Repercussion of physiotherapy intradialytic protocol for respiratory muscle function, grip strength and quality of life of patients with chronic renal diseases

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Submitted: 06/28/2010
Accepted: 08/22/2010

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This study was carried out at the Universidade Federal dos Vales do Jequitinhonha e Mucuri – UFVJM.

ABSTRACT

Introduction: Chronic kidney disease consists in the slow, progressive and irreversible loss in renal function and it is considered a social and economic problem worldwide, since it is linked to numerous diseases, as well as to higher public health spending. It is known that dialysis patients undergo a long period of restricted physical activity reflects in dysfunctions in various organical systems and in the quality of their lives. **Objective:** To verify the results of physical therapy intervention in patients on hemodialysis, for respiratory muscle function, grip strength and quality of life. **Methodology:** Experimental, non-randomized, quantitative and qualitative of a sample of 13 patients, 43.69 ± 9.28 years, on hemodialysis in the hospital Santa Casa de Diamantina/MG, selected by convenience. All patients were evaluated for maximal respiratory pressures (PI_{max} e PE_{max}) and peak expiratory flow (PFE), before and after physiotherapy, which consisted of 3 sessions per week for a period of 2 months weeks: exercises for upper limbs, with technique PNF and breathing diaphragmatic; strengthening exercises for lower limbs and use of exerciser ball. Statistical analysis was performed using the student-t test and significance value at $p < 0.05$. **Results:** Respective means for the variables before and after intervention were: PImáx (97.69 ± 28.3 cmH_2O e 98.46 ± 23.39 cmH_2O) p = 0.93; PEmáx (83.07 ± 31.19 cmH_2O e 88.46 ± 14.0 cmH_2O) p = 0.46 e PF (375.38 ± 75.23 L/min e 416.15 ± 57.37 L/min) p = 0.02. The dynamometer average pre intervention was: 57.23 ± 17.39 kgf and post intervention: 56.61 ± 16.09 kgf. In the SF-36, which evaluates the quality of life, improvement was observed in the eight domains, except the item 'vitality'. Of all the variables measured only the PFE was statistically significant. C**onclusion:** The proposed physical therapy protocol did not promote significant improvements in those variables, the statistical point, explaining in part the small sample size, time of protocol and proposed interventions.

Keywords: physical therapy (specialty), renal dialysis, quality of life, respiratory function tests.

[J Bras Nefrol 2010;32(4): 355-366]©Elsevier Editora Ltda.

INTRODUCTION

A new and challenging area for physical therapy is the physical and functional rehabilitation of patients with chronic kidney disease (CKD).[1] Chronic kidney disease can be defined, according to the Brazilian Society of Nephrology,[2] as the slow, progressive, and irreversible loss of renal function, a condition in which the kidneys have no functionality as a consequence of damage to the nephrons,[1-3] resulting in incapacity of the organism to maintain renal metabolic and hydroelectrolytic balance.[4-5] Renal dysfunction is characterized by a glomerular filtration rate (GFR) lower than 60 mL/min/1.73m^2, for more than three months, and, when GFR reaches levels lower than 15 mL/min/1.73m^2, the renal dysfunction is called end-stage CKD.[6]

Currently, CKD can be considered a severe public health problem, because of its high morbidity and mortality rates, and negative impact on physical and psychosocial aspects of patients advanced CKD[7-11]. According to data from the study by Coelho *et al.* (2008),[12] 96% of the dialyses in our country are performed at units of the Brazilian Public Unified Health Care System (SUS).

The most used renal replacement therapy is hemodialysis (HD),[4,6,11] a procedure in which blood is removed from the body and passed through an outer device called dialyzer. It requires repeated access to blood stream, which is usually provided by a surgically-created arteriovenous fistula.[13]

Despite its confirmed efficacy, alterations in the patients' quality of life (QOL), as well as in their physical and functional capacity, have been observed.[14-17] According to Soares *et al.* (2007)[4], HD is responsible for a monotonous and limited daily life. Jatobá *et al.* (2008)[6] have supported that statement, emphasizing that as a mandatory condition HD also significantly interferes with those patients' QOL.

