The Effect of Intradialytic Stretching Training on Restless Legs Syndrome and Sleep Quality in Hemodialysis Patients

Fauzi, Achmad1, Triaswati, Rusmai2

1Head of Research and Development, Department of Nursing, STIKES Abdi Nusantara, Indonesia
2Registered Nurse, Department of Nursing, Rumah Sakit Ketergantungan Obat Jakarta, Indonesia

Purpose: Intradialytic exercise could be a cornerstone of management in hemodialysis patients. The aim of this study was to evaluate the effect of intradialytic stretching training on Restless Legs Syndrome (RLS) and sleep quality among patients undergoing hemodialysis. Methods: This 8-week quasi-experimental design study involved adult patients undergoing chronic hemodialysis treatment for at least 3 months at the Drug Dependency Hospital Nephrology Unit in Jakarta. Nineteen participants were listed in each group, so a total of 38 participants were registered. Convenience sampling was used to select respondents. In addition, each respondent was asked to complete the International Restless Legs Syndrome Study Group (IRSSG) rating scale and the Pittsburgh Sleep Quality Index (PSQI). Results: The majority of respondents were women (55.3%), unemployed (71.1%), with duration of hemodialysis > 12 months (55.3%), and having hemoglobin levels less than 10 mg/dl (68.4%). The mean RLS before intervention was 1.74 (Standard Deviation [SD]=0.23) and after intervention, there was significant reduction in RLS score to a mean of 0.42 (SD=0.17) (p<.001). Similarly, mean sleep quality before intervention was 4.02 (SD=2.56) and after intervention, it reduced significantly to a mean of 6.16 (SD=3.18) (p<.001). Conclusion: Intradialytic stretching training could play a significant role in decreasing RLS and improving quality of sleep. Further studies with larger sample sizes and longer periods of intervention are required to validate our results and contribute to better patient outcomes.

Key Words: Intradialytic stretching training; Restless legs syndrome; Quality of sleep; Hemodialysis

INTRODUCTION

Restless Legs Syndrome (RLS) is a common neurological disorder, and can be primary or associated with other conditions. It is characterized by uncomfortable or abnormal sensations in the legs or arms, associated with an urge to move the limbs [1]. The symptoms usually occur at rest and at night, and can be temporarily relieved by movement [1]. In the general population, the prevalence of RLS ranges from 3% to 9%, depending on age and gender [2]. However, the prevalence of RLS in End-Stage Renal Disease (ESRD), which is an irreversible dysfunction demanding dialysis, is 66-70%, much higher than that in the general population [3]. The appearance of RLS in patients with ESRD affects quality of life adversely when compared to ESRD patients without RLS, likely due to poor sleep quality, insomnia, or depression [4,5]. Some medications such as dopaminergic and gabapentinoid class drugs have been reported effective in reducing RLS symptoms [6], but many patients are unable to stick to such pharmacological treatment because of side-effects such as vomiting, lightheadedness, fatigue, and irritability [7,8]. On the other hand, despite the facilities, employees, and time needed to complete an effective exercise training session, exercise therapy has many benefits and few side effects in patients.

Intradialytic exercise is physical exercise that is conducted during a hemodialysis session to enhance the strength and flexibility of the patient, thus promoting...
specific physical and mental health aspects [9]. The effect of intradialytic exercise is different from resistance or aerobic exercise and stretches, and uses different tools corresponding to the form of exercise [9]. The Kidney Disease Improving Global Outcomes (KDIGO) guidelines suggest daily exercise in patients with chronic kidney disease (at least 30 min/day, 5 times a week), while also considering their cardiopulmonary conditions and level of tolerance [3]. In addition, the exercise programs for multiple chronic conditions [10] are in accordance with the international Physical Activity (PA) guidance which is 150 min/week of moderate-intensity aerobic intensity [11]. Capitanini et al. further suggested that exercise routines should be comprehensively led by healthcare professionals in patients with hemodialysis [5].

Intradialytic exercise has beneficial effects on the general health and hospital stay of patients with hemodialysis [1,2]. Despite these advantages, few studies have assessed the impact of intradialytic stretching training on the level of RLS and sleep quality in hemodialysis patients, with mixed results [4,9,12-18]. Some studies revealed beneficial effects on solute clearance, especially in relation to uremic RLS, and poor sleep, depression and low quality of life [4,9,12]. The underlying mechanisms include elevated cardiac output and blood circulation to lower limbs, and capillary dilation of blood vessels, leading to the transport of even more solutes to the vascular compartment and the absorption of the dialysate tissue [13]. In addition, Aliasgharpour et al. [19] reported no statistically significant effect in 4 weeks, but significance was seen after 8 weeks of stretching exercises. There is evidence that a 6-month intradialytic exercise program was as effective as corresponding low-dose dopamine agonist therapy in minimizing RLS symptoms and reducing the level of depression, but only the dopamine agonist substantially improved quality of sleep [14-18]. Therefore, the effectiveness of intradialytic stretching training interventions in treating RLS and sleep in hemodialysis patients remains to be confirmed. The aim of this study was to evaluate the effect of intradialytic stretching training on RLS and sleep quality in patients undergoing hemodialysis.

