GUIDELINES

French Society of Cardiology guidelines for cardiac rehabilitation in adults

Recommandations de la Société française de cardiologie pour la pratique de la réadaptation cardiaque chez l’adulte

Bruno Pavy a,*, Marie-Christine Iliou b, Bénédictie Vergès-Patiois c, Richard Brion d, Catherine Monpère e, François Carré f, Patrick Aeberhard g, Claudie Argouach h, Anne Borgne i, Silla Consoli j, Sonia Corone k, Michel Fischbach l, Laurent Fourcade m, Jean-Michel Lecerf n, Claire Mounier-Vehier o, François Paillard f, Bernard Pierre p, Bernard Swynghedauw q, Yves Theodose r, Daniel Thomas s, Frédérique Claudot t, Alain Cohen-Solal q, Hervé Douard u, Dany Marcadet v, Exercise, Rehabilitation Sport Group (GERS)

a Service de réadaptation cardiovasculaire, centre hospitalier Loire-Vendée-Océan, BP 2, 44270 Macheou, France
b Hôpital Corentin-Celton, AP–HP, Issy-les-Moulineaux, France
c Clinique Les Rosiers, Dijon, France
d Centre Dieulefit Santé, Dieulefit, centre Bayard, Villeurbanne, France
e Centre Bois-Gibert, Ballan-Miré, France
f CHU de Rennes, Rennes, France

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Abbreviations: CSP, Code de la Santé Publique; FCR, Follow-up care and rehabilitation; FSC, French Society of Cardiology; HF, Heart failure; MET, Metabolic equivalent; NYHA, New York Heart Association; TEP, Therapeutic education programme; VT1, First ventilatory threshold.

* This text is an extract from the reference “Good Practice for Cardiac Rehabilitation in Adults in 2011”, which is available on the website of GERS (Groupe Exercice Rédaptation Sport of the French Society of Cardiology [Société française de cardiologie]; http://www.sfcardio.fr/groupes/groupes/exercice-readaptation-sport) and contains the complete bibliography, replacing the French Society of Cardiology text of 2002, version 2, establishing recommendations for cardiac rehabilitation in adults.

* Corresponding author. Fax: +33 02 40 78 44 60.
E-mail address: pavy.bruno@wanadoo.fr (B. Pavy).

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Background

"Cardiovascular rehabilitation is the sum of activities required to favourably influence the underlying causes of the disease, as well as to ensure the patients the best possible physical, mental and social conditions, so that they may by their own efforts, preserve or resume when lost, a place as normal as possible in the life of the community" (World Health Organization, 1993).

Rehabilitation in France is organized according to two decrees and one circular letter [1—3]. Follow-up care and rehabilitation (FCR) activities are now required. FCR for cardiovascular pathology is officially recognized as an FCR speciality with specific needs, which is subject to authorization by the Regional Health Authorities. Specialized FCR centres for cardiovascular pathology must be able to manage patients with cardiovascular problems, whatever the severity of the disease, either with conventional hospitalization or ambulatory care. To fulfill this last obligation, the French Society of Cardiology (FSC) recommends that a cardiologist takes responsibility for, and coordinates, specialized FCR for cardiovascular pathology.

The aim of rehabilitation in cardiovascular pathology is to enable patients to adapt their life as best as possible to their disease and to take responsibility for optimizing their health status. Cardiovascular rehabilitation is based upon the following three elements: exercise training and education on long-term physical maintenance; therapeutic optimization, which should be adapted to the state of the patient and their way of life; specific therapeutic education, which should be multidisciplinary and give the patient the means to improve their prognosis by adapted behaviours. The management of this approach must take into account the patient’s psychological state, as well as social, familial and vocational factors.

Cardiovascular rehabilitation is therefore a learning period in order to put in place a new way of life in the long term. It has proven effectiveness, which includes socioeconomics. It requires global patient management which must be generalized and also developed.

8 CCN, Paris, France
9 IFSI de Morlaix, Morlaix, France
1 Hôpital Jean-Verdier, AP—HP, Bondy, France
2 Hôpital européen Georges-Pompidou, AP—HP, Paris, France
3 Centre médical de Bligny, Brils-sous-Forges, France
4 Clinique Bordeaux-Nord, Bordeaux, France
5 Centre hospitalier des Armées, Marseille, France
6 Institut Pasteur de Lillé, Lillé, France
7 CHU de Lille, Lille, France
8 Clinique IRIS-Marcy l’Étoile, Lyon, France
9 Hôpital Lariboisière, AP—HP, Inserm, Paris, France
10 Centre William-Harvey, Saint-Martin d’Aubigny, France
11 Groupe hospitalier Pitié-Salpêtrière, AP—HP, Paris, France
12 CHU de Nancy, Nancy, France
13 CHU de Bordeaux, Pessac, France
14 Clinique Bizet, Paris, France
Recommendation 1: exercise training programme

Physiopathological basis [4–18]

Physical exercise induces beneficial effects in both primary and secondary prevention. One metabolic equivalent ([MET] 3.5 mL/minute/kg of oxygen consumption) improvement in functional capacity is followed by an almost 15% reduction in mortality. The recognized beneficial effects are due to intertwined mechanisms: reduction of systemic inflammation, sometimes subclinical, associated with these chronic pathologies; antioxidant effects; antithrombotic effects; neurohormonal effects; effects on remodelling and vascular function; and effects on muscular remodelling. These favourable effects of training apply to: cardiovascular risk factors; ageing; coronary artery disease; chronic heart failure (HF); and peripheral vascular disease.

Initial evaluation

Initial evaluation before cardiac rehabilitation is based, at least, on the following [19–24]: clinical evaluation (history and physical examination); resting electrocardiogram; transthoracic echocardiography; and exercise stress test (see below). Attention must also be paid to indications from other targeted examinations, including biological tests.

Exercise stress test

Exercise stress tests must fulfil the protocols and safety criteria for cardiological stress tests [21,25,26]. These tests are often performed under medical treatment. The initial test must be: maximal if possible or limited by the symptoms; in some cases limited by a maximal heart rate (i.e. patients with implanted defibrillators); and in some cases limited by a maximal arterial systolic pressure (i.e. following aortic dissection or aortic aneurysm surgery).

Cardiorespiratory exercise stress test with analysis of gas exchange should be performed whenever possible. This allows evaluation of aerobic capacity (oxygen consumption [VO₂] max or peak) and determination of the ventilatory adaptation threshold, which corresponds to the first ventilatory threshold (VT1).

An intermediary exercise stress test is indicated in case of new symptomatology under exercise or a therapeutic modiﬁcation that could affect the chronotropic function of the heart, or to update prescriptions according to the patient’s improved state of health. A final exercise stress test allows an objective evaluation of the patient’s physical capacities after rehabilitation.

A 6-minute walk test is used to evaluate the adaptation of the patient to submaximal efforts typical of everyday life [27–29]. A muscular strength test (e.g. determination of maximal voluntary force) is useful for certain patients to guide resistance training.

