the contraction and improve cough quality. Other institutions prefer to use both arms folded across the chest when coughing.

Equipment used to support respiratory physiotherapy and its methodology

- TriFlo II: Hold spirometer upright on your hand. Try not to tilt to either side. Exhale normally and put the nozzle of the apparatus between the lips. Inhale deeply until the subdial of the device ascends to the highest position possible. Hold your breath for a count of 3 (not matter how the Subdial descends). Remove the mouthpiece from the mouth and exhale normally[32].
- Flow Meter: To use it therapeutically, an assessment of peak expiratory flow (higher than 270 ml is considered normal)[32] must first be made. 3 measurements will be made, of which the highest number will be chosen and this figure will be divided into 3 volumes for repetitions.
- Fluter or Cornet: It combines positive expiratory pressure and high frequency vibrations. Slow, deep breathing with apnea of 2-3 seconds are performed, followed by a strong and prolonged exhalation[32].

2-3 sets of 7-10 repetitions of each exercise with rest between 15-30 seconds between repetitions and 45-60 seconds between sets will be performed. These exercises will be done 2 times a day. Either exercise will be done depending on the patient's need. Similarly, although an initial dosage of work and rest is established, it can be modified according to medical indication and tolerance of each patient.

Teaching radial pulse measurement and familiarization with the Borg scale[34]

They are very important to control the intensity and tolerability of the exercises in the conditioning session [17,35].

Teaching of transferring between bed-chair and chair-bed[17,36]

It is necessary to give ergonomic advice to the patient to make transfers with minimal effort possible and in positions that will not cause pain to the wound of the chest or leg, in case a saphenectomy is conducted.

Educational and informative lectures for patients and families[17,22]

The multidisciplinary group will tell about several issues that the patient and his/her family need to know before and after the operation:

- Hygiene. Integrity of the skin, prior shaving and washing; with emphasis on handwashing in the postoperative stage.
- Food. Adequate hydration and a balanced diet.
- Issues related to their stay in the surgical intensive and intermediate care units.
- All necessary instructions will be given so the patient can correctly continue his/her drug treatment, particularly the use of anticoagulants and other medications.
- Stress on the importance of controlling coronary risk factors in patients with ischemic heart disease will be made and they will be told about the benefit of the cardiac rehabilitation program for improving quality of life and their work and social reintegration.
- The support and collaboration of the family concerning all recommendations will be asked to help the patient be an object in their own recovery and rehabilitation.

Preoperative psychological intervention

Since the announcement of the surgical procedure, patients begin to experience strong emotional states, uncertainty, angst, anxiety, depression and stress caused by the disease itself, which are expressed in varying degrees depending on the tolerance and personality of each patient; and on their fear of pain and death. These factors break the daily balance linked to the social, professional and personal life, so that psychological intervention with the aim of promoting effective self-regulation mechanisms for effectively coping with surgical treatment and rehabilitation is necessary[37].

Psychological assistance is targeted at the individual and group psychotherapy, and counseling on family dynamics. Since the patient is admitted the following interventions shall be performed:

- Psychological interviews to explore possible areas of conflict, social support, their emotional reactions so far, personality, and identify strong emotional states: anxiety and depression. It also explores the mechanisms of personal auto-regulation, awareness-stress, perceptual defense, and coping styles

to the process set forth.
- Psychological testing: Dembo-Rubinstein Scale[38] for self-assessment, State-Trait Anxiety Inventory (STAI)[39], and Beck's[40] for depression are applied. Tasks to evaluate the intellectual and work capacity are also performed[41].

Conditioning sessions

Passive movement, assisted and free active exercises, as well as ambulation will be performed, in order to minimize as much as possible the loss of functional capacity, of muscle strength and of joint arches[15,17]. The exercise program for inpatient rehabilitation (**Table**) will be used as a guide.

6-10 repetitions of each exercise should be made 2 times a day, in combination with diaphragmatic breathing, considering changing this dosage or stop conditioning sessions if the patient had any signs or symptoms of exercise intolerance. The patient will walk the distance he/she can tolerate and that their clinical condition allows.