In addition to the influence on the QOL, both dialysis and the disease itself interfere with almost all body systems (cardiovascular, immune, endocrine/metabolic,[12,10,14,18] and muscle skeletal)[19], the respiratory system being specifically the most impaired according to some authors.[3,6,12,14] The most commonly found pulmonary alterations are as follows: limitation to air flow; obstructive disorders; a reduction in pulmonary diffusion capacity; and a decrease in respiratory muscle endurance and strength.[3,6,14] However, measuring respiratory muscle strength and function allows the early diagnosis of those changes, helping in establishing supervised training protocols.[13]

Some authors have emphasized that, along with impairment of the respiratory system, the muscle structure alterations[19] caused by the build up of uremic toxins result in symptoms, such as fatigue, atrophy, cramps, asthenia[9,10,15,20], and general muscle weakness.[6]

Some studies have reported that physical exercise training programs have modified morbidity and survival of azotemic patients, causing metabolic, physiological, and psychological benefits.[1,8,9,11] When properly supervised, exercises performed during HD are indicated and safe for those patients,[1,8,9] although they have not become routine in dialysis centers.[11]

Thus, the present study aimed at assessing the results of a physical therapy intervention on the respiratory muscle function, grip strength, and QOL of patients undergoing HD.

Methods

Project design

This is a nonrandomized, quantitative and qualitative experimental study, conducted after being approved by the Committee on Ethics and Research of the Universidade Federal dos Vales do Jequitinhonha and Mucuri, under the definitive register number 047/09.

Place and participants

The convenience sample studied comprised initially 24 patients with CKD undergoing HD at the Santa Casa de Diamantina, state of Minas Gerais. All patients were initially invited to participate in the study after being informed about it. After accepting, they provided written informed consent.

The assessment for eligibility to participate in the study included the following:

a) Inclusion criteria:
- Both genders
- Age range from 20 years to 70 years
- Patients undergoing HD three times a week, at the Hemodialysis Section of the Santa Casa de Caridade, city of Diamantina, state of Minas Gerais

b) Exclusion criteria:
- Hemodynamic instability
- Fistula in the lower limbs
- Pathological fractures
- Cognitive deficit or lack of coordination to operate the devices required
- Uncontrolled Diabetes mellitus (DM) and systemic arterial hypertension (SAH)
- Underlying disease other than DM, SAH, CKD
- HD frequency lower than three times a week
- Low adherence to the intervention protocol

Experimental protocol

The individuals selected underwent a physical therapy assessment prior to HD, at the first contact with the researchers. That assessment was standardized and performed with an individual form containing identification, clinical history, and physical examination of the patients, including assessment of the respiratory function, grip strength, and quality of life (Annex 1).

Respiratory function assessment

Respiratory function assessment consisted in measuring the maximal respiratory pressures and peak expiratory flow (PEF). Respiratory muscle strength was assessed by maximal inspiratory and expiratory pressures (MIP and MEP, respectively), based on the residual volume and total pulmonary capacity, respectively, by use of a vacuum manometer (*Médica Brasil*) connected to a mouthpiece, which measures pressures from 0 to 300 cmH_2O for expiratory pressures, and from 0 to -300 cmH_2O for inspiratory pressures.

The Assess® Peak Flow Meter was used to measure PEF (L/min), 60 L/min being the lowest value possible, and 880 L/min the highest value possible. The device, which allows the physical therapist to assess the severity of bronchial obstruction, is connected to a mouthpiece, and the patient is instructed to perform a forced and rapid expiration from his/her total pulmonary capacity.

For the above-cited assessments, a nasal clip was used, three measurements were taken, and the highest was recorded. The volunteers had been previously instructed about the use of the devices. The patients were seated on the HD chair, maintaining head and feet in the neutral position. The procedure followed the protocols of the Guidelines for Pulmonary Function Tests, according to a report by Souza (2002).[21]

Assessment of QOL

The instrument used to assess the QOL was the 36-Item Short-Form Health Survey (SF-36), translated and validated in Brazil by Ciconelli (1998) (Annex 2).[22] It comprises 36 items that assess the following domains: physical function; physical role; bodily pain; general health; vitality; social function; emotional role; and mental health. The results of each item vary from 0 to 100, 0 corresponding to the greatest impairment and 100 to no impairment.