Training modalities

This training includes endurance sessions and dynamic resistance sessions. Endurance training at a constant intensity is characterized by prolonged submaximal exercise (20 to 60 minutes), using the large muscles of the body. The intensity of the training can be prescribed according to the data shown in Table 1 [30–33].

Interval endurance training is characterized by alternating short-duration efforts of high intensity with periods of active recuperation. Several combinations are possible, with phases of high intensity (80 to 95% of maximal aerobic power) lasting from 10 seconds up to 1 or 2 minutes and with periods of active recuperation (20 to 30% of maximal aerobic power) for 1 to 4 minutes [34].

Dynamic resistance training is performed for muscular strengthening, with small weights, weighted wrist bands or elasticised bands, or by using weight benches with adapted equipment [35]; a succession of eight to ten different types of movement are repeated 10 to 15 times at a low intensity (30 to 50% of maximum strength). Two to three sessions lasting for 20 to 30 minutes are performed each week, adapted to each context (recent sternotomy or implantation of pacemaker/cardioverter/defibrillator) [36].

Gymnastic exercises on the floor, on a bar or in water optimize this reconditioning through workouts that include the upper and lower limbs to improve coordination, flexibility, balance and strength of muscles and ligaments.

Breathing exercises complete the programme (tidal volume, control of air flow and ventilatory rhythm). These may be performed individually or in training group sessions.

Electromyostimulation can be used alternatively or in combination with exercise training for patients in very poor physical condition or with HF [37].

Organization of training sessions

The training prescription must specify the type, intensity, duration and frequency of the sessions. Each endurance session includes a warm-up period of 5 to 10 minutes, a training period of 20 to 45 minutes and a cool-down period of at least 5 minutes. The optimal frequency of the sessions is three to six per week. A minimum of 20 sessions is required to obtain a significant improvement in functional capacity. In the most unfit patients and in patients with HF, a larger number of sessions are often necessary. Later on, supplementary sessions can improve compliance and allow exercise training advice to be updated. The organization of this must be personalized (i.e. number of sessions, frequency).

Regarding monitoring, a cardiologist must be present and available close to the training rooms in order to immediately intervene at the supervision team’s request. The presence of at least one qualified person is required in each training area during the sessions. The number of patients managed during an endurance or gym session should be adapted to ensure optimal supervision and patient safety.

Telemetric monitoring during the initial training sessions is recommended. If necessary, heart rate monitoring is subsequently maintained according to medical advice. Brachial artery pressure is monitored. Oxygen saturation monitoring is sometimes appropriate.

Recommendation 2: education programme

The education program must be structured and include education about the disease, signs, nutritional education, help
in smoking cessation, management of antithrombotic treatment and prophylaxis of infective endocarditis.

**Structured therapeutic education programme**

The ministerial decrees of 2nd August 2010 outlined the specificities and authorization conditions for the therapeutic education programme (TEP) for patients [38,39], which should conform to the quality criteria and the approaches defined by the guidelines [40,41].

Cardiac rehabilitation centres allow integration of the TEP into patient care. At these centres there are several structured activities facilitated by a multidisciplinary team, to help patients to become actively involved in control of their risk factors and disease, and thereby work towards cardiovascular prevention [42]. These collective group training sessions (Tables 2 and 3) are run by the medical and paramedical rehabilitation teams. These teams must be trained in the techniques of TEP and be competent for the issues addressed. The group teaching should be complemented by individual sessions.

The organization of the TEP must be carefully planned and coordinated, and regularly reviewed by multidisciplinary consultations.

**Table 1**  Prescription intensity in steady-state endurance training.

<table>
<thead>
<tr>
<th>Training heart rate</th>
<th>HR at first ventilatory threshold (VT1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>If exercise stress test with VO₂</td>
<td>THR = resting HR + [(max HR – resting HR) × K]</td>
</tr>
<tr>
<td>If exercise stress test without VO₂</td>
<td>K = 0.6 if patient is without beta-blockers</td>
</tr>
<tr>
<td>Karvonen formula</td>
<td>K = 0.8 if patient is taking beta-blockers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart rate limit</th>
<th>&lt; 10 bpm under the threshold for angina</th>
</tr>
</thead>
<tbody>
<tr>
<td>If patient has angina</td>
<td>&lt; 10 to 20 bpm under the pre-programmed triggering HR</td>
</tr>
<tr>
<td>If implanted cardiodefibrillator</td>
<td>After aortic dissection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Systolic arterial pressure &lt; 160 mmHg</th>
<th>Levels 12–14 on the 20-point Borg scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s sensations (respiratory, muscular)</td>
<td>Levels 4–6 on the 10-point VAS</td>
</tr>
<tr>
<td></td>
<td>Able to speak easily without becoming breathless</td>
</tr>
</tbody>
</table>

bpm: beats per minute; HR: heart rate; THR: training heart rate; VAS: visual analogue scale; VO₂: oxygen consumption.

**Nutritional education**

Several nutritional factors are directly or indirectly implicated in the occurrence and progression of coronary artery disease. A Mediterranean diet [43,44] and a high intake of omega-3 long-chain polyunsaturated fatty acids [45,46] have been proven by intervention studies to reduce cardiovascular morbidity and mortality.

It is important to establish a dietary survey (questionnaires applicable to French dietary habits and adapted to prevention of cardiovascular events) [47,48], provide nutritional education (individual and/or collective), promote a Mediterranean diet enriched in omega-3 for patients with coronary artery disease (Table 4) and adapt counselling according to the context (hypertension, diabetes, obesity, HF, renal insufficiency, malnutrition).

**Smoking cessation programme**

Tobacco is a major cardiovascular risk factor and to stop smoking is one of the most effective secondary prevention measures [49–51]. Controlling this risk factor is therefore part of all cardiovascular rehabilitation programmes.

In the initial assessment, tobacco consumption should be completely and precisely documented. The patient must be informed of the importance of stopping and must be offered support during the process of stopping and in the prevention

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**Table 2**  Educational themes.

<table>
<thead>
<tr>
<th>Collective group themes (suggestions)</th>
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</thead>
<tbody>
<tr>
<td>The heart and its function</td>
</tr>
<tr>
<td>Cardiovascular risk factors</td>
</tr>
<tr>
<td>Pathologies (coronary artery disease, heart failure, peripheral artery disease)</td>
</tr>
<tr>
<td>Cardiology investigations</td>
</tr>
<tr>
<td>Warning signs (angina, dyspnoea)</td>
</tr>
<tr>
<td>Self-assessment techniques (blood pressure, glycaemia)</td>
</tr>
<tr>
<td>Medications</td>
</tr>
<tr>
<td>Life-saving measures</td>
</tr>
</tbody>
</table>

**Table 3**  Practical workshops.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition</td>
<td>Reading labels</td>
</tr>
<tr>
<td></td>
<td>Choosing food at the supermarket</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Managing endurance training</td>
</tr>
<tr>
<td>Travel, sexuality, driving</td>
<td>Managing daily-life activities</td>
</tr>
</tbody>
</table>
Table 4  Antiatheromatous diet.