The control of the conditioning session will be done through the heart rate and Borg scale. The pulse oximetry finger can also be used.
- Heart rate: The heart rate may rise up to 20 beats above the heart rate obtained at rest[35].
- Borg scale (6 to 20): Method of subjective perception of exertion. The patient should perform their exercises and perceive the exertion as very, very light to light (range in Borg Scale of 6-12). This method, besides being safe and effective in controlling the intensity of the effort, is useful in patients with arrhythmias, chronotropic incompetence or implanted pacemaker on request[11,34,35].
- Blood pressure: Systolic blood pressure must be increased from 10 to 40 mmHg compared to that obtained at rest[35].
- Finger Pulse Oximeter: An instrument that expresses the value of the oxygen saturation rate, of heart rate and the pulse curve during the conditioning session. This saturation is normal > 95%, from 95-93% it is mild desaturation, from 92-88%, moderate desaturation and < 88%, severe desaturation[42].

Stage I: Surgical Intensive Care Unit (SICU)

The main objective of this stage is to avoid respiratory complications typical of cardiac surgery, and minimize the effects of the rest indicated in these early hours, so breathing exercises and mobilization of members are vital.

After 24 hours, if the patient is in stable condition from the clinical, hemodynamic and electrocardiographic points of view, physiotherapy will be started:
- Diaphragmatic breathing exercises: should be performed several times a day.
- Passive mobilizations (**Figure 2**) and assisted active exercises: 6 to 10 repetitions of each exercise 2 times a day should be done, in combination with diaphragmatic breathing. In the leg where the saphenectomy was performed the movement of bending-extension knee-hip should not be done until 72 hours after surgery.
- Although the patient is in the SICU, with personalized nursing care and constant monitoring of vital signs, you should be alert to any signs or symptoms of intolerance or complication in performing physiotherapy.

Figure 2. The physiotherapist performs active mobilization assisted by flexion and extension of the fingers 24 hours after the patient undergoes surgery in the SICU.

Stage II: Surgical intermediate care unit

At this stage the patient is between 24-72 hours after the operation. The objective pursued, besides avoiding respiratory complications and others due to bed rest, is to improve the breathing and functional capacity of the patient and introduce activities of daily living.

Techniques of breathing physiotherapy taught in the preoperative stage will continue, mainly diaphragmatic breathing, forced expiration and effective cough.

- 3 sets of 7 to 10 repetitions of each exercise will be done with rest from 15-30 seconds between repetitions and 45 to 60 seconds between sets. These exercises will be done 2 times a day, just as in the preoperative stage, although a dosage of work and rest is established, this will be done according to tolerance and clinical evolution of the patient.
- Other techniques that facilitate the release of mucus and promote coughing up accumulated phlegm are further added[32,33].

Table. Exercise Program - Inpatient rehabilitation.

STAGE I	STAGE II	STAGE III
Lying position, supine.	**Sitting position in bed or chair. If in wheelchair,** the patient must be sitting at a height that allows him/her to have the knee flexed to 90° relative to the hip and the floor.	**Standing position. Legs spread to shoulder width.**
1. Flexion and extension of toes.	**1**. Flexion and extension of the toes.	**1**. Movements of the neck. Forward flexion and back extension.
2. Dorsiflexion and active ankle plantarflexion.	**2**. Dorsiflexion and active ankle plantarflexion.	**2**. Lateral flexion to the right and left.
3. Inversion and active eversion of the ankle.	**3**. Inversion and active eversion of the ankle.	**3**. Neck rotation to the right and left.
4. Flexion-extension knee-hip, sliding your foot on the mattress.	**4**. Extension and flexion of knees.	**4**. Abduction-adduction of the shoulder (90°-180°).
5. Abduction and adduction of the hip.	**5**. Flexion of hip. Up and down one leg, alternating with the other.	**5**. Horizontal abduction-adduction of the shoulder. Arms raised to 90°.
6. Flexion and extension of the fingers.	**6**. Flexion and extension of the fingers.	**6**. Alternating flexion and extension of the shoulder.
7. Dorsal and palmar flexion. Radial and ulnar deviation of the wrists.	**7**. Dorsal and palmar flexion and radial and ulnar deviation of the wrist.	**7**. Flexion and extension of elbows.
8. Prono-supination of forearm with elbow flexion to 90°.	**8**. Prono-supination of the forearm with elbow flexion to 90°.	**8**. Dorsal and palmar flexion and radial and ulnar deviation of wrists.
9. Flexion and extension of elbows.	**9**. Flexion and extension of elbows.	**9**. Forward flexion and trunk extension.
10. Abduction and adduction of the shoulder. The patient abducts the arm (90°-180°) and returns to the initial position.	**10**. Abduction-adduction of the shoulder. The patient abducts the arm (90°-180°) and returns to the starting position.	**10**. Lateral flexion of the trunk.
11. Shoulder flexion (90°-180°).	**11**. Horizontal abduction-adduction of the shoulder. Arms raised to 90°.	**11**. Flexion of the hip with knee flexed.
12. Internal and external rotation of the shoulder. With the arm abducted to 90° and the elbow flexed.	**12**. Shoulder flexion (90°-180°).	**12**. Active dorsiflexion and plantarflexion of ankles.
13. Movements of the neck. Lateral flexion of the neck to the right and left.	**13**. Movements of the neck. Forward flexion and back extension.	**13**. Active inversion and eversion of the ankle.
14. Rotating the neck to the right and left.	**14**. Lateral flexion of the neck to the right and left.	**14**. Elevation of toes.
	15. Neck rotation to the right and left.	

