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Review Article

The Role of Physical Activity in Improving QOL of Patients Undergoing Hemodialysis

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ABSTRACT

Patients undergoing hemodialysis (HD) experience increased mortality rates and decreased physical activity, which has an impact on patients' low quality of life (QOL). Physical activity has positively affected cardiovascular function, strength, and overall health status. On the other hand, physical activity has not been proven to cause any health hazards in HD patients. However, physical activity has not become a routine practice for HD patients, and there are no clear guidelines for physical activity in HD patients. Due to the inherent condition, intradialytic aerobic exercise appears to be the most suitable physical activity method for HD patients. However, research is still needed to assess the effectiveness and safety of intradialytic exercise (IDE) for HD patients in the long term. Research results can be used as a reference in developing the most appropriate IDE guidelines for HD patients.

Keywords: end-stage renal disease, intradialytic exercise, aerobic exercise, quality of life.

Introduction

Hemodialysis (HD) is the predominant treatment approach for patients with end-stage renal failure (ESKD). Compared with those who are physically active regularly, HD patients who are classified as sedentary have a chance of dying by more than 60% every year. [1] HD patients who sit more tend to experience lower quality of life (QOL), and a decrease in VO2 max is connected to a higher risk of mortality.[1–3] A strong association exists between increased mortality and lower levels of objective, self-reported physical functioning.[4]

Physical activity methods in HD patients vary greatly, and they can be done intradialytic (IDE) or interdialytically. Until now, specific guidelines for physical activity in HD patients have not been established. The Kidney Disease Improving Global Outcomes (KDIGO) guidelines advise incorporating regular physical activity into the everyday routine of patients with chronic kidney disease (CKD) (minimum of 30 minutes/day, five times/week) and should be tailored to each individual's cardiovascular health as well as tolerance level.[5] International physical activity (PA) guidelines provide guidelines for performing 150 minutes/week of moderate-intensity aerobic PA in patients with chronic

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conditions.[6] The most appropriate physical activity for HD patients appears to be the IDE aerobic method. However, other recommendations include resistance exercise, interdialytic aerobic exercise, and a combination of resistance and aerobic exercise.[7] In principle, IDE focuses on increasing the patient's physical endurance and strength by addressing a range of psychosocial and physiological parameters.[8] IDE has been proven to positively affect the overall health and readmission rates for HD patients,[9,10], and improved QOL.[11–14] General guidelines recommend performing aerobic IDE within the first 2 hours of an HD session, with moderate to high intensity based on VO2 max assessment 10, for 30 minutes, lasting five weeks to 6 months, while most programs are 12 weeks long.[15] Apart from that, a health service team is also needed that involves many experts apart from nephrologists, including cardiologists, physiotherapists, exercise physiologists, renal dietitians, and nurses.[16] Special equipment also needs to be available, such as an ergometer connected to a bed or HD chair so that HD patients can benefit from aerobic exercise. This review is primarily concerned with assessing the benefits of physical activity and identifying the most suitable IDE methods for HD patients to improve their QOL

Benefits of Physical Activity in Improving Quality of Life

Compared with those who do not undergo HD, CKD patients who undergo HD have lower functional abilities. This is associated with lower physical activity levels, ultimately affecting their QOL.[17] A strong relationship exists between physical function and patient outcomes, including health-related QOL (HRQOL) and mortality.[4,18] Reduced physical function and low muscle strength impact their QOL, reducing their ability to carry out daily activities.[19,20] Compared with healthy people, CKD patients show a significantly lower ability to perform daily activities and reduced capacity to participate in social, entertainment, or independent exercise.[17] Sedentary HD patients had a greater than 60% chance of dying annually in contrast to those who engaged in regular physical activity.[1] It has been shown that self-reported physical activity is strongly associated with lower mortality and HRQOL in HD patients.[21] Likewise, QOL results according to SF-36, Physical Component Summary (PCS), and Mental Component Summary (MCS) results obtained can act as predictors of mortality and hospitalization rates.[22] Other studies also prove that physical activity is an independent predictor of death in HD patients.[23] In contrast, increased physical activity was linked to a decreased mortality risk.[24] Even participating in light physical activity is linked to a reduced mortality risk.[25] Importantly, regular physical activity is advantageous in every stage of kidney disease, enhancing physical fitness, muscle strength, and HRQOL.[26]

So, based on the evidence above, it is clear that physical activity affects the QOL of HD patients.[17] Therefore, to improve QOL in HD patients, one significant effort is increasing their physical activity.[27] However, it must be realized that carrying out and assessing physical activity in HD patients also presents numerous challenges.[28] Therefore, it is necessary to consider many things in determining the method of physical activity and the assessment that is most appropriate individually, primarily related to the resources and capabilities possessed by each dialysis unit.