METHODS

1. Study Design

This was a quasi-experimental study over 8 weeks that investigated the effects of intradialytic stretching workouts. Because of the complexity of the experiment, the researchers and dialysis patients could not be blinded from the intervention groups. The participants were sent for an evaluation of RLS and sleep quality before and after the intervention or control periods.

2. Setting and Sample

The study sample involved adult patients undergoing chronic hemodialysis for at least 3 months at the Drug Dependency Hospital Nephrology Unit in Jakarta. In both patient groups, the vascular dialysis control was an arteriovenous fistula. No patient had engaged in formal exercise classes or regular physical exercise (since nobody was allowed to engage in any physical activity) in the previous 6 months. Exclusion criteria were those with constraints preventing physical testing, any acute infectious or other inflammatory diseases, current malignancy with the exception of basal cell carcinoma, myocardial infarction or unstable angina over the last twelve months, existing heart or lung failure or liver disease, severe retinal diseases such as proliferative diagnosis and retinal hemorrhage, uncontrolled hypertension with systolic blood pressure ≥ 200 mmHg and/or diastolic blood pressure ≥ 120 mmHg, musculoskeletal and osteoarticular disorders; or other clinically determined conditions.

Sample size was calculated using power analysis, with the assumption of α for a 5% interval, a test power of 80%, and effect size of 0.50 for the strength program [1]. The total sample size was estimated to be 13 for each group. In order to prepared for potential dropouts, a total of 19 participants were recruited for each group, and in total there were 38 participants. A convenience sampling technique was used to select respondents.

We approached the head hemodialysis nurse, to whom we introduced the study purposes, inclusion and exclusion criteria, potential benefits, and efforts that would be taken to protect the subjects. The head nurse then informed eligible participants about the study prior to data collection. Participants were recruited during their clinical visit for hemodialysis. Subjects who agreed to participate were randomly allocated to the intervention and control groups.

3. Ethical Consideration

The research procedure followed the ethical standards of the Helsinki Declaration, and was accepted by ethical committee of the affiliated university (III/0123/KEPK/STIKEP/PPNI/JABAR/2019). All patients signed an informed consent form and were told that they had the right
to withdraw from the study at any point and for any reason. All the information was anonymized.

4. Instruments

The demographic questionnaire included gender, age, and working status. Clinical information included hemoglobin levels and duration of hemodialysis. In addition, each respondent was asked to complete the International Restless Legs Syndrome Study Group (IRLSSG) rating scale and the Pittsburgh Sleep Quality Index (PSQI). Permission to use these questionnaires was obtained prior to data collection.

The RLS was evaluated using the lower-limit clinical definition issued by the IRLSSG [20] comprising of 4 questions: (1) an intense desire to start moving the legs, typically followed or triggered by uncomfortable sensory experiences in the legs; (2) a desire to start moving, or the beginning or aggravation of uncomfortable sensations throughout periods of rest or lack of activity, such as lying down; (3) the urge to move, or unpleasant sensations partially or totally relieved by movement such as walking or stretching, as long as the minimal level of activity is continued; and (4) the tendency to move, or uncomfortable sensations partly or entirely reduced by exercise like walking or stretching, as long as the minimal level of action persists, but (4) with the attempt to move or the uncomfortable sensation stronger in the evening or perhaps, only occurring in the night or evening (1). Respondents with four "yes" were treated as having RLS. Respondents further performed the IRSSG Severity Scale with ten items to determine the severity of RLS symptoms. Patients were categorized into four classes of RLS ratings: mild (0~10), moderate (11~20), extreme (21~30), and very serious (31~40). The IRLS was found to have high levels of internal consistency, inter-examiner reliability, test-retest reliability over a 2~4 week period, and convergent validity [21].

The PSQI uses seven sections to assess sleep quality: subjective sleep quality, sleep latency, sleep length, chronic sleep efficiency, occurrence of sleep disruption, use of hypnotic-sedative drugs, and daytime dysfunction [22]. It is a 4-point Likert-type scale ranging from 0 (not at all) to 3 (three or more times a week). Responses to the 19 questions in the PSQI are scaled into seven components, which are totaled to provide a global PSQI score ranging from 0 to 21, with higher scores reflecting worse or poorer sleep quality. Participants with total PSQI scores of~5 were deemed to have sleep problems [22]. The PSQI is a widely used tool in research studies and clinical trials, and has been translated to several languages including Chinese, Spanish, German, and Hebrew, with comparable reliability and validity values. Cronbach’s $\alpha$ was .76 in the current study.

