Chapter

Renal Rehabilitation: A Perspective From Human Body Movement

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Abstract

The prevalence and incidence of advanced chronic kidney disease has grown progressively in most countries of the world. Hemodialysis is the most common treatment that replaces the renal function, and although it allows to replace the function of the kidney, the patients who undergo it can present numerous alterations that lead to a loss of functional physical capacity and a decrease in the quality of life related to health. It is unknown to what extent low physical activity, uremia and anemia determine the decrease in functional capacity of these patients. The functional tests most frequently used in the published literature are characterized by their ease of application and their low cost, since they do not require large measuring instruments to quantify basic qualities in subjects with impaired or dysfunction of the renal system from the aerobic capacity, muscle performance and flexibility as axes within the kinetic wellbeing which is committed in the stay of the renal hemodialysis units.

Keywords: rehabilitation, exercise, renal dialysis, physiotherapy

1. Introduction

Rehabilitation specialists currently perform in a variety of important intervention areas, positively diminishing the impact of various alterations, such as, renal dysfunction in hemodialysis care units [1]. Survival of patients with this disease at 5 years is 40% and the life expectancy of patients on dialysis is one fourth to one fifth of the general population [2]. Chronic kidney disease is becoming a serious health problem throughout the world and is one of the most known risk factors for cardiovascular disease, being this the main cause of morbidity and mortality in this patient population. On the other hand, physical inactivity has become a significant and independent risk factor for the accelerated deterioration of renal function, physical function, cardiovascular function and the quality of life of people in all stages of the disease. That is why we must prioritize good practices based on specific research, together with strong evidence on the multiple health benefits of regular and adequate amounts of physical activity in other cardio metabolic conditions, has led to physical inactivity be identified by national and international clinical practice guidelines as one of the multiple risk factors that require simultaneous intervention and principles for optimal prevention/management in rehabilitation. Despite

this awareness, physical inactivity is not systematically addressed by the renal care teams from the care of the physiotherapist's professional in this section of the hemodialysis units [3].

Other disease conditions can accelerate the loss of kidney function as it is: diabetes, obesity, high blood pressure among others can cause dysfunction of multiple systems. [4, 5]. That is why physical activity at adequate levels and regularly prescribed allow positive contribution to the impact of muscle mass loss and weakness, low aerobic capacity, vascular reserve capacity, frailty and disability, where the latter are evidenced in a quality of life compromised in chronic kidney disease [6–10].

Among the changes resulting from chronic renal failure, muscle dysfunctions occur, where studies have shown the presence of atrophy of muscle fibers resulting from an imbalance between the synthesis and degradation of muscle protein. There may even be decreased synthesis and/or increased degradation [11–15]. Several mechanisms lead to muscle dysfunction, among which are: the depletion of amino acids; chronic inflammation; inactivity; malnutrition syndrome; changes in capillary perfusion; peripheral neuropathy, among others.

Thus, the literature reports exercise intolerance associated with anemia and hypervolemia in users with chronic renal failure; studies have already shown the treatment of these conditions, however, does not improve the tolerance to exercise, and therefore, this intolerance consequently leads to a sedentary lifestyle, which further decreases the physical capacity, creating a vicious circle within of the condition of chronic kidney disease translated into implications in their quality of life [16–18].

The foregoing evidences the need to complement the processes of renal rehabilitation with the clear participation of the physiotherapist as a promoter of the human body movement from the areas of secondary, tertiary prevention and rehabilitation with the aim of diminishing the negative impact of the burden of the disease in the user and carer.

1.1 Physiotherapy in the field of renal rehabilitation

The treatment of patients with progressive renal failure can be divided into several components, including health promotion and primary prevention programs (based on risk groups), early planning of renal replacement therapy and the establishment of interventions to treat the progression of chronic kidney disease and increase the quality of life of patients. Physiotherapy is included in this component of the treatment, based mainly on specific programs of supervised physical exercise, with the aim of increasing the level of physical fitness and, consequently, improving the quality of life and reducing the need for antihypertensive medications; morbidity and mortality [19].

The physiotherapeutic action in renal hemodialysis units is based on the prescription of their therapeutic actions based on physical activity, where it has been possible to demonstrate the benefits of physical activity for patients with chronic renal failure [20] including: increase in tolerance to exercise; reduction of inflammatory mediators; increase in synthesis and decrease in muscle protein degradation; increase in the number and size of muscle fibers, thus increasing muscle strength; increase in hematocrit and hemoglobin. Central effects also occur: improvement of left ventricular function, decrease in the occurrence of cardiac arrhythmias, in addition to beneficial effects on coronary artery disease risk factors (hypertension, lipid disorders).