Assessment of grip strength

Grip strength was assessed by use of a hand dynamometer (North Coast) only in the upper limb without the fistula. The volunteers were placed seating on the HD chair, maintaining their shoulder in the neutral position and the elbow semiflexed. The device records five levels of strength intensity (kgf), and the mean of those levels is calculated. The instructions provided by Figueiredo *et al.* (2007) were followed.[23]

Interventions

The vital signs were collected every day prior to the intervention. After confirming the patient's stability, the patient was released for the exercise training. The protocol consisted of 25-minute sessions performed in the first two hours of dialysis, three times a week, for two months, adding up to 24 sessions. The sessions comprised upper and lower limb exercises performed with the patient in the seating, reclined position, according to the HD chair.

Upper Limbs

An exercise ball was used for the upper limb with the fistula, in three sets of ten repetitions, and 10-second intervals between the sets.

The upper limb without the fistula underwent the same training with the exercise ball in addition to the three following exercises:

1) exercises with 1-kg dumbbells following the diagonal movements of the Kabat Method associated with prolonged inspiration and expiration through the labial frenulum: outer flexion-adduction-rotation / outer flexion--abduction-rotation, and inner extension-abduction-rotation / inner extension-adduction--rotation, in the seating position;
2) shoulder abduction up to 90º, followed by horizontal adduction up to the median line;
3) elbow flexion and extension, in three sets of ten repetitions, with 15-second intervals between the sets and 20-second intervals between the exercises.

Lower Limbs

The lower limb training comprised the following three exercises:

1) alternate knee flexion and extension using 2-kg ankle weights;
2) alternate plantar flexion and dorsiflexion;
3) circumduction of the talocrural joint, in three sets of ten repetitions, with 15-second intervals between the sets, and 20-second intervals between the exercises.

After the two-month intervention, all variables were reassessed.

Statistical analysis

The descriptive analysis was performed with Excel 2007, and the statistical treatment and graphs by use of Prisma for Windows (version 4.0). The Student *t* test was used for paired measures before and after the physical therapy intervention. The statistical significance level of 5% was adopted ($p < 0.05$).

Results

Initially, the study comprised 24 individuals. However, 11 were excluded because of intercurrences in the dialysis treatment, hemodynamic instability, or low adherence to the physical therapy program.

Annex 1. Experimental protocol.

Individual form – Physical therapy in hemodialysis

Date: _____

Name: _____ Gender: ( ) F ( ) M

Date of birth: _____ Age: _____

Address: _____ Phone: ( ) _____

Profession: _____

Time of treatment: _____

Frequency of hemodialysis: _____

Dry weight: _____

Fistula site: _____

SAH: ( ) yes ( ) no

DM: ( ) yes ( ) no

Depression: ( ) yes ( ) no

Other pathologies: _____

Kidney transplantation: ( ) yes ( ) no When?:

Waiting list for transplantation? ( ) yes ( ) no

Lower limb edema: ( ) yes ( ) no When?

Cramps: ( ) yes ( ) no When?

Hypotension during HD: ( ) never ( ) sometimes ( ) frequently ( ) always

Diuresis: ( ) yes ( ) no

Fluid ingestion: ( ) up to 1L ( ) 1 to 2L ( ) more than 2L

Changes in daily life activities: :

Taking a bath ( ) yes ( ) no

Brushing teeth ( ) yes ( ) no

Getting dressed ( ) yes ( ) no

Feeding ( ) yes ( ) no

Personal care (shaving, brushing hair, putting on make-up) ( ) yes ( ) não

Physical activity: ( ) yes ( ) no Which? _____ Frequency? _____

Physical therapy: ( ) yes ( ) no

Smoking ( ) yes ( ) no For how long?: _____ Number of cigarettes per day: _____

Nutritional follow-up? ( ) yes ( ) no

Any change in diet? ( ) yes ( ) no

Which: _____

Medications in use (amount): _____

_____

Annex 2. SF-36 Questionnaire.