<table>
<thead>
<tr>
<th>Principles of Mediterranean diet adapted for coronary artery disease patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advise consumption of:</td>
</tr>
<tr>
<td>at least five portions of fruit and vegetables every day</td>
</tr>
<tr>
<td>extra virgin olive oil, tea, cocoa and soya (rich in polyphenols)</td>
</tr>
<tr>
<td>fish at least three times per week, including two servings of oily fish</td>
</tr>
<tr>
<td>foods rich in ALA: nuts, nut oil, rapeseed oil*</td>
</tr>
<tr>
<td>foods with a low glycaemic index</td>
</tr>
<tr>
<td>dry vegetables twice per week</td>
</tr>
<tr>
<td>two to three servings of fruits per day</td>
</tr>
<tr>
<td>foods rich in starch</td>
</tr>
<tr>
<td>fermented foods</td>
</tr>
<tr>
<td>foods rich in fibre</td>
</tr>
<tr>
<td>The consumption of wine and/or beer can be maintained unless contraindicated (alcohol dependence, pathological link to alcohol), limited to one to two glasses per day, during meals</td>
</tr>
<tr>
<td>Reduce consumption of foods high in saturated fat</td>
</tr>
<tr>
<td>Restrict red meat (beef once or twice per week, mutton/lamb once a month)</td>
</tr>
<tr>
<td>Replace butter with a margarine rich in omega-3 fatty acids</td>
</tr>
<tr>
<td>Restrict cheese to 30 to 40 g per day</td>
</tr>
<tr>
<td>Restrict cooked meats to 70 to 100 g per week</td>
</tr>
<tr>
<td>Restrict eggs to four to six per week</td>
</tr>
<tr>
<td>Avoid partially hydrogenated oils and palm oil (pastries, cakes, biscuits, Viennese pastries, ordinary margarines)</td>
</tr>
<tr>
<td>Reduce consumption of salt (especially in cases of hypertension and/or heart failure)</td>
</tr>
</tbody>
</table>

ALA: alpha linolenic acid (an essential precursor of omega-3 polyunsaturated fatty acids).
* The daily consumption of two spoonfuls of rapeseed oil provides two-thirds of the recommended intake of ALA.

of restarting. Nicotine substitutes can be provided on leaving the intensive care unit immediately following myocardial infarction [52]. Patches can be combined with oral forms to eliminate the desire to smoke completely [53]. The substitution is then reduced over a minimum period of 3 months, which can be prolonged if necessary. Behaviour and cognitive therapies are based on learning self-control, management of stress and self-affirmation techniques [54,55].

Anxiolytic/antidepressant treatments

Specific psychotherapy and/or medications to treat anxiety and/or depression may be essential in some cases. The nurses in the multidisciplinary team have the important role of listening to and motivating these patients [56–58]. Prolonged follow-up should be ensured, with close co-operation with the cardiologist and treating physicians, who should be made aware of the programme [59]. The patients should have a prescription for products to help them to stop smoking and prearranged follow-up consultations when leaving the rehabilitation centre. The medical report of the hospitalization addressed to the physician managing the follow-up must include details of the treatments started and the follow-up information. The multidisciplinary team should integrate a consultation with a tobacco addiction specialist. Alternatively, a member of the medical or nursing team should have received training about tobacco addiction.

Education on antithrombotic treatment

Because of the risks inherent in this treatment, patient education plays a crucial role in the correct use of antivitamin K treatment [60] (Table 5). It is important to provide education on the management of antivitamin K treatment (individual and/or collective), provide and/or update comments in the patient’s anticoagulant record book and provide the patient with record files containing details of antiplatelet treatments. General practitioners should be informed of the information and education provided to their patients.

Prophylaxis for infective endocarditis

The European recommendations of September 2009 [61,62] currently restrict prophylactic antibiotic use to: three categories of patients at the highest risk of infective endocarditis (carriers of prosthetic valves, those with a history of endocarditis and those with complete correction of cyanogenic congenital heart disease); only one situation of risk (dental treatment affecting the gums or the periapical region or accompanied by perforation of the buccal mucosa).

The patients concerned should be provided with information on prophylaxis, education concerning buccodental hygiene and a specific treatment card.

Recommendation 3: psychosocial management

Psychological management

Negative effect (anxiety, depression, propensity to anger and hostility) is important among the risk factors for coronary artery disease [63]. The type D personality profile (excessive negative effect and social inhibition) is associated with an increased risk of mortality or restenosis after stent implantation [64,65]. Depression is predictive of unfavourable outcomes in coronary artery disease patients [66,67] and should be screened for, and integrated into, the therapeutic objectives [68,69]. Following a cardiac rehabilitation programme significantly reduces mortality among depressed patients with coronary artery disease [70]. Job stress is a factor favouring progression of atherosclerosis and is a precipitating factor in major cardiovascular events.

Screening for psychological risk factors should be done using specific validated questionnaires (14-item Hospital Anxiety Depression scale, shortened version of the 13-item Beck Depression Inventory) [71,72].
Role of the psychologist or the consultant psychiatrist

The presence of a psychologist in the cardiovascular rehabilitation team is highly desirable. It is essential that the psychologist makes themselves available to all patients; they participate in the TEP, inform patients on the role of psychosocial factors and the notions of perceived stress, detect eventual sexual dysfunction in patients and take part in group meetings [73, 74].

Non-pharmacological approaches may consist of patient discussion groups complemented by individual interviews, meditation exercises (yoga, relaxation sessions) and techniques to help to control stress [75–77].

Pharmacological approaches may comprise hypnotics, which can be prescribed very occasionally on request, and antidepressants, which are prescribed in cases of diagnosed depression, panic attacks, symptoms of phobia and post-traumatic stress. The prescription of antidepressants should be combined with a prolonged personal follow-up beyond the rehabilitation period.

Return to work

Resuming work is one of the aims of cardiovascular rehabilitation and has personal as well as medicoeconomic consequences [78, 79].

Some studies on the factors influencing restarting work after acute coronary syndrome confirm the poor predictive value of clinical variables (20%) compared with demographic and socioeconomic variables (45%) [80]. Depression during the acute phase may also be a negative factor for resuming work, independent of clinical and sociodemographic data [81]. Furthermore, work perceived as restrictive (heavy load and little decisional latitude) may be associated with an increased risk of recurrence of cardiovascular events [82]. Stress management plays a determining role when resuming one’s professional life through the optimization of stress capacity and, psychologically, through the positive self-image generated by the patient.

The balance between the functional capacity of the patient and their work can be evaluated using scales, although this approach has limitations [83]. The results of the exercise stress test, particularly the cardiopulmonary exercise test, can be exploited to advise the patient and the occupational physician. The physical difficulty of the patient’s work can be assessed during ergonomic assessments or in on-site situations by ambulatory measurements of blood pressure and heart rate.

All cardiovascular rehabilitation programmes must include support for professional reintegration, particularly for patients in whom the clinical and/or psychological characteristics or the physical difficulty of the work are risk factors for not resuming work.