Technique using gravity

Postural drainage: postural drainage maneuvers that include changes in the patient's position to drain the different lung lobes are contraindicated, mostly for patients undergoing cardiovascular surgery, because the patient must remain supine, except in those interventions where median sternotomy is not performed. Usually the technique that raises the head of the bed to take the patient to a sitting position can only be applied. Thus, the upper lobe drain is facilitated.

Shockwave techniques

- Vibration-shaking: these are manual or mechanical oscillatory movements on the chest wall to modify the viscoelasticity of secretions. They are performed in expiratory time and perpendicular to the chest wall. Mechanical vibrations are performed with an electric vibrator.

Mobilization, active exercises, walking, and stair climbing[5,6,11,17,36,43]

- Passive mobilizations, active free or active assisted exercises depending on the physical state of the patient. 8 to 10 repetitions of each exercise should be done 2 times a day, in combination with diaphragmatic breathing.
- Walking: first in the ward and then in the hallway of the ward, starting with 25 and 50 meters, increasing from 10 to 15 meters per day, trying to have the patient complete at least 150 to 200 meters before hospital discharge.
- Stair climbing: start with 5 steps, increasing from 2 to 3 a day, trying to have the patient climb 20 steps before hospital discharge.
- Although mobilizations, exercises, walking and stair climbing have an initial dosage they will be subjected to individual tolerance and progress of each patient.
- The control of the conditioning session of this stage will be similar to the preoperative one.

Learning and familiarization with Borg Scale in the preoperative stage is very beneficial to control the conditioning session, as supraventricular tachyarrhythmias represent some of the most common complications in cardiac surgery. Atrial fibrillation is considered the most common sustained arrhythmia in the postoperative period, with an incidence ranging from 25-40% in CABG surgery, up to 60% in the valve surgery, reaching higher percentages when combined interventions are performed[44].

Postoperative psychological intervention

Based on the patient's individual characteristics and the results of the interview, observation, as well as tests and techniques applied, the strengthening of skills will continue to support patient recovery and stimulate the addition of physiotherapy intervention from the SICU until hospital discharge.

Stage III: Hospital Discharge

The patient is now able to be discharged from the hospital and start the recovery phase at home, for which he/she will be given a series of recommendations, which the patient has to comply with until his appointment with the rehabilitation cardiologist.

Since they are patients with chest surgery (those with heart disease usually undergo sternotomy and saphenectomy) one has to wait from 21 to 30 days (to ensure proper healing) for their incorporation in the convalescent phase in a specialized center or in a therapeutic area of the community, following the guidelines of the National Cardiac Rehabilitation Program in the Community[45]. These recommendations should be given in the presence of the physician, psychologist, physiatrist, physical therapist and family, so that the multidisciplinary team can explain every detail and satisfy any questions that the patient or their family may have about it.

PATIENTS WITH PACEMAKERS OR AUTOMATIC DEFIBRILLATORS

Although these patients undergo minor surgery for implantation of the devices, a general guidance is provided to avoid complications.

Implantation of pacemakers or defibrillators aims to maintain proper cardiac conduction and prevent death from onset of malignant arrhythmias. The device is usually inserted under the skin, in the infraclavicular space, from where the electrodes go through the subclavian vein and superior vena cava, to be fixed in the endocardium of the right ventricle, and some in the coronary sinus. To avoid displacement of the generator and the electrodes, especially during the time it takes for the incision to heal (1-2 weeks) and

for the electrodes to fix firmly in the heart chambers (4-6 weeks), it is recommended to avoid[17,46]:

- The elevation above 90° of upper limbs corresponding to the implantation area.
- Sudden movements of this limb.
- To carry weights higher than 2-3 kg.

