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Evaluation of the motor function of patients with renal failure undergoing hemodialysis: a cross-sectional study

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ABSTRACT

Introduction: Chronic Kidney Disease (CKD) is becoming a public health problem, due its chronic, progressive and irreversible kidney function. **Objective:** To evaluate the motor function of patients with CKD undergoing hemodialysis (HD) treatment. **Method:** a cross-sectional study carried out at João XXIII hospital in the city of Campina Grande-Brazil, from August to September 2016. Inclusion criteria were: subjects aged between 20 and 60 years old of both gender and who were undergoing HD treatment for more than 1 year. Those who presented cognitive and visual impairment, amputees, history of stroke or traumatic brain injury and underwent surgical procedure in the 6 months prior to the approach were excluded. Motor function assessment was performed by Motor Function Measurement Scale, which is divided into three dimensions: Dimension 1 (D1): standing position and transfers; Dimension 2 (D2): axial and proximal motor function; Dimension 3 (D3): distal motor function. To evaluate the muscular strength was used the Oxford scale and for the range of motion a goniometer was used. **Results:** The sample consisted of 20 patients. The correlation between D1 and D2 showed a significant positive association. Significant positive correlation was also observed on the strength of the lower limbs and D1 for all muscle evaluated. On the other hand, the strength of the upper limbs, relative to D2 and D3 showed a moderate positive correlation only between the flexors of the right shoulder and D2. Right elbow flexion was the only variable that presented a negative and moderate correlation with hemodialysis time. **Conclusion:** The strength and range of motion of the sample were lower than expected for people without pathology, in addition the evaluation methods present in this study were not sensitive to detect any dysfunction.

Keywords: Renal Insufficiency; Chronic; Renal Dialysis; Psychomotor Performance.

INTRODUCTION

According to Sesso et al.[(1)] the number of people with chronic kidney disease (CKD) in dialysis in Brazil was 42,695 in the year 2000. After 12 years this number reached 92,091, an increase of 3% per year. Furthermore, Spanaus et al.[(2)] claim that CKD is becoming a public health problem because of its chronic, unfavorable nature and its very high costs to the health system.

CKD is characterized by the progressive and irreversible loss of renal function defined by structural and/or functional abnormalities of the kidney for a period exceeding three months and it may also be characterized by structure or lesion in renal glomerular filtration rate lower than 60ml/min/1.73m^2[(3)]. This disease often causes kidney failure and in most cases requires the need for renal replacement therapy, such as peritoneal dialysis or hemodialysis, which increase survival and reduce morbidity and mortality[(2,4)].

Although CKD is a pathology that causes great damage to individuals, chronic renal failure, which is your consequence, presents in addition to the progressive and irreversible loss of renal function, impairment of the cardiovascular, nervous, musculoskeletal, respiratory, immune and endocrine. These factors may lead to impairment of patients' functional capacity and may be associated with the degree of impairment of the kidneys and underlying conditions[(5,6)].

Subjects with alterations in renal function present different symptomatologies, for example, low tolerance to physical exercises[(6)]. Therefore, it is necessary that individuals with chronic problems can minimize functional losses, in order to improve their autonomy to perform activities of daily living. For this to occur is necessary that motor function, flexibility, aerobic capacity, balance and cognitive functions must be intact[(7)].

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Considering the high prevalence of cases, the increasing incidence of people with CKD on dialysis treatment, possible changes in the functionality of these patients and the lack of standardization in the rehabilitation process due to clinical picture are different in these patients. The aim of this study was to evaluate the motor function of patients with CKD undergoing hemodialysis (HD) treatment.

METHOD

It is a cross-sectional study that followed the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[8]. It was carried out at João XXIII hospital in the city of Campina Grande-Brazil, from August to September 2016. This study was approved by the Research Ethics Committee of the Universidade Estadual da Paraíba (CAAE: 55297216.0.0000.5187).

Inclusion criteria were subjects aged between 20 and 60 years of both genders who were undergoing HD treatment for more than 1 year. Patients who presented cognitive alterations according to the Mini-Mental State Examination (MMSE), severe visual impairment, amputees, history of stroke or traumatic brain injury, and those who underwent a surgical procedure in the 6 months prior to the approach were excluded.

All the subjects were clarified about the research objectives and procedures to which they would be submitted and those who agreed to voluntarily participate in the study signed the informed consent form. Soon after, the sociodemographic data were collected through an interview to obtain information about age, HD time, presence of arteriovenous fistula in the upper limbs, history of previous pathologies and surgeries. All evaluations were done by a properly trained researcher.

Motor function assessment was performed using the Motor Function Measurement (MFM) scale. This scale is composed by 32 items that evaluate the static and dynamic functionality of individuals. It's score, by item, is graded from 0 to 3 and it is divided into three dimensions: Dimension 1 (D1) = standing and transfers; Dimension 2 (D2) = axial and proximal motor function; Dimension 3 (D3) = distal motor function[9].