Physical exercise is derived from the concept of physical activity, which is any movement of the body that spends energy above the basal level. Exercise then is all

planned, structured and repetitive physical activity that aims to improve or maintain one or more components of physical condition. Therefore the prescription of physical exercise is the orderly and systematic process by which a regime of physical activity and/or exercise is recommended individually, according to needs and preferences, to obtain greater benefits with the lowest risk to health [21].

From this perspective, health professionals require a multidisciplinary work [22] that mainly involves physiotherapists [23] to counteract the progress of non-communicable chronic diseases (NCD), using cost-effective actions that cover the entire population [24, 25].

1.2 Renal rehabilitation based on the strategy of the physical exercise in the unit of hemodialysis

The criteria for examination (anamnesis), evaluation and diagnosis, intervention processes, prognosis and evolution to contribute to the goals of the interdisciplinary group of renal rehabilitation at the hemodialysis units are set out in the process schema of the American Physiotherapy Practice Guide (APTA) [26].

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Among the fundamental aspects in the process of the anamnesis with the user is the process of collecting important data for the development of the clinical history in physiotherapy as are the physical qualities that are immersed in the stay of hemodialysis units. Likewise, comorbidities, medications, postural changes, vital signs, and anthropometric data will be analyzed in order to evaluate the physical condition in health, to subsequently plan the prescription of the appropriate exercise according to the degree of severity of chronic kidney disease.

1.3 Contraindications and precautions in the physical exercise in the hemodialysis unit

Among the contraindications for the practice of physical activity prescribed by physiotherapy, some exclusion criteria are considered: recent myocardial infarction; uncontrolled arrhythmias; uncontrolled hypertension (systolic blood pressure > 200 mm Hg and diastolic blood pressure > 120 mm Hg); unstable angina; severe decompensated diabetes (blood glucose > 300 mg/dL); dysfunction of the left ventricle; presence of neurological or motor impeding dysfunction, for the application of the protocol of physical activity.

At the beginning of each exercise session, if the patient has any symptoms that prevent them from performing the exercises, the team of the hemodialysis unit should be informed, where they will report some important aspects such as: perceived muscle fatigue, angina pectoris, lipotimias, pallor, syncope, pre-syncope, disproportionate dyspnea in relation to intensity of effort, arrhythmias and hypotension or the hypertensive response of being detected any of these symptoms is important to study the admission to the physiotherapy program in hemodialysis within the rehabilitation program renal.

1.4 Effects of the physical exercise in renal rehabilitation

Patients with chronic kidney disease are inactive, which reduces physical performance. Aerobic exercise interventions have been shown to increase maximum oxygen consumption in selected patients. In addition, preliminary evidence,

although mixed, suggests that aerobic exercise training may improve blood pressure, lipid profile, and mental health in this population.

The training with resistance exercises, although less studied, where an increase in muscular resistance and performance is observed, translates into an increase in functioning in their activities of daily life. Despite the evidence that exercise is safe and beneficial in patients with chronic kidney disease, dialysis patients remain inactive, where it is necessary to establish parameters from the evaluation, the advice of the physiotherapy intervention based on the physical exercise directed to the patients with this pathology.

The actions of physiotherapy are based on the evaluation of exercise capacity: measures of aerobic capacity assessment of exercise, muscle strength, and overall quality of life [27].

1.5 Muscular strength

The loss of muscle mass is the most important predictor of mortality in HD patients [28]. Muscular atrophy and, consequently, the organism is a generalized weakness, caused by the loss of strength, compared with normal subjects is 30–40% lower, making the patient physical deconditioning [29, 30]. Physical training is an important factor in the control and reversal of the loss, although the effects of this population have yet to be fully understood [31].

In this sense, Cantareli et al. [32] applied 5 months of resistance and strength training during HD, demonstrating the increase in muscle strength of the knee extensors and the average loads tolerated by MID: 4.71 ± 3.03 vs. 6.07 ± 2.62 vs. 8.42 ± 3.30 kg; MIE 4.85 ± 3.13 vs. 6.21 ± 2.82 vs. 8.57 ± 3.99 kg, $p < 0.05$. Other authors [33–36], studied the effect of aerobic and/or resistance also found a significant improvement in muscle strength.

Muscle fiber atrophy, type I and II, particularly type IIB, is an important factor that together with histochemical changes at low concentration of aerobic enzymes, low oxidative capacity, loss of capillarity and low levels of contractile proteins contribute to the muscle dysfunction [37, 38].

To verify the effects of exercise on the alterations present in patients with chronic renal failure in HD muscle, Sakkas et al. [12] examined the morphology of twin muscles in 12 patients before and after an aerobic exercise program performed three times a week for 6 months. The results showed that the proposed training improved muscle tropism, increased cross-sectional area by 46% and reduced the atrophy of muscle fibers of type I (51–15%), type IIA (5821%) and type IIB (62–32%). In addition, significant differences were found with respect to increased muscle capillarity.