PATIENTS IN THE HEART TRANSPLANT PROGRAM

Patients awaiting a heart transplant are usually individuals with heart failure in functional class III or IV of the New York Heart Association and with great physical deterioration after a long illness. Prior to surgery, and just like in all patients who will undergo a thoracic surgery, respiratory and muscle physiotherapy must be performed, considering that atrophy may be observed in these patients, which is necessary to treat with mobilization and gentle exercises, working if necessary, by separate muscle groups and then limb by limb, since the muscle weakness they could present prevents starting a global physiotherapy. Similarly, breathing reeducation, particularly diaphragmatic breathing is very important to avoid frequent hyperventilation in these patients[43,47].

After surgery, patients will continue the rehabilitation process established from stage I to III, considering that this process could be interrupted by periods, due to the possible complications of a surgery of this magnitude.

Dosages of mobilizations and exercises will be conducted with short periods of work, repeated several times and alternated with times for recovery. Increased dosages will depend on patient tolerance to seek a progressive increase in functional capacity. The Borg Scale will be used to control the conditioning session, as after heart transplants the lack of innervation does not allow the heart rate to be useful as a measure of the intensity of physical work. It is recommended that the patient perceives the effort in ranges of 11-13 and 13-15 progressively[43]. On the other hand, you must consider that the possible episodes of myocardial ischemia that may appear do not manifest as angina pain, but as dyspnea, so monitoring the conditioning session is extremely important[43,47].

These patients like all those who undergo cardiac surgery, are assessed by the multidisciplinary team from preoperative stage until hospital discharge and will be involved in all aspects including the proposed protocol, as well as physiotherapy, psychological and educational-nutritional intervention and job reinstatement. Secondary prevention in these patients is of great importance, since the risk factors that led to the disease and to cardiac transplantation are still present, so their inclusion in cardiac rehabilitation programs is vital.

GENERAL RECOMMENDATIONS

- It must be stressed that the physical conditioning program from the preoperative stage until hospital discharge is individualized for each patient, and it will only start when he/she is stable from the clinical, hemodynamic and electrocardiographic points of view. If signs or symptoms of exercise intolerance and fatigue, marked dyspnea, tachycardia, or marked bradycardia, dangerous arrhythmias, orthostatic hypotension and sudden rise of blood pressure appear, exercises will be temporarily suspended until being re-assessed by the physician.
- It is suggested that in order to protect the sternal suture and avoid unwanted pain related to the surgical wound, the front and side elevation of the arms, indicated in the exercise program for inpatient rehabilitation, be carried out only up to 90˚ in the first 30 days after the surgery.
- Although in this protocol exercises, techniques and breathing-incentive equipment for physiotherapy intervention are established, others which meet the same objective and are available in different services may be included.

CONCLUSIONS

The benefits of an adequate physiotherapy intervention from preoperative stage for quicker recovery of cardiac surgery, decreasing postoperative complications and hospital stay, as well as promoting secondary prevention of heart disease, have served as a basis for updating the protocol that contributes to unify criteria and working strategies in the hospital

phase of the National Cardiac Rehabilitation Program.