To measure muscle strength was used the Oxford scale, which quantifies the muscle strength of the upper and lower limbs by 6 degrees (0 to 5), considering the "degree 0" is with no signs of muscle contraction and "degree 5" is normal strength. All measurements of the upper limbs (shoulder flexors, shoulder abductors, elbow flexors, wrist flexors and wrist extensors) and lower (hip flexors, knee flexors and knee extensors) were done manually[10].

In order to measure the range of motion of the upper and lower limbs of each patient, an evaluation with the universal goniometer (CARCI® São Paulo, SP, Brazil) to obtain the data relating to flexion and abduction of the shoulder, elbow flexion, and flexion and extension of the wrists[11].

Statistical Analysis

To evaluate the normality of the data, the Shapiro-Wilk test was used for all quantitative variables. The Pearson correlation test was then applied to quantify the association between MFM, D1 with D2 and D2 with D3, as well as to measure the association between upper limb muscle strength between D2 and D3 and strength muscle of the lower limbs with D1. Subsequently, to evaluate the influence of the variables with significance, using the Pearson test, the simple linear regression test was used, obtaining the data of Analysis of Variance (ANOVA) and the value of r^2. The results of the descriptive statistics are represented by means ± standard deviation. For the data processing, the software *SPSS* (version 22.0) was used, and the significance level was 5%.

RESULTS

The study sample consisted of 20 patients. Table 1 illustrates the characteristics of these subjects in relation to gender, age, hemodialysis time, arteriovenous fistula and the presence of chronic pathologies.

Regarding motor function, we observed the following results using the MFM scale considering the 3 dimensions: D1: 88.0 ± 16.9, D2: 97.7 ± 7.0 and D3: 95.9 ± 9.9. Table 2 shows the strength of the sample quantified by the Oxford scale.

The correlation test between D1 and D2 showed a significant positive association (r= 0.764; P <0.001), whereas in the analysis between D2 and D3 there was no correlation (r= 0.163; *P*=0.493). When the Pearson correlation coefficient between D1 and D2 was analyzed, it was observed that the variable D2 can directly influence the D1 variable, presenting values of r^2=0.764 and adjusted r of 0.583. In the analysis of variance was observed an F of 25.186 and P <0.001, showing a good correlation.

Regarding the strength of the lower limbs with D1, a significant positive correlation (p <0.05) was observed for

Table 1. Demographic data and sample characteristics.

Variables	Results
Gender^(n)	
Male	17
Female	3
Age (Mean±SD)	51.1± 9.99
Hemodialysis (Mean±SD)	3.92 ± 2.62
Arteriovenous fistula^(n) MSD	6
MSE	14
Hypertensive^(n) Yes	17
No	3
Diabetics^(n) Yes	15
No	5

Note: ^(n): absolute number; SD: Standard deviation; Age in years; Hemodialysis time in years; Yes: has hypertension/diabetes; No: does not have hypertension/diabetes.

Table 2. Illustration of the degree of muscular strength of the upper limbs by the modified Oxford scale.

Muscular Group	MSD (n=20)	MSE (n=20)		MID (n=20)	MIE (n=20)
Shoulder Flexors	4.55 (± 0.60)	4.50 (± 0.51)	Hip Flexors	4.75 (± 0.44)	4.70 (± 0.47)
Shoulder abductors	4.55 (±0.51)	4.35 (± 0.58)	Knee Flexors	4.70 (± 0.57)	4.60 (± 0.59)
Elbow Flexors	4.65 (± 0.48)	4.40 (± 0.59)	Knee Extenders	4.70 (± 0.57)	4.60 (± 0.59)
Fist flexors	4.65 (± 0.48)	4.65 (± 0.48)			
Fist Extensors	4.70 (± 0.47)	4.70 (± 0.47)			

Note: Values represented by mean and standard deviation.

all muscle groups evaluated. However, the strength of the upper limbs relative to D2 and D3 showed a moderate positive significant correlation only between the right shoulder flexors and D2, as shown in table 3.

The elbow flexion of the MSD was the only variable that presented negative and moderate correlation (r = -0.41) with the time of hemodialysis. Table 4 shows the values of the amplitudes of movement of the upper limbs.

Table 3. Correlation between the means of muscle strength and the mean of D1, D2 and D3 scores.

