PROBLEMS AND PROSPECTS OF THE CARDIAC REHABILITATION

Abstract. Cardiovascular pathology continues to be a one of the most issue in global health, which causes the necessity for improvement of the efficiency cardiac rehabilitation programs. This literature review provides a basic analysis of the current state of cardiac rehabilitation, focusing on effective recovery and prevention of disease progression. This paper briefly discusses the historical progression of cardiac rehabilitation, the epidemiological background of cardiovascular diseases and provides an overview of the stages of the rehabilitation process of cardiology patients.

The effective and individualized multidisciplinary assessment of cardiac patients, especially in cases of comorbidities, plays an important role in healthcare,
serving as a fundamental basis that incorporates medical, psychological, and social aspects. The cardiac rehabilitation program is primarily based on the favorable effects of exercise-based cardiac rehabilitation, but complex programs also include educational sessions focusing on risk factors, modification of the lifestyle, diet recommendations, psychological support, and optimized pharmacotherapy.

Unfortunately, there are still some problems in the wide implementation of the cardiac rehabilitation all over the world like the low participation and completion among eligible patients.

Cardiac rehabilitation consists of the several following phases: hospitalization phase; outpatient phase; and maintenance phase with different aims and durations. Various training modalities proposed in the modern literature are presented in the paper – classical aerobic training, resistant training, high-intensity interval training and, also, some alternatives including Tai Chi and yoga.

Matter of low patients’ adherence for regular participation in the cardiac rehabilitation program is discussed along with propositions of improvement of this situation. Finally, it was estimated that the primary objective of cardiac rehabilitation program is to guarantee the safety, efficacy, and customization of exercise training in the frame of complex secondary preventive measures following the specific requirements of each patient.

**Keywords:** cardiovascular diseases, cardiac rehabilitation, training modalities, rehabilitation stages, patients’ adherence.
ПРОБЛЕМИ ТА ПЕРСПЕКТИВИ КАРДІОЛОГІЧНОЇ РЕАБІЛІТАЦІЇ

Анотація. Серцево-судинна патологія продовжує залишатися однією з найбільш актуальних проблем світової охорони здоров’я, що зумовлює необхідність підвищення ефективності кардіореабілітаційних програм. Цей огляд літератури містить базовий аналіз поточного стану кардіологічної реабілітації, що фокусується на ефективному одужанні та запобіганні прогресуванню захворювань. У цій статті коротко розглядається історичні аспекти розвитку кардіологічної реабілітації, епідеміологічні характеристики серцево-судинних захворювань і надається огляд етапів реабілітаційного процесу кардіологічних пацієнтів.

Ефективна та індивідуалізована мультидисциплінарна оцінка кардіологічних пацієнтів, особливо у випадках супутніх захворювань, відіграє важливу роль в охороні здоров’я, слугуючи фундаментальною основою, яка включає медичні, психологічні та соціальні аспекти. Програма серцево-судинної реабілітації в першу чергу базується на сприятливих ефектах кардіореабілітації за допомогою фізичних вправ, але комплексні програми також включають навчальні заняття з акцентом на зниження факторів ризику, зміну способу життя, рекомендації щодо дієти, психологічну підтримку та оптимізовану фармакотерапію.

На жаль, у широкому впровадженні серцево-судинної реабілітації в усьому світі все ще існують деякі проблеми, як-от низька участь у рекомендованих програмах серед відповідних пацієнтів. Кардіологічна реабілітація складається з кількох етапів: етап госпіталізації; амбулаторний та підтримуючий етапи з відповідно різними цілями та тривалістю впроваджених програм. У статті представлено різновид тренувальних методик, запропоновані в сучасній літературі – класичні аеробні тренування, резистентні тренування, високоінтенсивні інтервальне тренування, а також деякі альтернативні методики, включаючи тайцзи та йогу.