REFERENCES

1. Heberden W. Commentaries on the History and Cure of Disease. Philadelphia: Ed. Barrington & Geo D. Haswell; 1845.
2. Fernández P, Velasco JA. Rehabilitación del paciente con infarto agudo del miocardio. Movilización precoz. Valoración funcional y estratificación del riesgo coronario. En: Velasco JA, Maureira JJ, ed. Rehabilitación del paciente cardíaco. Barcelona: Ediciones Doyma; 1993. p. 81-90.
3. Dock W. The evil sequelae of complete bed rest. JAMA. 1944;125(16):1083-5.
4. Levine SA, Lown B. Armchair treatment of acute coronary thrombosis. J Am Med Assoc. 1952;148(16): 1365-9.
5. Rivas E. Programas multifactoriales de rehabilitación cardíaca. Importancia de los aspectos educacionales y modificación de conducta. En: Velasco JA, Maureira JJ, ed. Rehabilitación del paciente cardíaco. Barcelona: Ediciones Doyma; 1993. p. 30-36.
6. Maroto JM, de Pablo C. Aspectos especiales de la rehabilitación después de la revascularización coronario. En: Velasco JA, Maureira JJ, ed. Rehabilitación del paciente cardíaco. Barcelona: Ediciones Doyma; 1993. p. 125-38.
7. Maureira JJ. La rehabilitación de pacientes portadores de prótesis valvulares. En: Velasco JA, Maureira JJ, ed. Rehabilitación del paciente cardíaco. Barcelona: Ediciones Doyma; 1993. p. 139-50.
8. Maureira JJ. La rehabilitación de pacientes trasplantados de corazón. En: Velasco JA, Maureira JJ, ed. Rehabilitación del paciente cardíaco. Barcelona: Ediciones Doyma; 1993. p. 165 -74.
9. Rivas E, Ponce O, Hernández A. Rehabilitación de la Cardiopatía Isquémica. La Habana: Científico-Técnica; 1987. p. 26-8.
10. Cappellas L. Programas de rehabilitación en pacientes quirúrgicos. Rehabilitación. 2006;40(6):340-4.
11. Ilarraza H, Rius MD. Rehabilitación de pacientes operados de recambio valvular y de cardiopatías congénitas. En: Maroto -Montero JM, de Pablo Zarzosa C, eds. Rehabilitación Cardiovascular. Madrid: Panamericana; 2011. p. 358-74.
12. Piepoli M, Corrá U, Benzer W, Bjarnason B, Dendale P, Gaita D, *et al*. Secondary prevention through cardiac rehabilitation: from knowledge to implantation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur J Cardiovasc Prev Rehabil. 2010;17(1):1-17.
13. Pérez P. Revascularización Coronaria. En: Pérez-Coronel P, ed. Rehabilitación cardiaca integral. La Habana: Ciencias Médicas; 2009. p. 125-32.
14. Kiel MK. Cardiac rehabilitation after heart valve surgery. PM R. 2011;3(10):962-7.
15. American College of Sports Medicine. Exercise prescription for patients with cardiac disease. In: Thompson WR, Gordon NF, Pescatello LS, ed. ACSM's guidelines for exercise testing and prescription. 8th ed. Philadelphia: Lippincott Williams & Wilkins; 2010. p. 207-24.
16. Rivas-Estany E. El ejercicio físico en la prevención y la rehabilitación cardiovacular. Rev Esp Cardiol. 2011;11(Supl E):18-22.
17. Arranz H, Villahoz C. La intervención fisioterapéutica en el programa de rehabilitación cardiaca. En: Maroto-Montero JM, de Pablo Zarzosa C, eds. Rehabilitación Cardiovascular. Madrid: Panamericana; 2011. p. 301-18.
18. Hillis L, Smith P, Anderson J, Bittl J, Bridges C, Byrne J, *et al*. Guideline for coronary artery bypass graft surgery: A report of the American College of Cardiology Foundation/ American Heart Association task force on practice guidelines. Circulation. 2011; 124(23):e652-735.
19. Yánez-Brage I, Pita-Fernández S, Juffé-Stein A, Martínez-González U, Pértega-Díaz S, Mauleón-García A. Respiratory physiotherapy and incidence of pulmonary complications in off-pump coronary artery bypass graft surgery: an observational follow-up study. BMC Pulm Med [Internet]. 2009 [citado 12 Dic 2008];9:36. Disponible en: http://www.biomedcentral.com/content/pdf/1471-2466-9-36.pdf
20. Menz G, Porto M, Menna SS, Dall´Ago P. Espirometría incentivada con presión positiva espiratoria es beneficiosa después de revascularización de miocardio. Arq Bras Cardiol. 2010;94(2):233-8.
21. Miranda RC, Padulla SA, Bortolatto CR. Respiratory physiotherapy and its application in preoperative period of cardiac surgery. Rev Bras Cir Cardiovasc. 2011;26(4):647-52.