1 - In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
1	2	3	4	5

2 - Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same	Somewhat worse now than one year ago	Much worse than one year ago
1	2	3	4	5

3 - The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Activities	Yes, limited a lot	Yes, limited a little	No, not limited at all
a) Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	1	2	3
b) Moderate activities, such as moving a table, pushing a vacuum cleaner, sweeping the floor, or playing ball	1	2	3
c) Lifting or carrying groceries	1	2	3
d) Climbing several flights of stairs	1	2	3
e) Climbing one flight of stairs	1	2	3
f) Bending, kneeling, or stooping	1	2	3
g) Walking more than a mile	1	2	3
h) Walking several blocks	1	2	3
i) Walking one block	1	2	3
j) Bathing or dressing yourself	1	2	3

4 - During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
a) Cut down the amount of time you spent on work or other activities	1	2
b) Accomplished less than you would like	1	2
c) Were limited in the kind of work or other activities	1	2
d) Had difficulty performing the work or other activities (for example, it took extra effort)	1	2

5) During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
a) Cut down the amount of time you spent on work or other activities	1	2
b) Accomplished less than you would like	1	2
c) Didn't do work or other activities as carefully as usual	1	2

6 - During the past 4 weeks, how has your physical health or emotional problems interfered with your normal social activities with family, friends, or groups?

Not at all	Slightly	Moderately	Severe	Very Severe
1	2	3	4	5

7 - How much bodily pain have you had during the past 4 weeks?

None	Very Mild	Mild	Moderate	Severe	Very Severe
1	2	3	4	5	6

Annex 2. (cont.)

8 - During the past 4 weeks, how much has pain interfered with your normal work (including both work outside the home and housework)?

Not at all	A little bit	Moderately	Quite a bit	Extremely
1	2	3	4	5

9 - These questions are about how you feel and how things have been with you during the last 4 weeks. For each question, please give the answer that comes closest to the way you have been feeling.

	All of the time	Most of the time	A good bit of the time	Some of the time	A little bit of the time	None of the time
a) Have you felt full of energy?	1	2	3	4	5	6
b) Have you been a very nervous person?	1	2	3	4	5	6
c) Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d) Have you felt calm and peaceful?	1	2	3	4	5	6
e) Have you have a lot of energy?	1	2	3	4	5	6
f) Have you felt downhearted and blue?	1	2	3	4	5	6
g) Have you felt worn out?	1	2	3	4	5	6
h) Have you been a happy person?	1	2	3	4	5	6
i) Have you felt tired?	1	2	3	4	5	6

10 - During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little bit of the time	None of the time
1	2	3	4	5

11 - How true or false is each of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a) I seem to get sick a little easier than other people	1	2	3	4	5
b) I am as healthy as anybody I know	1	2	3	4	5
c) I expect my health to get worse	1	2	3	4	5
d) My health is excellent	1	2	3	4	5

The final sample comprised 13 patients, ten men (76.92%) and three women (23.08%), with a mean age of 43.69 ± 9.28 years. Their mean HD time until reassessment was 36.30 ± 26.10 months, and their mean number of physical therapy sessions was 22.53 ± 1.33 (Table 1).

Table 2 shows the respiratory measures assessed before and after the intervention. An increase in the MIP and MEP was observed after the intervention, but with no statistical significance. In contrast, the final PEF value showed a statistically significant increase.

The analysis of the SF-36 showed an improvement in all domains, except for "vitality", which was reduced. However, no item showed any statistically significant alteration. The pre- and post-intervention means, the percentage improvement, and the significance level are shown in Table 3 and Figure 1.

Table 1 Characterization of the sample

Patients	Gender	Smoker	Age	HD time (mounths)	Physical therapy sessions	BMI kg/m^2
1	M	N	43	12	23	20
2	M	N	48	102	19	24
3	M	N	46	56	21	22
4	F	N	46	38	24	21
5	M	N	46	38	23	37
6	M	N	44	31	23	26
7	M	N	45	7	24	21
8	M	N	59	40	23	32
9	M	EX	50	5	23	20
10	M	S	32	39	22	21
11	F	N	41	32	23	22
12	M	N	48	14	22	23
13	F	N	20	58	23	16
Mean and SD	M:F 10:3	S:N 1:13	43.69 ± 9.28	36.30 ± 26.10	22.53 ±1.33	23.46 ± 5.5

SD: standard deviation; HD: hemodialysis; M: male; F: female; BMI: body mass index; N: no; Y: yes; EX: ex-smoker.