A decision by the occupational physician of partial or complete unsuitability for the current job can have substantial consequences for the patient and should only be taken as a last resort.

All patients are encouraged to consult their occupational physician before returning to work in cases where it will be necessary to temporarily or permanently adapt their work (altered working hours, restructuring, changing jobs, training course). Therapeutic part-time work offers an opportunity to gradually return to work while allowing the patient to follow an ambulatory rehabilitation programme in parallel.

Recommendation 4: daily life

Driving motor vehicles

Aptitude for driving is dependent on the risk of loss of consciousness. The decree of 31st August 2010 modified the decree of 21st December 2005, establishing the list of medical conditions incompatible with driving light vehicles (private) and heavy vehicles [84]. Drivers of light vehicles are not subject to a preliminary medical aptitude test or regular examinations, whereas drivers of heavy vehicles—mostly professional drivers—are subject to tighter regulatory constraints.

Any physician expressing restrictions about the patient’s aptitude for driving must respect medical confidentiality and should therefore try to convince the patient to contact the medical commission of aptitude and provide all elements relevant to making a decision. The opinion, with supporting arguments, of the rehabilitation service must be clearly present in the patient’s medical file and, if the patient has no objections, in the release documents. Consultation of the tables specifying the aptitudes according to pathologies published in the French Official Journal is recommended before all decisions.

Travel advice

Coronary artery disease is one of the most frequent causes of hospitalization of Europeans abroad [85] and is the second

<table>
<thead>
<tr>
<th>Table 5 Education on antithrombotic treatments.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anticoagulant medications</strong></td>
</tr>
<tr>
<td>Knowledge of the name and dose</td>
</tr>
<tr>
<td>Indications and expected duration of treatment</td>
</tr>
<tr>
<td>Course of action when missed</td>
</tr>
<tr>
<td>Drug interactions</td>
</tr>
<tr>
<td>Notifying the presence of the treatment</td>
</tr>
<tr>
<td>Biological follow-up, target INR</td>
</tr>
<tr>
<td>Warning signs of overdose</td>
</tr>
</tbody>
</table>

INR: International normalized dose.
most frequent cause of death and repatriation of French citizens abroad [86]. Cardiac arrest is rare during flight. Since January 2010, all planes passing over French territories must be equipped with a semiautomatic defibrillator.

It is recommended to know the local health care structures prior to travelling (available at www.cimed.org), as well as the time typically taken to provide care locally. Contraindications to air travel for the coronary artery disease patient are [87]: coronary angioplasty or acute coronary syndrome less than 2 weeks prior to travel; coronary artery bypass surgery less than 3 weeks prior to travel; unstable HF; and uncontrolled supraventricular arrhythmia or ventricular arrhythmia.

Some general precautions are recommended before travelling: obtain health insurance for medicalized repatriation, covering the repatriation fees of patients with prior known cardiovascular disease; have a summary of the patient’s medical files translated into English if needed; have a reference electrocardiogram trace; have the name (international non-proprietary name) of prescribed medication; have a sufficient stock of medications to cover the journey; have the necessary treatment readily available in the aircraft and be in possession of a prescription; ensure sufficient time in airports (boarding, transit, etc.).

Trips to high altitude
An adapted physical condition and at least 4 weeks of clinical stabilization are required before considering physical activity over 1500 to 2000 m, following a negative exercise stress test [88,89].

Trips to tropical areas
There is no specific contraindication to vaccinations, but prophylaxis for malaria should be adapted as appropriate [90].

Sexual activity
Sexual health is a quality of life criterion according to the World Health Organization and requires appropriate management. The cardiologist is involved because there is a very strong statistical association between erectile dysfunction and cardiovascular disease; this is due to endothelial dysfunction [91–94].

Sexual activity involves a moderate physical effort (2.5 to 3.3 METs), added to which there is a non-negligible emotional component. Sexual activity should not be limited if the patient can achieve 60 watts on the bicycle or easily climb two flights of stairs. The risk of triggering an acute coronary syndrome following sexual activity is low, especially if the patient practices regular physical activity [93].

Several treatments for coronary artery disease have an effect on erectile dysfunction. It is important to speak to patients to reassure them and adjust the choice of treatments on an individual basis. Do not hesitate to work in a network with the help of other specialists (to screen for other possible causes: endocrine or urological). Specific inhibitors of type 5 phosphodiesterase, which are nitric oxide donors for the treatment of erectile dysfunction, have good haemodynamic tolerance and can be prescribed for stable coronary artery disease patients. The only contraindication is coprescription of nitrate derivatives, which carries the risk of a major hypotensive episode. Patients must be informed [95].

Cardiovascular rehabilitation favours the resumption of a sex life following a cardiac event [96].

Physical activity in sedentary patients
The rehabilitation period is the time to start or restart physical activity. The benefits should be maintained by continuing regular physical activity. The activities chosen should be appropriate for realistic integration into the professional, social and family life of the patient.

The objectives are as follows [97,98]: suggest new behaviours (walking, using the stairs, reducing the time spent in front of the television or the computer); encourage the practice of physical activity tailored towards endurance (walking, cycling, swimming), equivalent to 30 minutes of walking per day (or 3 or 4 hours per week), of moderate intensity (breathing easily, ‘slightly difficult’ on the Borg scale), possibly in a heart rate target ‘zone’; include strength training (gym, aquagym) twice per week; ensure regularity (support from family and friends, activity at a club, indoor activities); advertise the Heart and Health Clubs (www.fedecardio.com); avoid intense static efforts and bad weather (cold, wind); report all unusual symptoms (pain, dyspnoea, malaise); reduce or stop training in case of febrile episodes [99].

Physical activity in physically active patients
A history of sport activity is a factor that should be systematically investigated at the start of the programme. This is an excellent criterion favouring adherence to a training programme. It is, however, necessary to warn a patient who was physically active that stopping physical activity for a few weeks to a few months results in a loss of physical gains, especially endurance [100], and that physical activity must always be resumed progressively.

Resumption of regular exercise training at the start of rehabilitation often easier but the programme needs to be monitored to ensure that it is reasonably adapted to the current abilities of the patient. The training programme will often be more intense than that used for inactive patients of the same age. Evaluation at the start of rehabilitation is essential to help select the appropriate sport and intensity of training.

Previously published recommendations help to provide advice to patients about the types of non-competitive activities appropriate to the pathologies concerned [88,101–107]. For patients wishing to resume competitive sport, specific recommendations [108,109] are available to identify the sports that can be practiced in competition, according to the cardiovascular pathologies concerned; these are often restrictive because it has been demonstrated that participating in competition is a factor that can increase the risk of complications, particularly sudden death [110,111].
Table 6  Levels of evidence and proof.