Muscle strength is usually measured as maximal force by isokinetic dynamometry [39] and maximum torque, and absolute muscle strength using one maximum repetition [40] being the maximum weight that can be lifted in a single repetition of a given exercise by the physiotherapist.

1.6 Aerobic capacity

Several studies have shown that patients with chronic kidney disease on hemodialysis have reduced functional capacity and exercise capacity by about 50% lower compared to healthy subjects [41, 42]. Several factors associated with this reduction include decreased physical activity, muscle weakness, anemia, ventricular dysfunction, abnormal metabolic and hormonal controls [31]. Currently, great interest has been attributed to the assessment of the functional capacity of these patients through the six-minute walk test (PM6M) and other tests such as sitting and

standing up. These tests are simple and measure functional capacity through basic information, and provide important data to monitor the progress of the patient in the course of the disease thus evaluating the benefits of rehabilitation programs [43].

1.7 Quality of life

Research has shown that chronic kidney disease and hemodialysis are some of the pathologies and therapies that most affect the quality of life, since they lead to the limitation of cardiorespiratory and physical capacity, which can degrade performance in work activities and social life [41, 44, 45]. Studies show that physical activity can contribute to an improvement in the quality of life of patients with chronic kidney disease.

Painter et al. [46] found the effect of a program consisting of 8 weeks of exercises at home, of 8 weeks of cycle ergometer during dialysis on the quality of life of chronic kidney patients. After 4 months, the authors observed a significant increase in the following dimensions of SF-36: functional capacity (47.7 ± 28.3 vs. 53.4 ± 27 $p = 0.004$), physical (40.4 ± 40, 3 vs. 54.5 ± 21.4 $p < 0.001$), pain (60.5 ± 28.1 vs. 66.6 ± 28.6 $p = 0.003$) and general health (45 ± 21.9 vs. 49, 1 ± 22.5 $p = 0.05$). According to the authors of the SF-36 results clearly indicate that specific physical activity affects the physical aspects of health, because there were no changes in mental health scores in any group of patients. Consequently, Vilsteren et al. [35] at 12 weeks of intra-dialysis aerobic training observed a significant change in the components of vitality and the general state from the application of the SF-36 questionnaire ($p = 0.001$).

However, Cantareli et al. [32] in his clinical trial of seven patients showed that the average values of the physical aspects, pain, general health and vitality increased after achieving an increase in muscle mass, but it was not very significant.

1.8 Existing barriers for participation in physical activity programs in renal units

Physical inactivity is a strong predictor of mortality in patients with end-stage renal disease and is associated with physical malfunction. Patients with terminal stage kidney disease are inactive even compared to sedentary individuals without kidney disease. Therefore, it is necessary to identify those existing barriers that have been described by some researches in hemodialysis units such as: Early muscular fatigue in the execution of movement, asthenia and adynamia, post-dialysis fatigue [47].

However, the lack of guidance from nephrologists is probably not the only reason for patient's low levels of physical activity. In a study by Goodman and colleagues [48], lack of motivation and interest were some of the factors cited as the limitation of the patient's participation in physical activity.

The deficit in physical activity among patients on dialysis has been theorized that it is due to a lack of motivation secondary to the patient's barriers, including socioeconomic, psychological and the perception of physical disability, although the motivation towards the practice and adherence of A physical activity program may be related to the previous level of physical exercise performed by the subject [49, 50].

However, given the potential obstacles to providing exercise opportunities in the dialysis unit, a possible alternative would be to promote health education mechanisms towards tertiary prevention aimed at users with the goal of identifying times in their daily routine (outside of dialysis) and thus incorporate physical activity effectively in their activities of daily life. Some guidance and encouragement should be guided by recommendations directed at older people from health professionals [51, 52].

2. Conclusions

Studies of the barriers to the participation of renal users in hemodialysis units where exercise programs are being carried out are needed.

It is also important to consolidate elements of the evaluation, recommendations from physiotherapy and its contribution to the rehabilitation program in order to continue on the path of evidence-based practice.

However, participants must be motivated to participate in moderate physical activity according to the current recommendations or consensus of the renal rehabilitation. Users who experience early fatigue or asthenia may benefit from strength training interventions, taking into account that aerobic and resistance exercises should be initiated at relatively low intensity in patients with this disease and progress taking into account the level of tolerance to exercise in order to avoid undesirable effects or even the suspension of therapeutic exercise.

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Conflict of interest

The authors do not present conflicts of interest in the process of the narrative review type investigation.

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