Table 2 MIP, MEP, and PEF before and after the physical therapy intervention

Variables	Before PT	After PT	Difference %	p value
MIP	97.69 cmH_20 ± 28.32	98.46 cmH_20 ± 23.39	0.007	0.9334
MEP	83.07 cmH_20 ± 31.19	88.46 cmH_20 ± 14.05	0.05	0.4699
PEF	375.38 L/min ± 75.23	416.15 L/min ± 57.37	0.40	0.0292

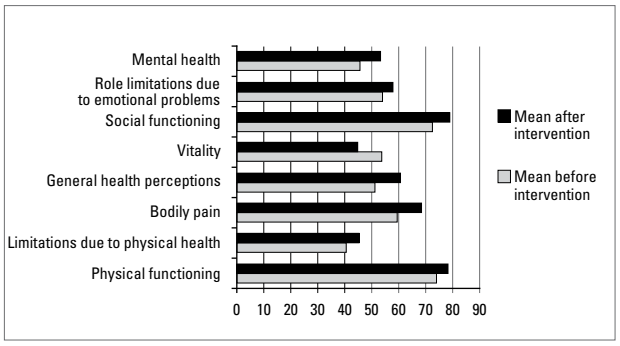
The values are shown as mean ± standard deviation. The difference in % of means before and after intervention. PT: physical therapy; MIP: maximal inspiratory pressure; MEP: maximal expiratory pressure; PFE: peak expiratory flow; p: significance level.

Table 3 Means of the SF-36 items before and after physical therapy intervention

Items	Mean before PT	Mean after PT	Difference %	p value
Physical functioning	73.84 ± 15.43	78.46 ± 25.44	0.046	0.4273
Role limitations due to physical health	40.38 ± 36.13	45.38 ± 38.26	0.05	0.7264
Bodily pain	59.23 ± 28.68	68.46 ± 21.74	0.092	0.3575
General health perceptions	50.92 ± 10.02	60.53 ± 13.64	0.096	0.0574
Vitality	53.46 ± 13.13	44.61 ±15.47	-0.088	0.0728
Social functioning	72.11 ± 24.01	78.84 ± 22.46	0.067	0.3156
Limitations due to emotional problems	53.81 ± 32.02	57.67 ± 38.86	0.038	0.7395
Mental health	45.23 ± 14.73	52.92 ± 10.60	0.076	0.0743

The values are shown as mean ± standard deviation. The difference in % of means before and after intervention. PT: physical therapy; p: significance level.

Figure 1. Scores of the means of each item of the SF-36 before and after intervention.



The grip strength was also reassessed and showed a decrease, when comparing pre- and post-intervention values, but the difference was not statistically significant (p = 0.8658) (Table 4).

Although some qualitative variables could not be objectively quantified during reassessment, several patients reported an improvement in lower limb pain, a decrease in the incidence of cramps, a greater feeling of well-being, and less fatigue on daily chores.

Discussion

Respiratory variables

The respiratory system is affected by both kidney failure and dialysis.[12] Alterations in the respiratory muscle function, pulmonary mechanics, and gas exchanges are frequent in patients with CKD .[6] Several studies have shown that such patients undergoing HD have a reduction in the respiratory muscle strength[3,6,7,14,16-18,20] and pulmonary function.[3,13,14,18,20]

On reassessment, the MIP and MEP values showed no statistically significant changes, which may have been due to lack of specific training to strengthen respiratory muscles. Rocha *et al.* (2010)[16] have reported that values greater than 60 cmH_2O clinically exclude respiratory muscle weakness, and they have also questioned the consensus that only patients with MIP below 60 cmH_2O need specific training for inspiratory and expiratory muscles. In that same study, the authors have reported reductions in MIP and MEP in patients with CKD undergoing HD when compared with healthy individuals. Some individuals of the present study had values different from those considered normal according to age and gender, but all values were greater than 60 cmH_2O during assessment.

According to Moreno *et al.* (2005)[24], respiratory pressure values in both healthy and non-healthy patients are influenced by body position. During the maneuver with the vacuum manometer, the position of the individuals of the present study depended on the inclination of the HD chair, which could be considered a factor influencing the results of the present study.

Parreira *et al.* (2007)[25], assessing the maximal respiratory pressures of healthy patients, have reported that measurements are influenced by the understanding about the maneuvers to be performed and by the will of the participants to cooperate and perform really maximum respiratory movements and efforts. That is in accordance with the study by Rocha *et al.* (2010)[16], who have discussed measurement as depending on the understanding and collaboration of the participants, and have concluded that learning the technique has a determinant effect, either positive or negative, on the results obtained. Those aspects can be considered as qualitatively influencing the results of the present study.