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Class I</td>
<td>There is evidence for or a general consensus that a diagnostic examination or a given treatment is beneficial, useful and effective</td>
</tr>
<tr>
<td>Class II</td>
<td>There are conflicting data and/or differences in opinion on the use or efficacy of a treatment or procedure</td>
</tr>
<tr>
<td>Class IIa</td>
<td>The weight of evidence or opinions lies in favour of usefulness/efficacy</td>
</tr>
<tr>
<td>Class IIb</td>
<td>The usefulness/efficacy is less well established by evidence/opinions</td>
</tr>
<tr>
<td>Class III</td>
<td>There is evidence for or a general consensus that a treatment or procedure is not useful/effective and in certain cases may be harmful</td>
</tr>
<tr>
<td>Proof A</td>
<td>Evidence based on several randomized clinical trials or meta-analyses</td>
</tr>
<tr>
<td>Proof B</td>
<td>Evidence based on a single randomized clinical trial or large non-randomized trials</td>
</tr>
<tr>
<td>Proof C</td>
<td>Consensus or opinion of experts and/or small studies, retrospective studies or registers</td>
</tr>
</tbody>
</table>

Recommendation 5: indications

The evaluation of indications takes into account the levels of evidence (Class I to III) and proof (grade A to C) according to the European recommendations (Table 6).

Coronary artery disease (medical)

The benefits of physical activity make a large contribution to secondary prevention in all coronary artery disease patients following myocardial infarction [112–115]. Rehabilitation of the coronary artery disease patient reduces cardiac mortality by 26% and overall mortality by 20%.

After acute coronary syndrome (Class I, Level A)

In the absence of complications, a symptom-limited exercise test under treatment can be performed 5 to 7 days after the event; a maximal exercise test without treatment requires a delay of 4 weeks [116].

The presence of stents should not delay the start of rehabilitation; the risk of stent thrombosis during training is very low (estimated to be 0.08%) [117].

Training may be started after stabilization of the clinical condition, under supervision, with cardiac monitoring during the initial sessions, with the aim of improving exercise capacity, which is a major prognostic factor [118]. A sufficient number of sessions [119,120] is essential.

The control of risk factors should be initiated or updated. Educational aspects (nutrition, tobacco) are essential for this population, who are usually young and active. Return to work should remain a priority [121,122]. Ambulatory rehabilitation should be promoted.

In stable angina or after angioplasty (Class I, Level B)

Antiangina medication should be optimized, guided by the exercise stress test, and the ischaemic and angina threshold should be raised through well-managed training.

A symptom-limited exercise test under treatment can be performed without delay after angioplasty [123], allowing completely safe early training, which improves prognosis and favours on-going activity at home [124]. The benefit is proportional to the amount of training [125]. Ambulatory rehabilitation should be favoured.

Cardiac surgery

Rapid management in a cardiac rehabilitation centre is recommended. For patients recently operated on, close surveillance of the clinical state allows earlier detection of any infectious complications (infection of operative wounds, unexplained febrile or inflammatory states).

The occurrence of pericardial effusion requires regular re-evaluation until it has disappeared; there is a continuing risk of secondary cardiac tamponade. The use of non-steroidal anti-inflammatory drugs has no proven efficacy [126,127].

All thromboembolic complications (postoperative phlebitis, intraventricular thrombus) require temporary cessation of training.

The effort and type of exercise must be adapted according to the sternotomy, the state of the operative wounds, anaemia and postoperative pain.

Coronary artery surgery (Class I, Level B)

The surgical notes and report must be included in the patient’s rehabilitation file.

At least three training sessions per week at a sufficient intensity are required to improve exercise capacity [128]. Interval training seems to be more effective than continuous training to facilitate continued activity at home [129].

Cardiac rehabilitation is one of the factors that favours a return to professional life [130,131].

Valvular surgery (Class I, Level B)

It is recommended to offer all patients who have undergone valvular surgery an adapted training programme and education on anticoagulants as early as the second week postoperation [132]. Early rehabilitation is effective and without risk after mitral valvuloplasty [133] or valvular replacement [134]. A combined training programme (endurance and resistance) appears to be the best choice [135]. The benefits in terms of exercise capacity are similar to those seen in coronary artery disease patients who have undergone surgery [136].

Surgery of the thoracic aorta (Class IIa, Level C)

Early rehabilitation following surgery for aortic dissection is beneficial; at a moderate intensity, maintaining systolic blood pressure under 160 mmHg, it is well tolerated [31]. A
similar protocol could be considered for patients with Marfan syndrome (with or without surgery) and in all situations that carry a risk of aortic dissection.

The risk of high exercise workload following surgery for aortic aneurism, with or without valvular replacement, has not been studied. The exercises are often limited according to the increase in blood pressure, although the value of this has not been formally demonstrated. Each case must therefore be evaluated according to its context.

Preoperation period (Class IIb, Level C)

Education and/or rehabilitation before coronary surgery can be offered to reduce the duration of hospitalization following surgery and limit postoperative complications—even depression [137—140]. It is recommended that a rehabilitation programme be offered only to patients with multiple comorbidity factors (overweight, diabetes, sedentary lifestyle, recently stabilized clinical state, unfavourable social context) in preparation for coronary or valvular surgery.

Heart failure

Heart failure due to systolic left ventricular dysfunction (Class I, Level A)

Cardiac rehabilitation is part of the therapeutic arsenal for use in patients with HF at stages II to III of the New York Heart Association (NYHA) classification. The rehabilitation programme is based on the overall management of the patient and should include at least an adapted exercise training programme, a TEP and optimization of other therapies [141].

The precise evaluation of the physical capacities and limitations of each patient requires a cardiorespiratory exercise stress test before starting reconditioning. The prescribed training programme is personalized [142]. For more severe cases (NYHA stage IIb), it is advised that the programme be started under supervision for inpatients, before considering ambulatory management.

The duration of the training programme is often longer than for patients without HF. A regular evaluation of exercise performance is often necessary (e.g. ‘midterm’ cardiorespiratory exercise test).

The training protocols for endurance use continuous training and/or interval training approaches (this training approach is particularly useful for the most frail patients) [143]. These protocols are also combined with resistance training using segmental muscular strengthening [144—146] and can be complemented with respiratory training and/or electromyostimulation. Other techniques improve compliance and quality of life (aquagym, Tai Chi, dance, etc.) [37,147—149].

Subject to the application of an adapted protocol and regular screening for any sign of decompensation, the risks associated with training in these patients are very low [150,151]. The benefits for prognosis appear to be favourable; failures are linked to poor long-term adherence [151].

Personal support throughout the training is useful. The role of therapeutic education is significant [150], due to its importance for reducing rehospitalizations (often linked to errors in diet or compliance to therapy).

The rehabilitation period allows adjustment of medical treatments.

Heart failure with preserved ventricular function (Class IIb, Level C)

Some studies have demonstrated the value of rehabilitation programmes in terms of quality of life, autonomy and reduction of hospitalizations [152,153].

Cardiac resynchronization (Class I, Level B)

A comprehensive cardiac rehabilitation programme following cardiac resynchronization enhances the beneficial effects of the device. Indeed, the peripheral improvements associated with training are complementary to the central improvements linked to cardiac stimulation, which explains the increased gain in exercise tolerance [154,155].

Therapeutic education must be based upon ‘life with’ an implanted device.