22. Portuondo MT, Marugán P, Martínez T. La enfermería en rehabilitación cardiaca. En: Maroto-Montero JM, de Pablo Zarzosa C, ed. Rehabilitación Cardiovascular. Madrid: Panamericana; 2011. p. 291-9.
23. Cano R, Aguacil IM, Alonso JJ, Molero A, Miangolarra JC. Programas de rehabilitación cardiaca y calidad de vida relacionada con la salud. Situación actual. Rev Esp Cardiol. 2012;65(1):72-9.
24. Fernández J, García E, Luengo E, Casasnovas JA. Actualidad en cardiología preventiva y rehabilitación. Rev Esp Cardiol. 2012;65(Supl 1):59-64.
25. Véronique LR. Prevención secundaria: el reto permanente. Rev Esp Cardiol. 2011;64(1):8-9.
26. Kwan G, Balady GJ. Cardiac rehabilitation 2012: advancing the field through emerging science. Circulation. 2012;125(7):e369-73.
27. Balady GJ, Ades PA, Bittner VA, Franklin BA, Gordon NF, Thomas RJ, *et al*. Referral, enrollment, and delivery of cardiac rehabilitation/secondary prevention programs at clinical centers and beyond: a presidential advisory from the American Heart Association. Circulation. 2011;124(25):2951-60.
28. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: a report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology Foundation/ American Heart Association task force on performance measures (writing committee to develop clinical performance measures for cardiac rehabilitation). Circulation. 2010;122(13):1342-50.
29. WHO Working Group. A program for the physical rehabilitation of patients with acute myocardial infarction. Freigburg (March 4-6), 1968.
30. Canet J, Mazo V. Postoperative pulmonary complications. Minerva Anestesiol. 2010;76(2):138-43.
31. Güell MR, Díez JL, Sanchis J. Rehabilitación respiratoria y fisioterapia respiratoria. Un buen momento para el impulso. Arch Bronconeumol. 2008;44(1): 35-40.
32. Alonso J, Morant P. Fisioterapia respiratoria: indicaciones y técnica. An Pediatr Contin. 2004;2(5): 303-6.
33. Kisner C, Allen L. Fisioterapia Respiratoria. En: Ejercicio Terapéutico. 1ra ed. Barcelona: Paidotribo; 2005. p. 525-53.
34. Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982;14(5):377-81.
35. Ilarraza H, Quiroga P. Planificación del entrenamiento físico. En: Maroto-Montero JM, de Pablo Zarzosa C, eds. Rehabilitación Cardiovascular. Madrid: Panamericana; 2011. p. 253-71.
36. Maroto JM, García-Baró B, Portuondo MT, Delgado J, Vallejo JL, López-Díaz C, *et al*. Resultados de un programa de rehabilitación cardiaca intensivo. RCAP. 2006; 3: 13-8.
37. Ríos-Martínez BP, Huitrón-Cervantes G, Rangel-Rodríguez GA. Psicopatología y personalidad de pacientes cardiópatas. Arch Cardiol Mex. 2009; 79(4):257-62
38. Rubinstein SY. Experimental methods of Pathopsychology and the experience of their use in clinical practice. Moscow: Aprel´ - Press; 2007.
39. Spielberger CD. Manual for the State-Trait Anger Expression Inventory (STAXI). Odessa, FL: Psychological Assessment Resources; 1988.
40. Beck AT, Steer RA, Brown GK. Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation; 1996.
41. Hernández E. El Psicólogo en un equipo multidisciplinario de trasplante de órgano. En: Hernández E, editor. Atención psicológica en el trasplante de órganos. Trasplante de Corazón. La Habana: Ciencias Médicas; 2007. p. 21-67.
42. Dempsey JA, Wagner PD. Exercise-induced arterial hypoxemia. J Appl Physiol. 1999;87(6):1997-2006.
43. Piña IL, Eisen HJ. Rehabilitación en el trasplante cardiaco: programa de entrenamiento. En: Maroto JM, de Pablo C, Artigao R, Morales MD, eds. Rehabilitación Cardiaca. Barcelona: Olalla; 1999. p. 419-30.
44. Iribarren JL, Jiménez JJ, Barragán A, Brouard M, Lacalzada J, Lorente L, *et al*. Disfunción auricular izquierda y fibrilación auricular de reciente comienzo en cirugía cardiaca. Rev Esp Cardiol. 2009;62(7): 774-80.
45. Ministerio de Salud Pública. Proyecto de Programa Nacional de Rehabilitación Cardíaca en la Comunidad. Rev Cubana Cardiol Cir Cardiovasc. 1989;3: 244-59.
46. de Pablo Zarzosa C, Maroto-Montero JM. Rehabilitación en portadores de marcapasos y desfibrilación. En: Maroto-Montero JM, de Pablo Zarzosa C, eds. Rehabilitación Cardiovascular. Madrid: Panamericana, 2011. p. 397-408.
47. Piña I. Rehabilitación en el trasplante cardiaco. En:

Maroto-Montero JM, de Pablo Zarzosa C, eds. Rehabilitación Cardiovascular. Madrid: Panamericana, 2011. p. 389-95.