Marchesan *et al.* (2008)[7] have performed a phenomenological study about the results of a program of respiratory muscle strength training by using a vacuum manometer in patients with CKD undergoing HD. They have concluded that, based on the reports of the patients, the following was observed: a decrease in breath shortness; an improvement in health and in the feeling of well-being; less monotony; and greater adherence to the dialysis treatment. Although it could not be quantitatively measured, the participants in the present study reported a greater feeling of well-being and less fatigue on daily chores. Those same authors, in a previous study[26] with respiratory muscle training with vacuum manometer (20 inspirations and 20 expirations) for patients undergoing dialysis, three times per week, for 15 weeks, have reported a statistically significant increase in MIP and MEP. However, that was the only study recommending that procedure for respiratory muscle strengthening, and, thus, consensus still lacks.

Table 4 Variables measured with the dynamometer before and after physical therapy intervention

Variable	Before PT	After PT	Difference %	p value
Dynamometer	57.23 kgf ± 17.39	56.61 kgf ± 16.09	-0.62	0.8658

The values are shown as mean ± standard deviation. The difference in % of means before and after intervention. PT: physical therapy; p: significance level.

A program of physical exercise with patients undergoing HD similar to that of the present study has been conducted by Coelho *et al.* (2006).[12] Their protocol has also been performed three times per week for eight weeks. Unlike our findings, those authors have reported a statistically significant improvement in MIP and MEP values, but not in respiratory muscle endurance. It is worth emphasizing that they used aerobic exercise training with cycle ergometer and treadmill, in addition to specific respiratory muscle training with Threshold™ Inspiratory Muscle trainer. Despite their results, those authors have concluded that further studies on physical therapy interventions during HD are necessary.

Regarding PEF and considering the bibliography selected, only the study by Queiroz and Nascimento (2006)[13] has assessed pulmonary function in isolation by use of the Peak Flow Meter. Those authors, describing the profile of respiratory function in 15 patients undergoing HD, have projected the reference values for PEF according to patient's gender, age, and height, and have reported a decrease in values as compared with those predicted. In accordance with our study, 12 individuals (92.31%) had a PEF value below normality and only one (7.69%) had PEF values within the normal range.

The other studies have used spirometry, a technique that includes PEF measurement among other variables. Bianchi *et al.* (2009)[20] have assessed pre- and post-HD variables in their study, and have reported a significant improvement in PEF after a HD session, justified by the balance between fluid removal during dialysis and bronchoconstriction due to bioincompatibility of the dialysis membrane. After the physical therapy intervention, our study reassessed PEF, whose significant improvement was observed. That was supported by the literature.

In another study,[28] recommending a training with low inspiration followed by prolonged expiration to expand the chest of patients with chronic obstructive pulmonary disease for two months, the authors have reported an improvement in PEF. Yet in another study,[29] Lima *et al.* (2008) have reported an improvement in the mechanics of the respiratory muscles and PEF of asthmatic children after an inspiratory muscle training protocol, including a technique similar to that of the present study: diaphragmatic breathing, ten repetitions, with slow inspiration and expiration through labial frenulum. Those authors have also used specific training with the Threshold™ Inspiratory Muscle trainer.

We believe that the mean PEF can have shown a significant increase due to the capacity of improving pulmonary expansion through the simple and effective technique of diaphragmatic breathing. Considering that CKD has a progressive and chronic course,[2] the fact that the means of the maximal respiratory pressures have increased, even in a non-statistically significant way, can be considered a positive sign.

Quality of life

Patients undergoing dialysis treatment are known to have alterations in their daily biopsychosocial aspects. Several studies have confirmed that.[4,5,10,14,15,17] The standardized and most commonly used instrument to assess QOL in the bibliography researched is the 36-Item Short-Form Health Survey (SF-36). By using that questionnaire, Faria *et al.* (2008)[18] have assessed patients with CKD undergoing dialysis and have found an impairment in the "general health perception" and "vitality" domains of all individuals studied. Those authors have found no significant alterations in the "physical functioning" and "role limitations due to physical health" domains. In our study, impairment in the "vitality" domain was also observed, while, in all other domains, an improvement was evidenced.