Ventricular assist device (Class IIa, Level C)

HF patients who have implanted ventricular assist devices are very severe cases. This type of device is implanted either as a bridge for cardiac transplantation or as destination therapy. In all cases, this is a particularly strong indication for cardiac rehabilitation [156], and concerns several chronic HF-related conditions. Patient education must also cover managing the assist device and anticoagulants. This type of complex rehabilitation requires centres specially trained in the highly technical management, in close collaboration with the surgical team.

Cardiac transplantation (Class I, Level B)

Cardiac rehabilitation of cardiac transplant patients has specific features linked to surgery, immunology and psychosocial consequences; the rehabilitation should be prolonged [157—159].

During the first 3 months, cardiac rehabilitation is regulated by surveillance and possible complications; the start of training should be light and progressive, guided by the cardiorespiratory exercise test and the sensations of the patient (due to denervation, heart rate is not the best supervision variable) [160].

The education of the patient must cover anti-rejection treatments, prevention of complications due to immunosuppression and cardiovascular risk factors.

Psychological management and social and professional support are particularly important in this context.

After 3 months, based on improvements in the patient, the cardiac rehabilitation programme can become more conventional.

Peripheral vascular disease (Class I, Level A)

Physical exercise improves rheology, endothelial function, extraction of oxygen and muscular metabolism. The development of collateral arteries is accompanied by a redistribution of blood flow towards the most active muscles
and increases metabolism of fatty acids by the leg, thereby optimizing the use of oxygen delivered to the tissues.

Training reduces the consumption of oxygen and improves walking power [161,162]. Supervised cardiac rehabilitation has an effect on the pain threshold, distance, duration and speed of walking.

Indications for rehabilitation in obstructive peripheral vascular disease are [163]: patient asymptomatic with ankle-brachial index less than 0.9; intermittent claudication; permanent chronic ischaemia; and follow-up of revascularization (endovascular or surgical).

The patient undergoes an initial functional evaluation: walking distance limits (pain/claudication) and speed of walking; familiarization with low-load ergometers; clinical criteria for disadaptation; and assessment of comorbidities. In cases of very limited walking ability, the exercise stress test can be performed with an arm ergometer, favouring dis-continuous protocols with a very slowly progressing increase in workload [164].

Walking on the flat or on a treadmill is the basic exercise to be performed three to five times per week. The speed and duration during the session should be varied and adapted to the capacities of the patient. Some authors advise alternating phases of rapid walking, generating moderate claudication, with phases of recuperation over a total duration of 50 minutes [165,166]. Walking in hot water is beneficial if the condition of the skin allows this.

Analytical exercises of the lower limbs should be included, focusing on eccentric contractions against low resistance and involving muscles from the feet to the base of the legs, combined, if necessary, with drainage of oedema, reflexology massage and passive mobilization (musculotendinous retraction).

A supervised programme lasting for 1 to 3 months must be followed by a daily walk of at least 20 minutes to maintain the benefits [165].

Therapeutic education and treatment of risk factors are essential in this very-high-risk population [163,167].

Specific cases

Amputee patients should be given a specialized adapted workload in a centre equipped for fitting the appropriate prosthesis. Following revascularization surgery, the operative wounds must be considered when designing gym programmes; regular training on the bicycle ergometer should be avoided in cases of arterial anastomoses in the groin.

Other indications

Implanted automatic defibrillators (Class Ila, Level B)

Indications for implanting automatic defibrillators are subject to specific recommendations. Patients often have another indication for cardiac rehabilitation (ischaemic cardiopathy, HF) but some patients receive the implantation only to manage arrhythmias. These patients are suitable for rehabilitation management with the aim of restoring self-confidence during physical activity and providing a specific therapeutic education [168–170].

A preliminary exercise test in the training programme allows the exercise programme to be personalized. The programmed triggering heart rate for the defibrillator must be known to train the patient at 10 to 20 beats per minute below this threshold.

Gym training and/or training of the upper body should be undertaken only with care during the weeks following implantation to prevent any complications at the surgical site or device leads.

Congenital cardiopathies in adulthood (Class Ila, Level C)

The aim of cardiac rehabilitation is to improve postoperative functional capacities, resulting in a more or less complex change in cardiac function from the cardiopathy, and to improve cardiac function and associated problems.

The training programme must take into account the presence of HF, arrhythmias, the degree of pulmonary hypertension and any exercise desaturation.

High cardiovascular risk (Class I, Level A)

In terms of primary prevention [171,172], all patients at high cardiovascular risk should be given treatment and support for the behavioural changes that are required, including education and dietary advice, help in smoking cessation and promotion of regular physical activity.

Support of cardiac rehabilitation allows these difficult-to-achieve goals to be fulfilled without assistance. Ambulatory care is the rule for this indication.

Recommendation 6: contraindications

Screening for complications

Complications observed in cardiovascular rehabilitation are usually independent of exercise training. Previous studies have demonstrated that the risk under supervised exercise is low [173–178]. The multicentre registry developed by the Exercise, Rehabilitation and Sport Group (FSC) has evaluated over 25,000 patients referred to cardiac rehabilitation under the required safety conditions and has followed up the occurrence of serious clinical events (death, infarction, cardio-circulatory arrest or any event requiring resuscitation) during the hour following exercise. The risk for this cohort was exceptionally low and no deaths were recorded per 0.74 million hours of exercise [179].

Training sessions should be performed under the continuous surveillance of a rehabilitation team trained for emergencies. The presence of a cardiologist in the room is not mandatory but a cardiologist should be present in the area and be able to intervene immediately at the request of the supervision team in case of emergency.

Outdoor activities, under supervision of a rehabilitation team trained for emergencies, should be performed and regularly tested according to a written protocol; this protocol should include warning and evacuation procedures and rapid access to a defibrillator (portable automatic or semiautomatic device). The types and modalities of outdoor activities should be prescribed by the cardiologist.
### Table 7  Formal contraindications to exercise training.

<table>
<thead>
<tr>
<th>Contraindication</th>
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<tbody>
<tr>
<td>Unstable acute coronary syndrome</td>
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<tr>
<td>Uncompensated heart failure</td>
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<tr>
<td>Severe uncontrolled ventricular arrhythmia</td>
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<tr>
<td>Intracardiac thrombus with high risk of embolism</td>
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<tr>
<td>Moderate-to-severe pericardial effusion</td>
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<td>Recent episode of thrombophlebitis with or without pulmonary embolism</td>
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<tr>
<td>Severe and/or symptomatic obstruction to left ventricular outflow tract</td>
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<tr>
<td>Any inflammatory pathology and/or progressive infection</td>
</tr>
<tr>
<td>Severe and symptomatic pulmonary artery hypertension</td>
</tr>
<tr>
<td>Incapacity to perform physical exercise</td>
</tr>
</tbody>
</table>

### Contraindications

The contraindications to the prescription of a cardiac training programme are similar to those for a cardiac exercise stress test; they are not frequent and often temporary (Table 7).