Обговорюється питання низької прихильності пацієнтів до регулярної участі в програмі кардіореабілітації та пропозиції щодо покращення цієї ситуації. Отже, встановлено, що основою метою кардіологічної реабілітаційної програми є гарантія безпеки, ефективності та адаптації фізичних вправ у рамках комплексних вторинних профілактичних заходів відповідно до конкретних вимог кожного пацієнта.
Introduction. Cardiovascular diseases (CVDs) cause more than 30% of all deaths worldwide. This indicator reaches 39%-47% (for females and males, respectively) in Europe, and most deaths in the United States are due to a CVD. The annual global number of CVD deaths more than 17 million; which happen mainly due to coronary artery disease (CAD) and stroke. Predispositions and risk factors of CVDs on a behavioral, biological, and social level were confirmed and implemented into primary and secondary preventive programs [1]. The causes and pathophysiology of CVD depend appreciably on the style of living. Major modifiable risk factors include smoking, lack of physical activity, and unproper diets (including excessive alcohol consumption). Behavioral risk factors can result in hypertension, increased blood glucose and cholesterol levels, and overweight or obesity. Determinants also exist at the social, economic, and cultural levels—globalization, urbanization, and population aging. Additional non-modifiable or partially modifiable risk factors include male gender, poverty, stress, and genetic predisposition. The occurrence and development of CVDs are also related to psychological disorders such as anxiety, depression, and sleep disorders [2].

During the past few decades, there were many beneficial trends in cardiovascular disease mainly due to effective prevention and treatment in middle-aged populations. Reductions in the CVD burden in developed countries were achieved through effective population-based prevention programs. According to the World Health Organization, up to 80% of premature heart disease, stroke, and diabetes and 75% of recurrent cardiovascular events could be prevented, reinforcing the need for optimized and holistic prevention strategies. Secondary prevention among high-risk CVD patients and treatment of acute events of coronary artery disease (CAD) could confer additional benefit [1, 3].

The aim of treatment and rehabilitation among older patients is to maintain an independent active life, wellbeing and the ability to move. Indeed, patients who will need cardiac rehabilitation (CR) are now older compared to usual CR patients during the earlier years when cardiac diseases such as CAD and acute coronary syndrome were more prevalent in the working-aged populations [4].

Defining the problem and arguing for the relevance of its investigation. CR now becomes the important part of the secondary prevention model that reduces mortality and the risk of recurrent events and improves CVD patients’ quality of life. A CR program is defined as a systematic, medically supervised program that helps patients recuperate from their cardiac event; adopt and adhere to healthy lifestyle habits; address comorbid conditions (depression, diabetes mellitus, sleep apnea); monitor for safety issues, including new or recurrent signs or symptoms; and, adhere to evidence-based medical therapies. A CR program may include a traditional center-based CR program that incorporates face-to-face interactions and supervised
exercise training sessions or, importantly, may include other alternative CR delivery models that meet all criteria for a safe and effective CR program. One potential strategy is the home-based CR approach (HBCR). Compared to the traditional center-based CR (CBCR) intervention, HBCR relies on remote monitoring and coaching with indirect exercise supervision [5, 6].

Unfortunately, there are still some problems in the wide implementation of CR. The low participation and completion among eligible patients remain largely tricky. Between 2007 and 2011, participation in CR was lower than 20% in both Medicare sampling and the Veterans Affairs (VA) healthcare system in the United States. Although with the improvement of public awareness about health, this situation has improved, it is still not optimal. The National Audit of Cardiac Rehabilitation (NACR) reported that only 50% of eligible patients on average were accepting CR across England, Northern Ireland, and Wales in 2018. Moreover, the imbalanced distribution of healthcare resources also needs to be considered; this imbalance is likely to lead to the unavailability of CR for patients in some low- and middle-income countries [7].

**The aim of the study** was to describe structures, variants and methods of cardiac rehabilitation in general and discuss their advantages and disadvantages as well as perspectives of improvement patient’s adherence.

**The main part.**

CR has been found effective in improving cardiac functions, reducing diseases recurrence, hospital readmission, and mortality in patients with cardiovascular diseases, and is cost-effective. CR has been recognized as a class 1A recommendation for secondary prevention of cardiovascular diseases by the European Society of Cardiology, the American Heart Association, and the American College of Cardiology Foundation [7, 8].