Parsons *et al.* (2006),[5] through a five-month program of intradialytic physical exercise including a cycle ergometer and mini-stepper with a sample of 13 patients, have reported no significant difference in applying the SF-36 or the specific questionnaire for kidney disease (Kidney Disease Quality of Life Questionnaire). In addition, they have also reported no statistically significant correlation between both questionnaires. Those authors have concluded that the program proposed was an important adjuvant to dialysis treatment. Coelho *et al.* (2008)[11] and Martins *et al.* (2004)[17] have reported that the above-cited questionnaires are the most commonly used ones for patients with CKD. Based on that information, the present study chose to use the generic SF-36. Comparing the results of the study by Parsons *et al.* (2006)[5] with those of our study, we infer that the protocol suggested in our study was not used long enough to determine a statistically significant improvement in the SF-36 domains.

In addition, as our sample was limited to an experimental group, comparison with a control group was not performed, which could provide more results and conclusions. One study cited by Moura

et al. (2008)[8] has evidenced an improvement in the "physical functioning" and "mental health" domains of SF-36 in the experimental group, which underwent a physical exercise program comprising aerobic and muscle strength training for 16 weeks, as compared with the control group.

Soares *et al.* (2007)[4] have recommended an active exercise training for lower and upper limbs, consisting of 24 sessions, three times per week, similar to the protocol of the present study. After the intervention, they applied the SF-36 and observed an improvement in the "bodily pain" domain, worsening of the "physical functioning" domain in four of their seven individuals, which is not in accordance with our results that showed an improvement in the "physical functioning" and "bodily pain" domains. However, in those authors' results and ours, the items showed no statistically significant alteration. They have also observed impairment in the "vitality" and "role limitations due to physical health" domains, which were better in our study. Those authors have justified their findings due to the small size of the sample and lack of routine physical exercise programs in dialysis centers, which can also explain some results of the research. On the other hand, Reboredo *et al.* (2007)[10] have found a significant improvement in the "physical functioning", "general health perception", "vitality", and "social functioning" domains after three months of intradialytic aerobic training.

Finally, Corrêa *et al.* (2009)[9] have reported results similar to ours: an increase in the means of four of the eight SF-36 domains, however, with no statistical significance after specific training for lower limb strengthening.

Physical therapy studies about patients with CKD are still scarce[12]. Individuals with a more active life style are known to tend to have better self-esteem and a positive perception of psychological well-being, thus increasing their QOL.[9] Thus, physical rehabilitation programs have already proved to be beneficial to improve general health and QOL in patients undergoing dialysis.

Grip strength

Grip strength measurement is an important component of hand rehabilitation protocols. Patients with disorders in the upper limbs are most commonly assessed, before and after therapeutic procedures, by use of a dynamometer, which is a standardized instrument, recognized in the literature, showing good validity and reliability indices.[23] Patients on dialysis have impaired muscle structure and function, which can manifest as proximal muscle atrophy and weakness.[9]

In the intervention program proposed by Coelho *et al.* (2006),[12] the patients underwent 24 sessions for strengthening the hand flexor muscles by using the Digiflex hand exerciser, with a progressive increase in exercise weight and time, three times per week, for eight consecutive weeks of training. The exercise sessions preceded the HD sessions. The results obtained by those authors have shown a significant improvement in the strength of the hand flexor muscles. That finding differs from ours, which showed a non-statistically significant reduction in upper limb strength. Our results could have been influenced by the use of a light weight for the hand muscle and by the reduced number of repetitions.

One study cited by Najas *et al.* (2009)[27] has assessed 22 patients in their early fifties, who underwent an exercise program for muscle strength in the first two hours of dialysis, three times a week, for 31 weeks. The exercise for strength was performed with a weight of 50% of 1RM, in three sets of 15 repetitions of knee extension. The strength of the knee flexors increased, evidencing that exercise programs increase muscle strength and physical function. Corrêa *et al.* (2009)[9], assessing muscle strength, have observed that 83.3% of the studies report an increase in muscle strength after a three-month training of mild to moderate intensity in patients undergoing HD. Thus, the negative impact generated by the decrease in physical activity in that population was reduced.