Some patients may refuse all or part of the rehabilitation programme; their desire as well as the clear information given by the doctor on the benefit/risk ratio of rehabilitation should be noted in the patient’s medical records. Discussion between the parties involved decides what follows.

Some physical or psychological disabilities in a patient may require an adjustment of the programme according to the facilities at the centre.

### Recommendation 7: specific populations

#### Women

Women referred to cardiac rehabilitation are on average 10 years older than men; the most frequent risk factors are hypertension, diabetes and increased tobacco use [180].

There are several barriers to cardiovascular rehabilitation: under prescription; lack of family support or domestic help; fear of non-adapted training, especially in older patients; and comorbidities, especially musculoskeletal disease [181].

The beneficial effects of cardiovascular rehabilitation on morbidity and mortality reported in recent meta-analyses [182,183] also apply to women (although this population is underrepresented). Although their exercise capacities are significantly lower than those of men of similar age and training habits (by 25% to 35% on average), the improvement in exercise tolerance after cardiac rehabilitation is significant, especially if initial capacities are low (< 5 METS) and for patients aged over 75 years.

#### Diabetic patients

Between 20 and 30% of the overall population undergoing cardiac rehabilitation are diabetic [184]. These patients have a higher frequency of associated cardiovascular risk factors, polyvascular injuries and comorbidities; they are often overweight and poorly conditioned to physical exercise [185].

Patients with poor glucose tolerance (1.10 g/L < glycaemia < 1.26 g/L) should be warned of their high cardiovascular risk and the development towards diabetes.

Regular physical activity [186] significantly improves the diabetic patient’s glycaemic control, leading to an average reduction in glycated haemoglobin of 0.6% and a reduction in degenerative complications of diabetes [187]; it is also accompanied by a reduction in visceral fat and subcutaneous adipose tissue. In addition, glycaemic control plays a major role in wound healing in postoperative patients. Reduction of glycaemia is correlated with the number of endurance exercise sessions; this effect is extended after the end of the session. The effects of endurance training on glycaemic control are limited over time (about 30 hours) showing evidence of the need for regular physical activity [188].

The presence of complications of diabetes (retinopathy, nephropathy, neuropathy) does not contraindicate training, but in the presence of proliferative retinopathy very intense efforts should be avoided.

Activity in water is preferred because the discomfort linked to joint problems and overweight is reduced [189—191].

Optimal control of blood pressure combined with glycaemic balance improves prognosis [192].

Blood glucose should be checked before exercise in every patient with diabetes. In addition, blood glucose testing should also be performed at the end of 4 to 6 hours after each physical activity session in patients treated with insulin or insulin secretagogues (sulphonureas or glinides), to reduce the risk of hypoglycaemic episodes. Self-assessment of glycaemia allows early identification of hypoglycaemia and is an effective means of preventing severe hypoglycaemic episodes [193].

The patient’s rehabilitation team and the patient should know how to counteract the signs of hypoglycaemia and how to manage these in emergency situations: stop exercise, combined with consumption of simple and complex sugars.

When blood glucose before exercise is greater than 250 mg/dL (13.9 mmol/L), ketonuria needs to be checked. If the patient is without ketosis, feeling well and properly hydrated, then physical activity can be performed with caution, with regular capillary blood testing recommended at least hourly during the training session.

Therapeutic education of the diabetic patient aims to ensure that the patient understands the effects of their medications, particularly those that can cause hypoglycaemia (sulphonamides, glictiazides and insulin), and to help the patient perform self-monitoring (recorded in a notebook). The psychological benefits of cardiac rehabilitation [194] favour the active involvement of diabetic patients in changing their behaviour.

The cardiac rehabilitation period provides the opportunity to obtain specialist advice according to the combined recommendations of the FSC and the Francophone Society of Diabetes [195—198]. The opinion of a diabetologist is useful to guide therapeutic choices, adapt the times for taking medications under particular working conditions (shift work, night work and meals eaten at the work place or in the company restaurant) and improve patient education.
Elderly patients

The elderly population is defined by the World Health Organization as being aged over 60 years but most studies consider patients aged over 75 years.

The prescription of and participation in cardiovascular rehabilitation programmes remains rare among elderly patients, particularly women [199], despite the recommendations of experts and guidelines [200]. There are several reasons for this: the small differences between the normal aged and pathological heart [199,201]; the frequency of depressive syndromes and social isolation [199]; and the frequency of comorbidities.

Rehabilitation should be performed in a centre specialized in cardiovascular pathology when the principal diagnosis is cardiological without prohibitive comorbidities or if the patient is able to regain or consolidate autonomy in their daily life. In other cases, a stay in a geriatric rehabilitation centre should be considered.

The objectives of cardiovascular rehabilitation programmes are essentially to improve autonomy; limitations of physical capacity are the most cited factor affecting the quality of life of elderly cardiac patients, notably in cases of HF [202]. Reconditioning to exercise in this elderly population gives benefits similar to those in younger subjects in terms of maximal or submaximal exercise capacities [203].

Some methods seem particularly adapted to elderly subjects—notably interval training, which is rapidly effective and well tolerated [204]. Segmental strength training, training using light resistance on machines and aquagym training [147] improve muscular strength and help these patients to regain their autonomy.

Dietary measures and lifestyle changes should be promoted, as in younger populations.

Notably, the beneficial effects of stopping smoking and controlling blood pressure are similar to those in younger populations [205].

Recommendation 8: organization

Legislation and regulations

These recommendations include recent regulatory developments applicable to the establishment of and the technical conditions of the service of FCR [1–3,38,39].

The decrees of application and the legal circular for interpretation establish the general working conditions for FCR services. The management of cardiovascular pathologies is subject to particular conditions stated in a dedicated file (File C) attached to the legal circular. The general role of FCR includes care, re-education and rehabilitation, prevention, therapeutic education and help with reintegration.

In addition to the measures concerning the internal organization of care (types of pathology and patients managed, required expertise, continuity of care, material resources), the decrees lay down that certain arrangements “based on the organization of the FCR structures, fulfilling the aim of flexibility in the management of patients”’. These are the validation of the indication and the evaluation of the needs and objectives before all admissions, establishing coordination, networks or management procedures between FCR and upstream and downstream organization, the role of expert advice and registration with the Operational Resource Repertoire.

Cardiovascular FCR units are, like any other hospital establishment, subject to Law No. 2009-879 of 21 July 2009 concerning hospital reform and health care for patients in the various areas of France (called the HPST Law). Similarly, cardiovascular rehabilitation units must develop (article L. 6113-2 of the Code de la Santé Publique [CSP]) “a policy of evaluating professional practices, methods of organization of health care and all activities concerning overall management of the patient” as part of a policy of continuous improvement of quality and risk management, as credited by an external certification process (article L. 6113-3 of the CSP).

Personnel

Medical expertise

Article D. 6124-177-30 al.2 of the CSP requires the on-site presence of a cardiologist, who is able to intervene immediately during the rehabilitation phases.