Development and progression of the CR has a such long history. Even in 1772, Heberden observed the beneficial effects in the patient he advised to saw wood for 30 min daily over 6 months. In 1952 the first inpatient exercise training program for patients with CAD was described by Newman et al. Controlled physical activity began during the second week in the hospital and increased until discharge at 6 weeks. In the 1960s, progressively earlier mobilization after the acute coronary event was practiced. Guidelines for CR were first established by the American College of Sports Medicine and the AHA. Rehabilitation and secondary prevention gained broad support as an essential component of comprehensive care in patients with CAD [3, 9].

By the 1970s, a model of structured “rehabilitation” for patients with CHD was progressively introduced around the world. The benefits of supervised exercise programs provided a new approach to post-discharge care and eventually evolved into outpatient or traditional cardiac rehabilitation. This concept of rehabilitation was a logical progression, where patients who survived a Myocardial Infarction, required a period of supervised exercise to overcome the deconditioning associated with previously recommended treatment. Recommendations at the time were focused on exercise and included stating that “the physician is responsible for both
the safety and effectiveness of the exercise prescription” and that “all exercise should be supervised…with sessions once to twice per week for one year” [3].

Also in the 1970s, the Framingham Heart Study had identified risk factors for CVD and their role in prevention and management was becoming widely acknowledged. The identified risk factors included high blood pressure, high blood cholesterol, tobacco use, obesity, diabetes, and physical inactivity, psychosocial issues along with non-modifiable factors including age, gender and genetic predisposition. These factors subsequently became an integral part of primary and secondary prevention of CVD. This focus also increased emphasis on the importance of physical activity and exercise in addressing multiple risk factors and hence the evolving rehabilitation programs initially were mostly exclusively exercise-only but over time they progressively included multidisciplinary education and psychosocial support for patients [3, 9].

The International Council of Cardiovascular Prevention and Rehabilitation was established in 2011 with primary goal to join societies (worldwide), support CVDs’ prevention, and promote CR as an essential part of the care.

According to the most recent update in September 2021, the American Heart Association (AHA), the American College of Cardiology (ACC), and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) have issued comprehensive guidelines about exercise training in the context of cardiac rehabilitation [2].

A CR program is primarily based on the favorable effects of physical exercise (exercise-based CR), but comprehensive programs also include educational sessions focusing on risk factors, lifestyle and its modification, nutritional advice, psychological support, and optimized pharmacotherapy [3].

*Fig. 1. Comprehensive cardiac rehabilitation and its core components [3].*
CR consists of the several following phases: Hospitalization phase (Phase I); Outpatient phase (Phase II); and Maintenance phase (Phase III/IV). Phase I is initiated early in the hospital (in 48 hours) and is aimed at patient cardiovascular system adaptation to physical activity and has a crucial role in terms of discharge planning. A long-term secondary prevention plan is created during that phase [10].

The outpatient CR program (Phase II) lasts typically till week 36 after the CVD event. The main part of the outpatient program is monitored physical exercise, optimized based on personalized clinical assessment, with input from exercise stress testing (cardiopulmonary exercise testing; e.g., spiroergometry or walk tests). Phase II is considered crucial concerning the stimulation of favorable lifestyle changes and adherence to secondary prevention principles.

The aim of Phase III/IV is to maintain the established lifestyle changes under minimal professional supervision with the target of stabilization of patient's health. Exercise programs have the potential to shift from supervised sessions to independent, home-based routines, albeit with the understanding that the continued availability of exercise facilities and guidance from healthcare professionals are still considered significant assets [10, 11].

The safety of this approach is an essential precondition for a complete CR application. Low, moderate, or high risk of CR complications can be estimated based on the patient's complete clinical profile (including a detailed history and physical examination), ejection fraction, functional capacity, the presence of ischemia (ST segment changes during exercise stress testing), and uncontrolled cardiac arrhythmias [12].

Some of the main goals of an optimally set exercise-based CR program are the achievement of improved cardiorespiratory fitness (CRF), exercise tolerance, and quality of life (QoL). Mounting evidence has firmly established that low levels of CRF are associated with a high risk of CVD and all-cause mortality [3, 4].

