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RECOMMENDATIONS OF EXERCISE THERAPIES IN REHABILITATION OF PATIENTS WITH KIDNEY DISEASES: PHYSIOTHERAPY ASSESSMENT

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ABSTRACT
Renal rehabilitation is a process to conduct treatments for the patients suffering from kidney disease and support to help them for their smooth achievement of social rehabilitation. Patients with dialysis-dependent kidney failure carry some additional burden of co-morbidity, such as, diabetes mellitus, hypertension, cardiovascular disease, infections, and many others. Approximately 10% of the world population is affected by chronic kidney disease and the incidence of dialysis is quite high. The patients those undergoing hemodialysis are at increased risk of sarcopenia or frailty and serious health problems as compared to people with normal kidney function. Such complications lead to kidney transplantation and ultimately lead to adverse health outcomes such as functional dependence, hospitalization, and death. Exercise rehabilitation is a well established therapy in patients with kidney disease. Despite more than three decades of exercise research in patients with kidney disease, its applications were not very common in practice. It is only in recent days it gets some attraction. Thus, in the present study, an attempt has been made to assess the exercise therapies in renal rehabilitation.

KEYWORDS: Renal rehabilitation, Exercise therapy, Kidney disease, Dialysis.

INTRODUCTION
Rehabilitation is defined as to include all means to alleviate the effects of conditions that may bring about disabilities and social disadvantages and achieve social integration of people with such conditions (Yamagata et al., 2019). Therefore, renal rehabilitation is defined as a long-term comprehensive program consisting of exercise therapy, diet therapy and water management, drug therapy, education, psychological/mental support, etc., to alleviate physical and mental effects based on kidney disease and dialysis therapy, prolong the life expectancy, and improve psychosocial and occupational circumstances (World Kidney Day: Chronic Kidney Disease, 2015; Koley, 2024). Nevertheless, renal rehabilitation, in its actual meaning, is to conduct all treatments and support to help all patients with kidney disease smoothly achieves social rehabilitation instead of simply implementing exercise therapy. In recent years, a concept of renal rehabilitation has become widely popular among nephrology specialists, dialysis specialists, kidney transplantation specialists, rehabilitation specialists, nutrition specialists, guideline specialists, nurses, physiotherapists, and representatives of patients.

Chronic kidney disease (CKD) is a major risk factor for dialysis, also increases the risk of cardiovascular diseases and is closely related to lifestyle-related diseases such as diabetes mellitus and hypertension. Moreover, dialysis patients develop complications including cardiovascular diseases, infections, and malignant neoplasms and have a very poor prognosis. Approximately 10% of the world population is affected by CKD, and millions die each year because they do not have access to affordable treatment (Couser et al., 2011; Cupisti et al., 1998).

The Life Options Rehabilitation Advisory Council (LORAC) (Medical Education Institute, Inc.; Madison, WI, USA) was established in 1993, to integrate various areas of rehabilitation. Subsequently, in 1994, for the first time, the standard of comprehensive care for nephrological patients included recommendations regarding the implementation of physical exercise. The "5 x E" programme was developed, which consisted of the following areas of intervention:

1. Encouragement – supporting positive attitudes and active participation in treatment in order to achieve independence and better treatment results,
2. Education – dissemination of knowledge on kidney diseases and methods of their treatment,

3. Exercise - assessing the functional status of patients and a proposal of training programmes,
4. Employment - supporting the patient in maintaining gainful employment or taking up employment,
5. Evaluation - includes an individual systematic assessment of each undertaken programme intervention (The Life Options Rehabilitation Advisory Council, (1994).

It is mention worthy that lack of sufficient physical activity is a strong predictor of mortality among patients with end-stage renal disease (ESRD) and is associated with poor physical exercise (Chu et al., 2022; Ashby et al., 2019; Navaneethan et al., 1999).

In spite of number of scientific reports on the safety and effectiveness of physical exercise for patients with ESRD, the medical community still perceives it as a contraindication to physical exercise, and fails to popularize it to the patients. Patients' fear of the loss of vascular access, as well as frequent states of anxiety or depression, is also factors that limit the undertaking of physical exercise

Physiotherapy assessment in chronic haemodialisis patients

The patients undergoing haemodialysis require some qualifications for participation in exercise therapy, the cooperation of an interdisciplinary team consisting of leading nephrologists, cardiologists, physiotherapists, and diabetologists. As part of physiotherapeutic assessment, an interview with the patients and physical examination should be carried out before initiating rehabilitation. The interview should include questions such as: basic personal and social data, diagnosed diseases, current treatment, surgical procedures and current ailments.