5. Data collection

The exercise program was monitored twice a week for 8 weeks. Each session was 15 minutes long. We monitored the adherence of patients to the exercise and stretching program, and any symptoms reported during the exercise. At rest and after training, arterial blood pressure and heart rate were monitored. Intense physical fatigue, chest pain, dizziness, pre-syncpe, tachycardia, and hypotension were among the conditions that necessitated interrupting the exercise.

Intradialytic stretching exercises including ankle plantar flexion, stretching the gastrocnemius, stretching the soleus, stretching the hamstrings, and stretching the quadriceps, were offered by trained nurses and researchers. Intradialytic stretching exercises were done during the third and fourth hours of hemodialysis. Intradialytic stretching exercises were conducted with the patients seated or lying down on a dialysis seat or bed.

The control group did not undergo intradialytic stretching training but instead received warm-up exercises. These involved: (1) neck stretching, (2) arm stretching, (3) shoulders up-and-down, and rotation, (4) chest and upper chest stretching, (5) single knee lift, and (6) limb stretch. After the study, the control group was provided with training equivalent to that of the experimental group.

6. Data Analysis

Data were analyzed by SPSS/WIN version 23. Descriptive statistics were used to explain respondents’ demographic information, as well as other study variables. The independent t-test and chi-squared test were used to compare the demographics of the samples in the intervention and control groups. A paired t-test test was used to evaluate scores before and after the test, and ANCOVA was used to compare the effect of the intervention in the intervention and control groups. Age and pre-test score were considered covariates. A $p$-value $<.05$ was considered significant.

RESULTS

Of the 38 participants who joined this study, 19 were placed in the intervention group and 19 were placed in the control group. The majority of respondents were women
Table 1. Demographic Characteristics of Studied Participants (N=38)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Intervention group (n=19)</th>
<th>Control group (n=19)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>44.95±9.37</td>
<td>46.26±11.04</td>
<td>.037</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>8 (42.1)</td>
<td>9 (47.4)</td>
<td>.179</td>
</tr>
<tr>
<td>Women</td>
<td>11 (57.9)</td>
<td>10 (52.6)</td>
<td></td>
</tr>
<tr>
<td>Working status</td>
<td></td>
<td></td>
<td>.673</td>
</tr>
<tr>
<td>Employed</td>
<td>5 (26.3)</td>
<td>6 (31.6)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>14 (73.7)</td>
<td>13 (68.4)</td>
<td></td>
</tr>
<tr>
<td>Duration of hemodialysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 12 months</td>
<td>9 (47.4)</td>
<td>8 (42.1)</td>
<td>.372</td>
</tr>
<tr>
<td>&gt; 12 months</td>
<td>10 (52.6)</td>
<td>11 (57.9)</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 mg/dL</td>
<td>14 (73.7)</td>
<td>12 (63.2)</td>
<td>.054</td>
</tr>
<tr>
<td>&gt; 10 mg/dL</td>
<td>5 (26.3)</td>
<td>7 (36.8)</td>
<td></td>
</tr>
</tbody>
</table>

M=mean; SD=standard deviation.

Table 2. Analysis of Restless Leg Syndrome Changes Before and After Intradialytic Stretching Exercise (N=38)

<table>
<thead>
<tr>
<th>Group</th>
<th>Categories</th>
<th>Before n (%)</th>
<th>After n (%)</th>
<th>Before M±SD</th>
<th>After M±SD</th>
<th>Difference M±SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Light</td>
<td>0 (0.0)</td>
<td>11 (57.9)</td>
<td>1.74±0.23</td>
<td>0.42±0.17</td>
<td>1.32±0.47</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>5 (26.3)</td>
<td>8 (42.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>14 (73.7)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Light</td>
<td>0 (0.0)</td>
<td>2 (10.5)</td>
<td>1.68±0.34</td>
<td>1.47±0.27</td>
<td>0.21±0.53</td>
<td>.104†</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>6 (31.6)</td>
<td>5 (26.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>13 (68.4)</td>
<td>12 (63.2)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

M=mean; SD=standard deviation; † p-value from paired t-test.
Note: p-value of the ANCOVA test was .001. Age and pre-test scores were considered as covariates.