There are several training modalities which are recommended during II – IV phases of CR. Aerobic endurance exercise is the gold standard of the outpatient training program. A training session should include the warm-up, main exercise, and cool-down. Preferred types of exercise include walking, jogging, cycling, or rowing. The optimum exercise intensity should be within the range of 40%-70% of the heart rate (HR) reserve or 50%-80% of the exercise capacity (peak HR, peak VO2) achieved during exercise stress testing. The incremental cardiopulmonary exercise test allows matching the different physiological responses of different exercise intensity to the individual patient’s pathophysiological and clinical status, maximizing the benefits from aerobic exercise training in CR [4, 5].

Resistance training is also recommended to supplement CR especially for elderly patients, resulting in enhanced self-management and QoL. The exercise can be based on using the patient's body weight, elastic bands, free weights, or fitness machines. Current experience shows that a combination of endurance training and resistance training (combined training) is more efficient than either modality on its
own. Higher efficiency of combined training was demonstrated on improved CRF and muscle strength [2, 4].

Such findings constitute the basis for high-intensity interval training (HIIT), in which high-intensity activity intervals alternate with lower-intensity activity (or passive recovery) intervals. Compared to the conventional continuous moderate-intensity training practice, studies have reported on HIIT being more effective in improving CRF while remaining safe [10].

Apart from the above-mentioned well-established modalities, other feasible training alternatives also may be used for CR. Some of these alternatives include Tai Chi and yoga. For example, Tai Chi has favorable psychological impacts, including reduced anxiety and depression. Yoga as a combination of physical and respiratory exercise and meditation can also be a useful CR supplement. Yoga was demonstrated ability of stress reduction and improvement of the autonomous nervous system's function, thereby affecting cardiovascular risk factors. Also, the inclusion of respiratory training can support the effect of conventional aerobic exercise and, hence, should become a standard option of CR [3].

Deficient use of CR is a global problem. Factors affecting the entry into CR include, in particular, patient awareness, education of physicians, availability, and inclusion of rehabilitation in the comprehensive care scheme, financial support, and timing of referral and enrolment. As to participation and adherence to the training program, primary barriers include work conflicts, family responsibilities, financial costs, fear of the exercise, lack of motivation, or a long travel distance. Lack of social support and comorbid conditions, such as arthritis, osteoporosis, and urinary incontinence, were also reported in a review focusing on female patients [13].

Successful interventions to improve adherence included, among other things, a gender-tailored CR program, because for some patients, public or mixed-gender exercise may represent a serious barrier. Individual patient education based on the Learning and Coping Strategies improved adherence compared to the standard program. This type of intervention appeared to be efficient, particularly in HF patients and low-income and low-educated patients. It is suggested that patients may need ongoing attention and guidance during the outpatient phase of CR but also in the long-term maintenance of their lifestyle changes [4, 14]. Also, strategies based on unsupervised delivery are most efficient for improving CR adherence. The home-based program is a feasible solution; it is a CR alternative in a home setting, including exercise, monitoring, control sessions, letters, and telephone calls. A home-based program may be a reasonable option for selected clinically stable low-moderate risk patients who are eligible for CR but cannot attend a conventional center-based CR program, so, may increase adherence of patients to participation in the cardiology rehabilitation programs [8, 14].

**Conclusions and perspectives.**

Cardio-vascular diseases continue to be a prominent issue in global health, the common reason for hospitalization and cause an inability to work, emphasizing the necessity for efficient cardiac rehabilitation programs.
Cardiac rehabilitation programs conform to evidence-based recommendations for exercise prescription, which have undergone modifications throughout the years to incorporate advancements in research and clinical practice.

CR produces economic savings and better adherence to medical therapies in addition to lowered hospitalization and improved quality of life. CR should be formulated according to national healthcare systems.

CR programs may include traditional (center-based CR models) and novel delivery options (home-based CR models, remote monitoring, or mobile health strategies to link patients with CR professionals, either alone or in combination with center-based CR) as part of the program. The programs may also incorporate the core clinical and operational components of an industry-standard service that provides, tracks, and reports on safe and effective exercise.

Future cardiac rehabilitation programs may focus on targeting populations with a higher risk, including individuals with numerous comorbidities, those who have experienced recurrent cardiovascular events, and younger patients with a familial propensity to heart disorders.

References:


Література:


