

**66 - EXERCISE CAPACITY ON HEMODIALYSIS PATIENTS**CELEIDE PINTO AGUIAR PERES<sup>1,2</sup>ANTONIO FERNANDO BRUNETTO<sup>1</sup><sup>1</sup>Universidade Estadual de Londrina - UEL- PR<sup>2</sup>Universidade Estadual do Oeste do Paraná - UNIOESTE - PR[cperes@certto.com.br](mailto:cperes@certto.com.br)**INTRODUCTION**

Patients with ESRD on hemodialysis program are less active when compared with the general population and the pathogenesis of physical disability has not been fully elucidated<sup>1,2,3</sup>. Muscle weakness is common in these patients, with some contributors are recognized factors such as changes in energy metabolism, neuropathy, muscular atrophy, malnutrition, myopathy and deficiency of carnitine and depression by promoting inactivity física<sup>4,5</sup>. The atrophy of the muscle fibers in these patients occurs mainly in type II fibers, with decoupling capillary-myofibrils, reducing the oxidative capacity, to prevent blood perfusion and transport of oxygen. The magnitude of the muscular strength of chronic kidney is between 30 and 40% when compared with individuals normais<sup>6</sup>. Among the many factors that cause disorders, there was a decrease of protein-calorie intake, disuse and atrophy of muscle imbalance protein that is part of the pathogenesis of myopathy uremic<sup>7</sup>. Recent studies show that physical activity may contribute to the planned improvement in exercise capacity and quality of life of this population<sup>8</sup>. The muscles responsible for breathing act as a diaphragm and intercostals may have histological and functional changes resulting from ESRD<sup>9,10</sup>. Between test of functional capacity at low cost and easy applicability can cite the tests of distance in six minutes (6MWT) and Shuttle Walk Test (SWT)<sup>11</sup>. The 6MWT is a test shows that sub capacity of prediction of mortality and correlated with quality of life and dyspnea. The SWT is an incremental test up with good reproducibility and correlation with the distance walked in maximum oxygen consumption, similar to that obtained in tests conducted at maximum treadmill<sup>11</sup>. Muscle strength of lower limbs can be evaluated with the test load of a repetition maximum (1RM)<sup>12</sup>. In Brazil, there are no reports in the literature for assessing the ability of exercise in patients with ESRD on hemodialysis program associated with spirometry and peripheral muscle strength. This study aimed to demonstrate the profile and assess exercise capacity of patients with ESRD in HD, in both sexes.

**METHODS**

Were studied 58 patients with ESRD in HD of the Kidney Institute of Londrina - PR (32 men and 26 women) over 18 years of age, there are at least three months, making HD on average four hours per session, three times per week, Fresenius machine in 4008 B (Fresenius Medical Care, Berlin, Germany), with blood flow of 300-400 ml / min, using dialysis in polysulfone or cellulose acetate. Were excluded patients with coronary artery bypass grafting less than six months, osteomioarticulares limitations of the lower limbs it impossible to achieve the functional tests, symptomatic cardiovascular disease, chronic obstructive pulmonary disease (COPD), cognitive, uncontrolled hypertension, acute myocardial infarction (AMI) or stroke less than six months and patients who participate in any regular program of physical activity. The research project was approved by the Research Ethics Committee in Human Beings of the Londrina State University (UEL), and each patient signed a consent free and clear. The test was conducted at 6MWT interdialysis, a day after the second session of hemodialysis of the week. For the tests, patients were instructed to use shoes and comfortable clothes, no food is at least an hour before and not do any physical activity in the 24 hours preceding the tests. Before you start testing the patients remained fifteen minutes at rest in the sitting position for the stabilization of vital signs. After this period were recorded vital signs (blood pressure), heart rate and respiratory rate). The degree of dyspnea, pain or fatigue of the lower limbs was assessed by the scale of perceived exertion - Borg Scale (BS)<sup>13</sup>. Patients were instructed to stop the tests only when they feel intolerant or if the effort to reach its highest level of exhaustion. At the end of the tests, the distances covered were recorded and checked again the vital signs and level of perceived exertion. For this test standardization 6MWT was followed the Statement of the American Thoracic Society (ATS): Guidelines for the Six-minute Walk Test<sup>14</sup>, in which the patients were instructed to walk as quickly as possible, 30 meters from meter to meter demarcated in line straight, between two cones, for six minutes. Every minute, patients were encouraged by standardized sentences and the distance traveled was recorded. The predicted value for 6MWT was calculated based on Troosters<sup>15</sup>. For the SWT was followed the pattern described by Singh<sup>10</sup>, where the patients were instructed to walk around two cones separated by 10 meters away, for as long as possible, according to the speeds increased, under the supervision of a beep standardized, issued by a ring-CD, and finalized by the patient for their intolerance of maximum effort. The appraiser interrupted the test when the patient failed to reach the mark of two meters from the cone or present signs of physical exhaustion. The value of the maximum volume of oxygen consumption (VO<sub>2</sub>max) in ml / kg / min was obtained by the formula  $4.19 + (0.025 * \text{total distance})$ <sup>10</sup>. The 6MWT and SWT were performed on the same day, with at least thirty minutes. The measures distances were measured in meters. During the tests, the HR was monitored, in the midst of a half minutes, by frequencymeter polar Si placed first in 810 patients and the time spent during the entire test was recorded by a stopwatch, and from 6 minutes to 6MWT and variable in SWT. Muscle strength of lower limbs (quadriceps) was evaluated by test load by the method of 1RM<sup>12</sup>. Spirometry was performed with apparatus Pony Graphics (COSMED, Italy) and the technique applied in accordance with the standards described by the American Thoracic Society (ATS)<sup>14</sup>, spirometrics values were analyzed to slow vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1), forced expiratory flow (FEF), peak expiratory flow (PEF) and maximum voluntary ventilation (MVV), and were obtained directly after careful explanation and demonstration of how the patient should proceed. The predicted values were obtained according to Knudson<sup>16</sup>. The respiratory muscle strength was evaluated by the test of maximal respiratory pressures, following the protocol described by Black and Hyatt<sup>17</sup>, where the pressures were assessed maximum inspiratory and expiratory (MIP and MEP) after a thorough explanation, demonstrating the correct procedure the patient's technique. The highest values were used for analysis, while the predicted values were described by Neder<sup>18</sup>. The equipment used was an analogue-digital manometer (Makil, Brazil). Statistical analysis was used the program GraphPad Prism. The Shapiro-Wilks test was used to assess the distribution of variables. We used the Student t test to compare the means. The statistical significance was set for  $\alpha = 5\%$  ( $p < 0.05$ ).

**RESULTS**

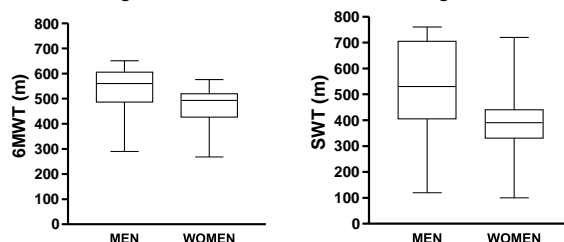
The characteristics of the patients are shown in Table 1.

**Table 1** - Physical and clinics characteristics

Characteristics	Pacientes em hemodialysis (n=58)	
	Mean $\pm$ SD	Mean $\pm$ SD
	Men (32) (n=32)	Women (26) (n=26)
<b>Physical data</b>		
Age (years)	46,1 $\bar{y}$ 12	50,5 $\bar{y}$ 12
Dry Weight (Kg)	69,4 $\bar{y}$ 11	62,9 $\bar{y}$ 15
Height (m)	1,7 $\bar{y}$ 0,1	1,6 $\bar{y}$ 0,1
BMI (Kg/m <sup>2</sup> )	24,7 $\bar{y}$ 3	24,9 $\bar{y}$ 5,9
Kt/V	1,2 $\bar{y}$ 0,2	1,4 $\bar{y}$ 0,2
<b>Duration of HD per session (hours)</b>	4,0 $\bar{y}$ 0,1	3,6 $\bar{y}$ 0,4
<b>Time in HD (months)</b>	47,6 $\bar{y}$ 44	45,8 $\bar{y}$ 40
<b>Spirometric values</b>		
FVC (%predito)	81,2 $\bar{y}$ 11	79,6 $\bar{y}$ 15
VEF <sub>1</sub> (%predito)	86,3 $\bar{y}$ 13	88,3 $\bar{y}$ 20
VC (%predito)	73,1 $\bar{y}$ 15	68,0 $\bar{y}$ 17
MVV (%predito)	87,0 $\bar{y}$ 19	72,0 $\bar{y}$ 23
PEF (%predito)	87,3 $\bar{y}$ 25	73,5 $\bar{y}$ 19
ETF (%predito)	86,4, $\bar{y}$ 35	82,6 $\bar{y}$ 33
<b>Values of respiratory pressure</b>		
MIP (%predito)	83,6, $\bar{y}$ 23	53,5 $\bar{y}$ 16
MEP (%predito)	124,7 $\bar{y}$ 33	88,3 $\bar{y}$ 30

Values expressed as mean  $\pm$  standard deviation. **BMI** = body mass index, **FVC** = FVC, **FEV1** = Forced expiratory volume in one second, **VC** = slow vital capacity, **MVV** = maximum voluntary ventilation, **PEF** = peak expiratory flow, forced expiratory flow = **ETF**, **MIP** = pressure maximal inspiratory, **MEP** = maximal expiratory pressure.

In the race of the patients 63.7% were white, 32.7% were black and 3.4% were yellow. 20.6% patients were smokers. Among men, 43.9% presented with ventilatory function is normal (FVN) and 56.1% with mild restrictive disorder (MRD). While in women, 59.5% were presented with FVN, DRL 27.0%, 10.8% moderate disturb restrictive (MDR) and 2.7% severe restrictive disorder (SRD). In 6MWT, the average of the values of the distances covered in men was 537.22  $\pm$  84m, with limits of variation between 290.0 meters and 651.0 meters, and among women was 468.68  $\pm$  74m with limits of variation between 268,0m and 576.0m (Figure 1). The HRmax obtained was 175 rpm in men and women 163bpm. The maximum speed achieved during the test was 2.53 m / s for men and 3.20 m / s by women. In the test SWT, the average of the values of the distances covered in men was 533.41  $\pm$  166m with limits of variation between 120.0 meters and 760.0 meters, and among women was 393.24  $\pm$  139m with limits of variation between 100,0m and 720.0 meters (Figure 1). The distance traveled in SWT was 40.1 m higher in men compared to women. The HRmax obtained during the test was 189bpm in 167bpm men and women. The maximum speed achieved during the test was 12.7m/s for men and 12.0 m/s by women. The average duration of the SWT was 7.93  $\pm$  1.9 min. The average values of  $VO_{2max}$  calculated by SWT was 17.5  $\pm$  4 ml / kg / min in men and 14.0  $\pm$  3 ml / kg / min in women.

**Figure 1.** Walk tests in six minutes (DP6min) and Shuttle Walk Test (SWT).

The result of test 1RM of the lower limbs for both sexes showed a mean value of 9.0  $\pm$  3kg in men with limits of variation between 5.0 kg and 16.8 kg and 5.5  $\pm$  2kg in women with limits of variation between 2.0kg and 12.0kg.

## DISCUSSION

The ability to exercise in patients with ESRD showed to be reduced. When comparing the figures obtained by 6MWT this sample, it was observed that the average was significantly reduced when compared to the levels required for healthy individuals<sup>19</sup>. According to Oh-Park individuals with ESRD walk less than sedentary individuals and a normal of their studies, the average values of distance was 405m for patients in HD<sup>20</sup>. Another survey showed that in healthy sedentary individuals the distances covered were 599.5m versus 505.0m in chronic renal patients in HD<sup>21</sup>. According to ATS the average distance traveled for the general population is 630m<sup>16</sup>. In this study, the average distance traveled was 530,8 $\pm$ 102m, including both genders. Troosters<sup>15</sup>, evaluated healthy subjects by the test 6SWT and had an average of 631.0  $\pm$  93m distances walked and Rendelmeier<sup>22</sup>, considers the proper distance of 700m in 6MWT test in normal individuals. This shows a reduction in exercise in chronic renal may adversely affect the prognosis of these patients. Of the patients who had the 6MWT lower than the predicted values (25.64%) noted that the  $VO_{2max}$ , was diminished for all. In patients who walked within the levels required for 6MWT (74.36%) the values of  $VO_{2max}$  are compatible with sedentary the same age range. By SWT, the average values for men and women was 475.7 $\pm$ 179m distance covered was similar to previous studies with chronic renal patients undergoing HD and lower when compared to that observed in the general population. In assessing the strength of the quadriceps muscle of the figures show the average is low, both among men and women. Previous studies have reported marked reduction in muscle strength of lower limbs in patients with ESRD, compared with normal subjects, limiting the ability funcional<sup>23,24</sup>. Van den Ham, compared the results of tests of muscle strength of the quadriceps isokinetic dynamometer in chronic renal patients in HD, and reported that these patients had muscular 25.5% lower than those saudáveis<sup>25</sup>. Another study showed that chronic renal patients evaluated by dynamometer showed reduced muscle strength when compared with individuals sedentários<sup>4</sup>. Leikis et al conducted a cohort study analyzing strength of the quadriceps muscle in chronic renal patients in stages 3 and 4 of the disease, followed by two years, and showed reduced muscle strength over time while maintaining the concentration of hemoglobina<sup>26</sup>. According to Coelho, the values of  $VO_{2max}$  in these patients are approximately half the expected values for healthy sedentary individuals in their study and the mean value of oxygen consumption was 78.61% of the average expected<sup>27</sup>. Sietsema found in his studies that  $VO_{2max}$  values of greater than 17.5 ml / kg / min is a strong predictor of survival in patients with ESRD<sup>28</sup>. In our study, the assessment of cardiorespiratory capacity ( $VO_{2max}$ ) is compatible with the literature, with an average of values of  $VO_{2max}$  for both genders, below the normal some below normal (16.1 $\pm$  4mL/Kg/min). As for respiratory muscle strength, on average are on expected, but many patients (39) were below

the normal, the MIP was 75.64% and 24.35% of MEP. This shows that patients in this sample showed changes in inspiratory and expiratory muscular strength. We can consider that the loss of muscle strength in patients with ESRD may be widespread, and may be associated with factors such as anemia causing dysfunction throughout the muscles esquelética<sup>29,30</sup>. As for the evaluation of lung function, several patients showed a decrease in values of FVC, FEV1, VC, MVV, PEF or ETF. The decline in FVC indicates decrease in lung volume and is related to disturbances and restrictive in this study we can see that 56.1% of men and 27.0% for spirometry show characteristics of mild restrictive disorder. The decline in VC was expected because it is a parameter that varies according to the change in the FVC. The MVV, which estimates the maximum breathing capacity, and is dependent on the strength muscular<sup>31</sup>, proved to be within the limit of normal (= 80% predicted) for men and below that figure for women.

### CONCLUSION

This study showed that this population there are limitation of exercise capacity in both genders, reduced muscle strength in the quadriceps, pulmonary function, respiratory muscle strength. The tests proposed for analysis of the capacity of exercise equipment are of low cost and easily applicable. Due to the values of VO<sub>2</sub>max obtained emphasize the need for a therapeutic approach for cardiopulmonary rehabilitation and metabolic that can use these tests to a rolling control.

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**EXERCISE CAPACITY ON HEMODIALYSIS PATIENTS****ABSTRACT**

**Introduction:** Despite the technical advancements found in the techniques of dialysis in recent years, patients with end-stage renal disease (ESRD) on hemodialysis show intolerance to exercise, due mainly to the decline in muscle strength as a result of dysfunction and atrophy of skeletal muscle and changes Metabolic. **Objective:** This study aimed to demonstrate the profile and assess exercise capacity of patients with ESRD on hemodialysis, in both sexes. **Methods:** Patients were evaluated using the tests of distance in six minutes (6MWT) and Shuttle Walk Test (SWT), spirometry, manometry, maximum oxygen consumption ( $VO_2\text{max}$ ) calculated by SWT and the quadriceps muscle strength by testing a repetition maximum (1RM). We studied 58 patients (32 male,  $48.2 \pm 13.2$  of mean age) on hemodialysis. The data were expressed as mean, standard deviations, medians, proportions and minimum and maximum values. We used the Student t test to compare mean differences between the sexes. The statistical significance was set for  $\alpha = 5\%$  ( $p < 0.05$ ). **Results:** The patients with ESRD had reduced exercise capacity, reduced muscle strength of the quadriceps, reduced lung function and respiratory muscle strength and low maximum oxygen consumption. **Conclusion:** The results suggests that the patients showed significant functional changes and can certainly be evaluated by the tests proposed, with low cost and high practicality. These tests can also be used in the evaluation and development of physical activities supervised.

Key words: chronic kidney disease, hemodialysis, exercise capacity

**CAPACITÉ D'EXERCICE CHEZ LES PATIENTS SUR L'HÉMODIALYSE****RÉSUMÉ**

**Introduction:** Malgré les progrès techniques dans les techniques de dialyse au cours des dernières années, les patients atteints de maladie rénale chronique (MRC) sur l'hémodialyse à montrer l'intolérance exercice, en raison principalement de la baisse de la force musculaire à la suite de dysfonctionnements et de l'atrophie du muscle squelettique et des changements Métaboliques. **Objectif:** Cette étude visait à démontrer le profil et l'exercice d'évaluer la capacité des patients atteints de MRC sur l'hémodialyse, dans les deux sexes. **Méthodes:** Les patients ont été évalués en utilisant les tests de distance en six minutes (DP6min) et test de marche de navette (SWT), la spirométrie, manométrie, la consommation maximale d'oxygène ( $VO_2\text{max}$ ), calculé par SWT et la force du muscle quadriceps par l'essai d'une répétition maximum (1RM). Nous avons étudié 58 patients (32 hommes,  $48,2 \pm 13,2$  de âge moyen) sur l'hémodialyse. Les données ont été exprimées en moyennes, écarts types, médianes, les proportions et valeurs minimales et maximales. Nous avons utilisé le test t de Student pour comparer les différences moyennes entre les sexes. La signification statistique a été fixé pour  $\alpha = 5\%$  ( $p < 0,05$ ). **Résultats:** Les patients co MRC a réduit la capacité exercice, la réduction de la force musculaire du quadriceps, réduit la fonction pulmonaire et la force musculaire respiratoire et une faible consommation maximale d'oxygène. **Conclusion:** Les résultats suggèrent que les patients ont montré d'importants changements fonctionnels et peuvent être évaluées par les épreuves proposées, avec un faible coût et pratique de haut. Ces tests peuvent également être utilisées dans l'évaluation et le développement des activités physiques supervisés.

Mots-clés: maladie rénale chronique, l'hémodialyse, l'exercice des capacités

**CAPACIDAD DE EJERCICIO EN PACIENTES EN HEMODIÁLISIS****RESUMEN**

**Introducción:** A pesar de los avances en las técnicas de diálisis en los últimos años, los pacientes con enfermedad renal crónica (ERC) en diálisis presentan intolerancia al ejercicio, debido principalmente a la disminución de la fuerza muscular como consecuencia de una disfunción y atrofia de los músculos esqueléticos y los cambios metabólicos. **Objetivo:** Demostrar el perfil y evaluar la capacidad de ejercicio de los pacientes con enfermedad renal crónica en hemodiálisis, en ambos sexos. **Métodos:** Los pacientes fueron evaluados utilizando las pruebas de la distancia en seis minutos (DP6min) y prueba de caminata de servicio (SWT), espirometría, manometría, el consumo máximo de oxígeno ( $VO_2\text{max}$ ) calculado por SWT y la fuerza muscular del cuadriceps por una repetición de pruebas máximo (1RM). Se estudiaron 58 pacientes (32 varones,  $48,2 \pm 13,2$  de media de edad) en hemodiálisis. Los datos se expresaron como media, desviación estándar, medianas, proporciones y valores mínimo y máximo. Se utilizó la prueba t de Student para comparar las diferencias de medias entre los sexos. La significación estadística se estableció para  $\alpha = 5\%$  ( $p < 0,05$ ). **Resultados:** Los estudios presentaran reducción de la capacidad de ejercicio, reducción de la fuerza muscular de los cuadriceps, reducción de la función pulmonar, de la fuerza muscular respiratoria y de consumo máximo de oxígeno. **Conclusión:** Los resultados sugieren que los pacientes mostraron importantes cambios funcionales y pueden ser evaluadas por las pruebas propuestas, con bajo costo y de alta practicidad. Estas pruebas también se pueden utilizar en la evaluación y el desarrollo de actividades físicas supervisadas.

Palabras clave: insuficiencia renal crónica, hemodiálisis, la capacidad de ejercicio

**CAPACIDADE DE EXERCÍCIO EM PACIENTES EM HEMODIÁLISE****RESUMO**

**Introdução:** Apesar dos avanços técnicos observados nas técnicas de diálise nos últimos anos, pacientes com Doença Renal Crônica (DRC) em hemodiálise apresentam intolerância ao exercício físico, decorrente principalmente, da diminuição da força muscular como resultado de disfunção e atrofia do músculo esquelético e alterações metabólicas. **Objetivo:** O objetivo deste estudo foi demonstrar o perfil e avaliar a capacidade de exercício dos pacientes com DRC em hemodiálise, em ambos os sexos. **Métodos:** Os pacientes foram avaliados através dos testes de distância percorrida em seis minutos (DP6min) e Shuttle Walk Test (SWT), espirometria, manovacuometria, consumo máximo de oxigênio ( $VO_2\text{máx}$ ) calculado pelo SWT e a força muscular do quadriceps pelo teste de uma repetição máxima (1RM). Foram estudados 58 pacientes (32 do sexo masculino;  $48,2 \pm 13,2$  de média de idade) em hemodiálise. Os dados foram expressos por médias, desvios-padrão, medianas, proporções e valores mínimo e máximo. Utilizou-se o teste t de Student para comparação das médias das diferenças entre os sexos. A significância estatística foi estabelecida para  $\alpha = 5\%$  ( $p < 0,05$ ). **Resultados:** os pacientes co DRC apresentaram reduzida capacidade de exercício, reduzida força muscular do quadriceps, reduzida função pulmonar e força muscular respiratória e de reduzido consumo máximo de oxigênio. **Conclusão:** Os resultados permitem concluir que os pacientes estudados apresentaram importantes alterações funcionais e podem ser avaliados seguramente pelos testes propostos, com baixo custo e alta praticidade. Estes testes podem ainda ser utilizados na avaliação e evolução de atividades físicas supervisionadas.

Palavras chave: doença renal crônica, hemodiálise, capacidade de exercício.