Muscular group	D1	Muscular group	D2	D3
R Hip FL	r=0.771*	R Shoulder FL	r = 0.642 **p= <0.01**	r = 0.390 p= 0.089
L Hip FL	r=0.649*	L Shoulder FL	r = 0.081 p= 0.736	r = 0.271 p= 0.248
R Knee FL	r=0.845*	R Shoulder ABD	r = 0.356 p= 0.123	r = 0.314 p= 0.177
L Knee FL	r=0.803*	L Shoulder ABD	r = -0.014 p= 0.953	r = 0.127 p= 0.594
R Knee EXT	r=0.845*	R Elbow FL	r = 0.439 p= 0.053	r = 0.364 p= 0.115
L Knee EXT	r=0.803*	L Elbow FL	r = 0.014 p= 0.953	r= -0.093 p= 0.697
		R Fist FL	r = 0.439 p= 0.053	r = 0.364 p= 0.115
		L Fist FL	r = -0.237 p= 0.315	r = 0.312 p= 0. 180
		R Fist EXT	r = 0.492 p= 0.027	r = 0.424 p= 0.062
		L Fist EXT	r = -0.211 p= 0.372	r = 0.371 p= 0.180

Note: FL: flexors, ABD: abductors; EXT: extensors; R: right; L: left; *p<0.05;

Table 4. Range of motion of the upper limbs.

Motion	MSD (n=20)	MSE (n=20)
Shoulder Flexor	143.45 (±35.66)	141.50 (±22.59)
Shoulder Abductor	115.50 (±20.20)	104.85 (±15.62)
Elbow Flexor	106.25 (±28.90)	124.45 (±12.17)
Fist Flexor	64.45 (±25.20)	63.80 (±17.68)
Fist Extensor	55.05 (±21.64)	61.40 (±16.77)

Note: Values in mean and standard deviation.

DISCUSSION

In this study, a survey of several physical variables such as range of motion and strength of upper and lower limbs was performed to verify if there were associations with the three dimensions present in the MFM. There was a significant positive correlation between D1 and D2. Similarly, a positive correlation between lower limb strength and D1 was observed in all muscle groups evaluated. However, the strength of the upper limbs relative to D2 and D3 showed a moderate positive significant correlation only between the right and left shoulder flexors. The elbow flexion of the MSD presented a negative correlation with the time of HD.

Muscle weakness is a frequent complication in patients with CKD[12] and according to Soares, Zehetmeyer and Rabuske (2007)[13] and Medeiros et al.[14], the strength of patients submitted to HD compared to the strength of subjects without pathologies is 30% to 40% lower. There are reports that the musculature of the lower and proximal limbs are the most affected[15]. The present study observed, in all muscle groups evaluated, a small decrease in the degree of strength. However, in the upper limbs, in addition to this decrease, there is a variation between the strength of the flexors and abductors of the shoulder and left elbow flexors, which presented lower values compared to the right upper limb.

A justification for this difference is related to the presence of arteriovenous fistula in the left upper limb in 70% of the patients with CKD, so it may have caused local physical restraint and discomfort, thus altering performance in activities[16]. Another justification would be the presence of some risk factors such as carnitine deficiency, malnutrition, myopathies, muscle atrophies, parathormone excess and toxicity, uremic toxins, vitamin D deficiency[17] and changes in muscle perfusion[18] which can result in people's lack of strength. Corroborating these findings of Moura et al.[6], also found gait alterations and decreased aerobic capacity of individuals with arteriovenous fistula.

In the evaluation of the three dimensions of MFM, D1 obtained a lower average of scores than others, suggesting a greater difficulty of the patients in standing tasks and transfers. Iwabe et al.[9], also found limitations in patients with type 1 myotonic dystrophy in these activities under the justification of lack of strength in the distal segments of the lower limbs.

Another finding was the positive correlation of the strength of the hip extensors with D1 and strength of the upper limbs with D2 and D3 under the justification of muscle strength being directly related to daily life activities and their completeness in order to be able to perform the different types of required tasks.[19] Despite the justifications for muscular function, some investigators report that frequent lesions that occur in the sensory and motor nerves in patients undergoing dialysis treatment may also have an influence on motor function[20]. In addition, advanced age and degree of renal impairment are factors that may also compromise neural functionality[21].

In relation to the range of motion of the upper limbs only the elbow flexion of the right upper limb showed a negative and moderate correlation with the hemodialysis time. This can be justified because of the disuse and the accomplishment of movements with small joint amplitude[22].

This study presented as limitations the size of the sample which may have made the results not representative. In addition, the use of motor assessment instruments in the population was not sensitive to detect disabilities.

CONCLUSION

Although the strength and range of motion of the specimen were smaller than expected for people with no pathology, the assessment methods used in this study were not sensitive to detect any statistically significant motor dysfunction. It is suggested the need for further studies regarding the consequences of arteriovenous fistula and its association with motor disorders.

AUTHOR'S CONTRIBUTION

All the authors worked actively for the study, revising the important intellectual contents, besides the analysis and interpretation of the data; Felipe Heylan Nogueira de Souza critically reviewed and approved the final version for publication. All of them are responsible for all aspects of the work ensuring the accuracy and integrity of the information contained therein.

CONFLICTS OF INTEREST

The author(s) declare that they have no competing interests.

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