Physical Activity Methods in Hemodialysis Patients

Many various exercise methods for HD patients whose efficacy and weaknesses have been studied. These include resistance exercise, aerobic exercise, a blend of resistance and aerobic exercise, range of motion, respiratory muscle training, stretching exercise, electrical muscle stimulation, walking exercise, peripheral muscle training, and sham exercise/usual care.[10] Among the various exercise methods, aerobic exercise is proven effective in improving QOL, whereas stretching exercise significantly reduces QOL compared to usual care.[10] Since HD patients have several typical limitations, aerobic exercise seems to be the most suitable method. However, combining resistance with aerobic exercise can also be an alternative if the patient can tolerate

the program. Resistance exercise, as a form of physical activity, trains muscles to contract against the equipment used to increase strength, endurance, mass, size, and muscle hypertrophy. Incorporating progressive resistance into an exercise program improved muscle strength.[7] Based on biochemical and molecular physiology analysis, combining resistance exercise with aerobic exercise improves exercise capacity, VO2 max, and 6-min walk test (6MWT). Combining resistance exercise and aerobic exercise is the method that has the most significant impact on 6MWT.[10] Resistance exercise promotes the number of muscle mitochondria, increases oxidative phosphorylation, and triggers mitochondrial biogenesis by activating the peroxisome proliferator-activated receptor g coactivator 1a signaling pathway in reaction to increased intracellular Ca2+ and reactive oxygen species. Increases in cyclic adenosine monophosphate (AMP) and p38 mitogen-activated protein kinase occur due to adenosine triphosphate (ATP) breakdown and increased adrenergic stimulation.[10,29]

Outcomes of Aerobic Intradialytic Exercise in Hemodialysis Patients

Most dialysis patients experience decreased muscle strength and aerobic power, making them less capable of tolerating the energy demands of various daily activities.[15] They also start with a lower exercise tolerance, which can hinder integrating an exercise program into their usual treatment. Indeed, the effects of exercise during HD remain a controversial issue.[30] Some studies have not observed notable changes in self-reported HRQOL after IDE programs. However, most have discovered significant positive physical impacts in programs lasting from 5 weeks to 6 months, with many programs being 12 weeks long.[15] Increasingly, many studies have shown that even light exercise can positively affect patients' mental and physical health. These benefits include improvements in lower extremity muscle strength, aerobic capacity, lipid metabolism, and systolic blood pressure, and they also show benefits from HRQOL.[15] Based on a systematic review and meta-analysis, aerobic IDE has a notable beneficial impact on QOL, both MCS and PCS.[8,10]

Taking into account the conditions inherent in HD patients and the many benefits if carried out on HD days, aerobic IDE seems to be the most reasonable choice. Some of the benefits of IDE include that it is an easy intervention, does not involve additional time, increases compliance, provides encouragement within an organized environment, and can be directly monitored by medical staff.[31,32] IDE causes increased muscle blood flow, and a more significant amount of open capillary surface area in the working muscle will facilitate a higher flux of urea and related toxins from the tissue to the vascular compartment and subsequent removal through the dialyzer.[33] IDE can also increase dialysis efficiency by reducing solute rebound, which occurs due to increased perfusion of skeletal muscle, which in turn has the potential to improve its health.[34] Besides increasing dialysis efficiency, IDE has also been shown to improve VO2 max and QOL.[11–14]

Aerobic Intradialytic Exercise Regimens to Improve QoL

There are many variations in the implementation of aerobic IDE in HD patients. The following are several examples of IDE aerobic programs from several researchers that have been proven to provide an increase in QOL, including:

- The exercise program consists of warming up for 5 minutes and cycling for 10-15 minutes for three months with an intensity of 12-16 points on the Borg scale. This program resulted in a percentage change in the total QOL score of 37.7%.[35]
- Patients receive IDE passively using electrically powered pedaling at a moderate speed for 30 minutes per session (3 times 10-minute exercises with a 20-minute recovery period) within the first 2 hours of the dialysis session. After the 8-week washout, the patient actively pedaled in the same way for eight weeks. This exercise program resulted in a change in the total QOL-SF-36 score of 20.8%.[30]

- The exercise program includes a warm-up, aerobic exercise, and cool-down. Warm up by passive stretching of the lower extremities and aerobic activity using a bicycle at a speed of 0.5 km/hour (approximately 35 rpm) for 5 minutes. Following that, the conditioning phase involved 30 minutes of exercise within the first 2 hours of dialysis, with intensity based on the 11- and 13-point Borg scales. The cool-down phase consisted of 2 minutes of cycling with a minimum load at 35 rpm and passive stretching of the lower extremities. This exercise program resulted in a change in the total QOL-SF-36 score of 14.7%.[36]
- The exercise program involves cycling for 45 minutes at a speed of 45–50 rpm during the 2nd and 3rd hours of the 4-hour HD session. Training resistance was set to range between 65% and 75% of maximum power capacity (in watts), evaluated at the start of training, reassessed, and adjusted every two weeks with a submaximal cycling test. Every training session incorporated a warm-up and cool-down of 5 minutes each. The program led to a 25% improvement in QOL, primarily resulting from changes in physical health rather than mental health. [33]

Conclusion

Patients undergoing HD who are classified as sedentary generally have a low QOL. Physical activity has been shown to affect the overall health of HD patients positively. However, physical activity has not become a routine or an integral part of managing HD patients. Considering the existing limitations, with lower exercise tolerance, the IDE aerobic program appears to be the most appropriate physical activity method for HD patients. However, further research is necessary to examine the effectiveness and safety of IDE in the long term, which can be used as a reference in developing the best physical activity guidelines for HD patients, especially regarding the type of exercise and equipment, intensity, duration, and exercise modality.

Declarations

Competing interests

The authors declare no conflict of interest.

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Author's Contribution

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