A few studies have used a protocol for strengthening the hand flexor muscles to evaluate an effective method to increase the muscle strength of patients with CKD.[12,30] However, that is an important intervention, because the hand grip strength gives an idea of the total body muscle strength, since it correlates with the strength of elbow flexion and of leg and torso extension.[30]

All individuals in our study showed hand grip strength values above the borderline value considered as weakness, according to the study developed by Santos (2008),[30] who has proposed the threshold of strength deficit based on the BMI of his sample, which was also calculated for the present sample (Table 1).

We believe that the protocol suggested in the present study has not had an effect on the hand grip strength of the sample studied, because the technique with the exercise ball is volitive, depending on the maximum effort of the patient.

Physical exercises during HD

Evidence has suggested that low intensity physical exercise programs, adequately prescribed and performed during HD, are necessary for rehabilitation in CKD[1,9] and are healthy for patients, generating functional, physical, and psychosocial benefits.[5,7,9,11]

The need for the presence of a physical therapist in dialysis centers is emphasized by the diversity of muscle skeletal alterations in patients with CKD,[19,31] since that professional can significantly contribute in preventing, delaying, and improving several complications of those patients.[9] However, the literature has shown that different types of training have been performed with patients on HD, such as aerobic, endurance, and a combination of both, and a consensus about the best type still lacks.[32]

Regarding the physical exercise prescribed for respiratory muscles of the present study, Moreno *et al.* (2005)[32] have confirmed that the training of the upper limbs and their proximal segments has been considered fundamental in the pulmonary rehabilitation program, with positive and rehabilitating interference in the limitations of that system. In addition, training of the respiratory muscles provides greater capacity to physical exercise and greater tolerance to fatigue.[33]

Renault *et al.* (2009)[34] have compared the effects of Exercises of Diaphragmatic Breathing (EDB) and Incentive Spirometer (IS) in patients undergoing coronary artery bypass grafting surgery by using the following variables: forced vital capacity; first-second forced expiratory volume, maximal respiratory pressures, and oxygen saturation. Those authors have reported no significant differences in the respiratory variables studied in patients undergoing EDB and IS in the post-operative period of coronary artery bypass grafting surgery.

Some studies, through systematic literature review,[8,10,11] have reported the effects of physical exercises on dialysis patients. Moura *et al.* (2008)[8] have analyzed 13 articles involving aerobic physical exercise associated or not with muscle strengthening during HD. They have concluded that most protocols reported beneficial effects on aerobic capacity, muscle strength, and control of cardiovascular risk factors, but the way of applying those programs differed regarding intensity, frequency, and duration. Reboredo *et al.* (2007)[10] and Coelho *et al.* (2008)[11] have reported the same beneficial factors, in addition to improvement in the QOL of those patients. Nevertheless, they have reported that the routine prescription of exercises to that group of patients is still not common[10] and that further clinical trials are required.[11]

Limitations of the study

Some factors can be considered as limiting in the present study. The sample was reduced because several patients had hemodynamic instability or intercurrences in the dialysis treatment during the intervention. Considering the long time required by the second phase of methodology, a reduction in adherence was observed. That is justified by the fact that the great majority of patients lived in the neighboring cities and had to travel to get to the dialysis unit, where they arrived already tired. The results may have been influenced by the disposition of the dialysis machine, restricting the upper limb exercises, and by the patients' fear to undergo the physical therapy protocol during HD. Some important variables that could have interfered with the patient's clinical condition, and, thus, with the application of the physical therapy protocol, such as medications, hemoglobin, serum concentrations of creatinine, urea, potassium, calcium, erythropoietin, and types of dialytic membranes, have not been considered.

Conclusions

In conclusion, the physical therapy protocol proposed has not determined a significant improvement in the variables analyzed in patients undergoing HD from the statistical viewpoint, except for the PEF measurement. This is partially justified due to the small size of the sample, protocol time, and interventions proposed.

Most of the bibliography analyzed aimed only at assessing the alterations caused by dialysis treatment. Thus, the greatest difficulty in performing this study was to find reference values to compare with our results. Further studies about physical therapy interventions during HD are required.

Acknowledgements

We thank the staff of the Centro de Hemodiálise da Santa Casa de Diamantina, state of Minas Gerais, for their support and attention, and specially the patients, who believed in the protocol and reported an improvement, continuing up to the end of the intervention. We also thank Prof. Vanessa Pereira de Lima for her dedication, support, guidance, and teaching, which were of utmost importance for our professional formation and personal growth.

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