1. Evaluation of anthropometric parameters

According to the UK Kidney Research Consortium Clinical Study Group for Exercise and Lifestyle Recommendations (Baker et al., 2022), the physical examination of a patient should include: assessment of dry weight, measurement of body height and circumferences, calculation of the indicators like, Body Mass Index (BMI), Waist to Hip Ratio (WHR) and Waist to Height Ratio (WHtR) and assessment of body composition components. As specified by the WHO, the BMI standard for adults (18.5-24.9 kg/m^2), may also be applied in the population of haemodialysis patients, provided that dry weight is substituted into the formula. BMI (<18.5 kg/m^2), resulting from malnutrition, significantly increases the risk of mortality (Shen et al., 2021). WHR and WHtR, however, are more sensitive indices of central obesity and significantly correlate with the risk of developing CKD and premature death (Shen et al., 2021; Liu et al., 2019).

2. Evaluation of circulatory system function

Prior to the beginning of the exercise training programme, it is necessary to assess the circulatory system in conditions of rest (heart rate and blood pressure, echocardiogram, electrocardiogram) and exercise (Exercise electrocardiogram). These tests are necessary to exclude contraindications to undertaking increased physical efforts, to determine its optimal intensity and then evaluate the effectiveness of training programmes.

In order to determine the optimal training intensity and exclude possible contraindications, it is necessary to conduct a stress test (exercise ECG). The stress test enables: assessment of exercise tolerance (expressed in MET or W), coronary capacity based on the occurrence (or not) of electrocardiographic criteria for myocardial ischaemia, observation or detection of arrhythmias and conduction disorders and detection of other abnormal responses to exercise (Piotrowicz et al., 2017).

3. Cardiopulmonary exercise test

For assessing the physical fitness, cardiopulmonary Exercise Test (CPET) is considered as the most accurate method. The main evaluated parameter is maximal oxygen uptake (VO_2 max), peak oxygen uptake (VO_2peak) – for patients with severely reduced performance or with significant risk factors, and the maximal heart rate (HRmax). This test allows for comprehensive determination of the patient's physical capacity, with an analysis of circulatory and respiratory system responses to exercise as well as indirect assessment regarding muscular system function. Being an important prognostic indicator, it also allows for the diagnosis of patients from the highest risk groups (Kurpesa et al., 2014). The CPET test can further be used to precisely determine individual heart rate ranges, including the frequency of heart contractions in the area of aerobic changes (so-called "oxygen pulse"). Nonetheless, conducting such a test requires specialized equipment and qualified personnel and, therefore, it is not a standard test. A physiotherapist can carry out functional tests, which are supplementary to the patient's assessment, as well as the basis for programming the rehabilitation process and evaluating its effectiveness, including physical exercise tolerance tests.

4. The 6-Minute walk test

The 6-Minute Walk Test (6-MWT) is used to assess exercise tolerance and, indirectly, physical capacity. The test result consists of the distance expressed in meters, with an accuracy of 1 meter (6-MWD - 6 Minute Walking Distance) and the degree of subjective fatigue level according to the 10- or 20-point Borg scale. Walking a distance of 600-700 m is considered satisfactory, while covering a distance of less than 300 m indicates poor prognosis (ATS Committee, 2002). However, it is recommended to determine the reference distances based on the available formulas:

- men: 6-MWD = (7.57 x body height in cm) - (5.02 x age) - (1.76 x body mass in kg) - 309 m,

- women: 6-MWD = (2.11 x body height in cm) - (2.29 x body mass in kg) - (5.78 x age) + 667 m (Enright and Sherrill, 1998).

Importantly, the obtained result in meters allows for indirect determination of the peak oxygen uptake VO_2 peak, according to the formula below (Ross et al., 2010): Mean VO_2 peak (ml/kg/min) = 4.948 + 0.023 x average 6-MWD (meters).

Assuming that the maximum heart rate during 6-MWT corresponds to the heart rate at the level of the anaerobic threshold, its values achieved during the 6-MWT can be used to determine the training heart rate at the level of aerobic metabolism among patients, especially in the group at a moderate and high risk of experiencing complications during physical training (Piotrowicz et al., 2017; Gayda et al., 2004; Luxton et al., 2008).

5. Evaluation of limb muscle strength

The gold standard for measuring muscle strength is the dynamometer test. This test can be used to perform direct functional assessment of selected muscle groups or kinematic chains in isokinetic conditions at various angular velocities and in isometric conditions. The obtained results reliably assess muscle strength, however, conducting such a test requires specialized equipment and qualified personnel. Therefore, it is not a standard test. Thus, in physiotherapeutic clinical practice, other forms of testing muscle strength, using hand-held devices or functional tests, have been used.

6. Handgrip strength

Handgrip strength (HGS) measurements are non-invasive, easily accessible and easy to perform. This test is being increasingly applied to evaluate a patient's health or to control the effectiveness of treatment. According to Leal et al. (2010), handgrip strength is a useful tool for systematic and continuous assessment of muscle mass among haemodialysis patients. The procedure is repeated twice, with a 1-minute interval for rest between trials, and the result is the average of the 2 measurements in kilogrammes (Hamilton et al., 1992) or the better result for each hand or the better result for the dominant hand. The measurement of grip force should always be made under the same conditions and with the same dynamometer (Leal et al., 2010; Hillman et al., 2005).