Due to the potential complexity of the cardiovascular pathologies managed, the risk of death and the required specific expertise, the FSC recommends that the medical responsibility and coordination of FCR units specialized in cardiovascular problems is performed by a qualified physician specialized in cardiology and vascular illnesses or a qualified specialist in cardiovascular pathology; this physician is also responsible for organizing the continuity of patient care. It is preferable that the coordinating cardiologist has documented expertise (university diploma) in the field of cardiac rehabilitation. The medical team includes one or several collaborating cardiologists as appropriate and, where possible, other specialists, such as a diabetologist or nutritional doctor, psychiatrist, tobacologist, occupational physician, physical and rehabilitation medicine physician and pneumologist.

In addition to follow-up and therapeutic adaptation, the cardiologist: validates the eligibility of the patient; in collaboration with the multidisciplinary team and the patient, establishes a treatment plan, which should be periodically re-evaluated; performs the necessary cardiology examinations of patients during their stay and decides on further examinations as deemed necessary; and plans the programmes and supervises the exercise training programme and therapeutic education sessions.

Paramedical expertise

The mandatory paramedical personnel include a nurse, a physiotherapist, a dietician and a social worker. Although not mandatory, the presence of a psychologist is highly desirable. The paramedical team may also include other personnel (e.g. an auxiliary nurse, a physical education instructor and an occupational therapist). It is imperative that all the personnel are regularly trained in emergency procedures and are motivated and trained in therapeutic education activities.
Facilities

Accommodation

Conventional or ambulatory hospitalization must conform to current regulations. The rooms must be equipped with a call device, adapted to the patient’s status. Access to medical fluids is organized within time scales compatible with safety requirements”. “The spaces necessary for friends and family members to be close to patients” are also required.

Professional areas

The layout of all premises must facilitate the first steps of resuscitation on site and evacuation of the patient. These premises must include: an “emergency room” equipped for emergency procedures and cardiac resuscitation before transfer (one or several beds with an emergency trolley, cardioscopes, defibrillator, intubation equipment and breathing gas supplies); a technical area allowing non-invasive examinations to be performed for functional evaluation and surveillance of patients; a training room (each patient must have a surface of at least 4 m² of gymnasium space available; a therapeutic pool and access to outdoor tracks can be included among the resources according to the possibilities of each centre); a physiotherapy area for managing individual physiotherapy treatments; a relaxation area is desirable; and an education area reserved for providing information to and therapeutic education of patients and their families.

Equipment

The functional evaluation of the patient and the prescription of types of training require medicotechnical equipment, including a standard electrocardiograph, equipment for telemetric monitoring, equipment for exercise tests and cardiac and vascular Doppler echography.

Desirable equipment includes a device for a cardio-pulmonary exercise test, a continuous ambulatory electrocardiograph system with recording of events, a pulse oximeter, a device to measure ambulatory arterial pressure and heart rate monitors.

Equipment for exercise training programmes and patient education includes gym equipment (weights, barbells, benches, mats), exercise machines (and, if possible, various different machines, such as a bicycle ergometer, treadmill, rowing machine, weights bench and crank), educational audiovisual equipment and educational tools.

All of the training rooms should have call facilities (telephone or other) for use in emergencies. Emergency trolleys should be sufficient in number and located to be available for any emergency arising in the unit. In particular, an emergency trolley should be placed in the exercise test room during examinations and in immediate proximity to the training rooms. It should contain: first aid treatments with medications and equipment for injection and perfusion; a homologated defibrillator; intubation and ventilation equipment; medical fluids; and aspiration equipment.

The validation and proper functioning of the equipment must be regularly checked. The trolley next to the training rooms must also include a sphygmomanometer and an electrocardiograph.

Care security and management of emergencies

Article D. 6124-177-30 of the CSP states that “the continuation of medical care is ensured by a qualified specialist physician or a physician competent in cardiology and vascular medicine or a qualified specialist in cardiovascular pathology. At least one nurse should be present with the patients in training areas. If there is any need, a qualified cardiology specialist intervenes immediately”. The legal circular DHOS/01 No. 2008-305 of 3rd October 2008 states that the continuity of care ”is ensured by an on-site or on-call doctor, by the presence of a night nurse and by the availability of physiotherapy at the weekend and on public holidays. Emergency medical intervention must be possible at any instant. The possibility of patient transfer to an intensive care unit at any moment must be organized by convention”.

The FSC recommends the presence of a doctor authorized by the coordinator to ensure the continuity of care and to manage emergencies on site. Failing this, an organization with an on-call cardiologist is recommended “to ensure a time to physician intervention that is compatible with patient safety”. The procedures for emergency calls should be known by the professionals and tested regularly. Emergency procedures should be written, validated and circulated.

During the training phases, the presence of medical personnel in the training room is not required but the cardiologist should be able to intervene immediately if needed (article D. 6124-177-30 of the CSP).

Strategy for cardiac rehabilitation

The objectives and types of programmes should be personalized according to age, lifestyle, cardiac pathology and proximity to the patient’s home. The initial consultation is fundamental and evaluates the medical state and psychological profile of the patient, the risk factors and the professional context; it allows the patient to be referred for rehabilitation involving complete, weekday hospitalization or ambulatory care. The programme, the types of surveillance, the follow-up and the evaluation are all similar for all types of organization.

Although the possibility of home-based cardiac rehabilitation is included in the new official rules, this type of care is not currently used in France for cardiovascular rehabilitation. However, a meta-analysis study has demonstrated the effectiveness of this type of management for low-risk patients [206]. The organization of telemedicine could facilitate and ensure the safety of this type of rehabilitation.

Medicoeconomic aspects of cardiovascular rehabilitation

Cardiac rehabilitation has a favourable cost-benefit ratio for all types of cardiac disease (ischaemic heart disease or HF) and for patients of any socioeconomic status; it reduces the costs of long-term management. Diverse studies show that after a myocardial infarction, exercise training has good cost-efficacy ratio, which is better than treatment
strategies such as lipid-lowering, thrombolysis and coronary artery bypass grafting but lower than interventions to stop smoking [207–211].

In France, offering more equal access and tailored rehabilitation programmes should result in a reduction of health care costs.

Conclusions and perspectives

The management of patients with chronic pathologies such as cardiovascular diseases is a national priority for public health. The constraints are becoming stronger, as a consequence of a growing demand for health care linked to the high and growing prevalence of cardiovascular problems and the reductions in the allocation of both financial and medical resources.

Faced with this challenge, cardiovascular rehabilitation, placing the patient at the centre of the health care plan, is particularly appropriate: the exercise training programme, therapeutic education and psychological support and assistance are also factors for increasing patient autonomy and responsibility in the management of their health care.

The various hospital legislations since the year 2000 have formalized this new type of patient management and the development of telemedicine covered by article 78 of the HPST Law (Law No. 2009-879 of 21 July 2009) is a pertinent response to the problem of follow-up and motivational support of patients in their home and to the reduction in medical resources in several areas of France.

These factors, associated with the required information and promotion of cardiovascular rehabilitation within the cardiology medical community through organized teaching of this specialty (both university training and continuing education), will make this a central approach in the management of patients with cardiovascular disease.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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