(55.3%), unemployed (71.1%), with duration of hemodialysis more than 12 months (95.3%), and hemoglobin levels less than 10 mg/dL (68.4%). The average age of respondents in the intervention group was 44.95 years (Standard Deviation [SD]=9.37; range, 29~62 years). The average age of respondents in the control group was 46.26 years (SD=11.04; range, 29~62 years). There was a significant different in age distribution between the intervention and control groups (p=.037) (Table 1).

After undergoing intradialytic stretching exercises, about 57.9% of respondent reported light symptoms of RLS, while about 10.5% of control group respondents reported light symptoms of RLS. The mean RLS before intervention was 1.74 (SD=0.23) and after intervention, there was significant reduction in RLS with a mean=0.42 (SD=0.17) (p <.001). In the control group, the mean RLS score before intervention was 1.68 (SD=0.34) and after intervention, there was no significant reduction in RLS with a mean=1.47 (SD=0.27) (p=.104) (Table 2).

About 84.2% of respondents reported good sleep quality after receiving intradialytic stretching exercise, but in the control group, only 21.1% of respondent reported good sleep quality. The mean sleep quality before intervention was 4.02 (SD=2.56) and after intervention, there was significant reduction in sleep quality with the mean=6.16 (SD=3.18) (p <.001). In the control group, the mean sleep quality before intervention was 3.90 (SD=1.98) and after intervention, there was no significant reduction in sleep quality with a mean=5.19 (SD=2.17) (p=.042) (Table 3).

DISCUSSION

This study found that intradialytic stretching exercise could reduce RLS. Our finding was consistent with that of a study conducted by Aliasgharpour et al. [19], which reported that stretching exercises on patients’ feet in the first hour of dialysis (3 times a week for 8 weeks) effectively reduced RLS by the end of 6th week. However, no noticeable
improvement was observed in this analysis from the 6th week up to the end of the 12th week. Eight weeks of exercise may therefore suffice to prove the effectiveness of stretching exercises on the severity of RLS symptoms. In comparison, some researchers such as Ohayon and Roth [23] have shown that fairly intense physical activity before bedtime is significantly correlated with the severity of RLS symptoms. The present study also found that most respondents (71.1%) were unemployed and that physical exercise reduces the symptoms, as RLS symptoms appear or worsen with inactivity [23]. Therefore, patients on hemodialysis are particularly recommended to avoid intensive physical activities before going to bed. Having a moderate, daily exercise program would help reduce symptoms of RLS and we can thus monitor the effectiveness on patients. The exercise regimen is an economical intervention with few side effects, and can be performed without assistance. By educating patients, nurses can help relieve symptoms of RLS and thereby take a meaningful step towards healthcare goals.

Our research found that exercise with intradialytic stretching could improve quality of sleep. Previous systematic review found that exercise in patients undergoing hemodialysis effectively improved sleep quality; however, the type of intervention varied with options such as intradialytic cycling, yoga-based exercises, and aerobic exercise [12]. Numerous strategies explaining the relationship between exercise and sleep were suggested. The proposed mechanisms involved changes in body temperatures, changes in neurotransmitter production, enhanced energy usage/metabolism, exhaustion of the brain and nervous system, changes in mental state/symptoms of anxiety, changes in heart rate and variation in pulse rate, growth hormone production, brain-derived neurotropic factor secretion, enhanced fitness level, and changes in body composition [24]. While heavy workouts can exacerbate the symptoms of RLS, especially before sleep, and can lead to sleep disturbance and chronic insomnia, moderate or light exercises can be beneficial throughout the day to relieve RLS symptoms. Furthermore, the quality of sleep may be influenced by potential factors such as smoking, the use of alcohol or coffee, and psychological factors [25,26]. Furthermore, the probability remains that our findings may have been influenced by these specific factors. However, our approach has not monitored these factors; therefore, future research is required to identify those factors that may influence the quality of sleep in people undergoing hemodialysis.

There was some limitation to this study. Our analysis may have been inadequate to identify major changes in certain variables because of the nature of quasi-experiments, and due to the limited sample size. In fact, there was also potential selection bias in that those who agreed to participate in the study may have different characteristics than those who didn’t. Finally, there was a baseline age difference between groups which could have influenced our outcomes.

In conclusion, this research indicates that intradialytic stretching training could play a significant role in decreasing RLS and improving quality of sleep, but further large-scale studies and longer periods of intervention are required to validate our results and contribute to better patient outcomes such as quality of life and death. Nurses should provide education programs on intradialytic stretching, and educate and empower patients during hemodialysis exercises in compliance with developed protocol.

**CONFLICTS OF INTEREST**

The authors declared no conflict of interest.

**AUTHORSHIP**

Study conception and design - FA and TR; Data collection - TR; Data analysis and interpretation - FA and TR; Drafting of the article - FA and TR; Critical revision of the article - FA.
REFERENCES