7. Measurements of lower limb muscle strength

Measurements of lower limb muscle strength on a dynamometer stand allow for functional evaluation of extensor and flexor muscle function, acting on the knee joint in isometric and isokinetic conditions at various angular speeds. The most frequently tested muscle group is that of the quadriceps (Rousseau et al., 2018; Souweine et al., 2017). Quadriceps strength testing includes, among others: peak torque, mean power, and total work determining the functional state of the muscles (Collado-Mateo et al., 2019; Dziubek et al., 2016).

8. The sit to stand test

The Sit to Stand Test (STST) can be performed in 30- or 60-second versions. The test result is the number of complete cycles. It indirectly evaluates the muscle strength of the lower limbs (Rikli and Jones, 2001; Fiłon et al., 2019).

9. The arm curl test

The Arm Curl Test (ACT) indirectly assesses upper limb strength. The result of the test is the number of correctly performed flexion and extension movements in the elbow joint within 30 seconds (Rikli and Jones, 2001).

10. Accelerometers

Accelerometers are easy-to-use devices that track physical activity and periods of inactivity. They provide objective information on: the number of steps taken, energy expenditure expressed in kcal and as a metabolic equivalent (MET), body position, amount of sleep and wakefulness, detection of awakenings and the level of exercise intensity (Herbert and. Czarny, 2013).

11. Pedometer

Pedometer is a small device that evaluates the number of steps taken, and also allows to estimate the distance covered for a given period of time, e.g. during a walk, hiking, training or running. The most important parameters that can be measured: the number of steps and the number of calories burned during the examined period. A watch, a pedometer or an app installed on a mobile phone can now be used to assess daily physical activity (and step count).

The indices proposed by Tudor-Locke et al. (2011) for the classification of physical activity measured with a pedometer in healthy adults were used to classify the level of physical activity as: sedentary lifestyle (4,999 steps per day); low activity (5,000-7,499 steps per day); moderately active (7,500-9,999 steps per day); active (10,000-12,499 steps per day) and very active (12,500 steps per day). In dialysis patients, the daily number of steps on days without dialysis should exceed 4,000. Therefore, the Japanese recommendations from 2018 (JSRR) state that people without locomotor system dysfunctions gradually reach the value of 4,000 steps, and then exceed it on days without dialysis (Hoshino, 2021).

12. The Barthel Index (BI)

The Barthel Index (BI) is used to assess the mobility of patients. It helps to define and describe what activities the patient can perform on his/her own and to what extent she/he needs help. The Barthel Index is one of the scales evaluating Activities of Daily Living (ADL), which determine how independent the patient is in terms of self-care. A score below 40 may qualify a person for long-term care (Mahoney and Barthel, 1965).

13. The International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) is considered by many scientists to be the only viable method for measuring physical activity among large populations. The questionnaire estimates the duration, frequency and intensity of physical effort performed within the last 7 days (Biernat et al. 2007). On the basis of the obtained results, the examined person qualifies for 1 of 3 levels of physical activity, i.e. insufficient, sufficient and high. However, the survey is subject to a high risk of error. Respondents may misinterpret questions, incorrectly estimate the time of performing a given physical activity or include the same physical activity in several domains. It is recommend that the survey be conducted by a trained interviewer (Biernat et al., 2007).

14. The Kidney Disease Quality of Life – Short Form (KDQoL)

The Kidney Disease Quality of Life – Short Form (KDQoL) questionnaire is currently one of the most complete tools for subjective assessment of quality of life available to the people suffering from kidney diseases. It provides information on: physical and mental health, feelings related to the disease and satisfaction with medical care. It is a specific version of the SF-36 questionnaire, supplemented with issues relating to the problems faced by patients undergoing renal replacement therapy (Hays et al. 1997).

15. The Beck Depression Inventory (BDI)

The Beck Depression Inventory (BDI) is considered as an accurate and reliable tool for assessing symptoms of depression. The scale contains 21 questions that relate to all the most important symptoms of depression. The first 13 questions concern the cognitive-affective area (a specific mood change associated with self-blame, regressive and self-punishing wishes). Other questions regarding somatic problems accompanying mood disorders (sleep disorders, fatigue, loss of appetite and weight, somatic complaints, loss of libido). The severity of depression is assessed by summing up the points obtained in individual questions: 0-11 – 'no depression', 12-26 – 'mild depression', 27-49 – 'moderately severe depression', 50-63 – 'very severe depression' (Beck et al. 1961 and 1996).

CONCLUSION

From the discussion of the study, it might be concluded that, as many as 14 physiotherapy assessment methods were recommended for exercise therapies in rehabilitation of patients with kidney diseases. The physical exercises should be encouraged by the nephrologists and physiotherapists to the patients undergoing hemodialysis, as one of the rehabilitation protocols.

Declaration by authors

The authors hereby declared that it was their original peace of research and had not been sent to any other journal for publication.

Ethical approval

Approved.

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Conflict of interest

The authors declared no conflict of interest.

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