Complementary Therapies in Clinical Practice 34 (2019) 41–45

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

Effect of yoga on physical and psychological outcomes in patients on chronic hemodialysis

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A B S T R A C T

Introduction: Patients on chronic hemodialysis suffer from a myriad of problems associated with dialysis including increased cardiovascular disease, deconditioning, fatigue, sleep disturbances, anxiety and depression, and decreased health related quality of life. Yoga has been reported to have positive effects on distress and functional performance in patients with chronic diseases. The effect of yoga in patients on chronic hemodialysis is unknown. For the purpose of this study, papers were reviewed to determine the effect of intradialysis yoga on distress and functional performance in patients undergoing chronic hemodialysis.

Methods: This integrative review examined studies published in Pubmed, CINAHL and PsychINFO. The search terms included: yoga, hemodialysis, dialysis.

Results: Two RCTs met the criteria. Yoga showed improvement in several outcomes including: quality of life, pain, fatigue, sleep disturbance, physical function as well as a number of biochemical variables. Further well designed RCTs need to be conducted.

1. Introduction

Currently in the U.S. there are approximately 468,000 patients on chronic hemodialysis (HD). Medicare costs associated with caring for patients on hemodialysis (HD) is $26.2 billion [1]. Survival rate for patients on chronic HD is shorter than the general population (35%) and the prevalence of cardiovascular disease is double that of the general population [1]. Hypertension, poor physical functioning, psychosocial factors such as depression and lack of adherence to HD associated treatment regimens are associated with increased morbidity and mortality in this population. Health related quality of life has been found to be significantly lower among patients on maintenance HD than in the general [2]. Some of the symptoms can be reduced by increasing exercise such as yoga.

2. Background and significance

There has been an increased trend in the use of yoga in Western cultures as a means of exercise and training fitness. Yoga originated in India approximately 2000 years ago with the original purpose of personal and spiritual development [3]. In western cultures, it has expanded in promoting physical and mental health. With the growing interest of yoga for health, yoga therapy has evolved in the U.S. to treat various medical conditions. Yoga uses breathing, postures and meditation to help focus the mind and engage the body in low to moderate physical activity. Studies have found that yoga may be beneficial to patients with chronic diseases by improving their quality of life, cardiovascular risk factors, physical functioning and mood disorders [3,4]. Eda [4] found that yoga improved functional performance and decreased distress in patients with chronic disease including COPD, cardiovascular disease, breast cancer, obesity and diabetes mellitus.

3. Physical health

Patients on maintenance HD are much more sedentary than patients in the general population and require 9–12 h of treatment per week. The substantial amount of time required for HD treatment limits patients on HD from participating in exercise programs. According to Johansen, Kysen, Young, Hung da Silva and Chertow [5] physical activity declines by approximately 3.4% each month after initiation of HD. Physical fitness and physical function which involves the ability and capacity to perform activities of daily living is severely reduced in adults with chronic kidney disease, declining from 70% of the expected norm at early stages of chronic kidney disease to 50% with initiation of dialysis [6].

Sedentary behavior and poor physical fitness are associated with increased morbidity and mortality in this population. A systematic review conducted by Heiwi and Jacobson [7] found that all regular exercise training (regardless of type of exercise, intensity, length of intervention or supervision) improved aerobic capacity in adult patients (n = 928) in all stages of chronic kidney disease including HD. Various exercise interventions were associated with improved aerobic capacity, muscular functioning, cardiovascular function (resting systolic and diastolic blood pressure and heart rate), walking capacity and health

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https://doi.org/10.1016/j.ctcp.2018.11.004
Received 11 August 2018; Accepted 6 November 2018
1744-3881/

related quality of life as well as a reduction in chronic inflammation [7]. Positive effects were found after only three months of regular exercise. Heiwe and Jacobson [7] found there was a decrease of approximately 4–7 mm Hg in systolic BP after regular exercise training. This is a significant decrease because even a slight decrease (2 mm Hg) in systolic blood pressure in an average population can lower coronary heart disease, stroke, and all-cause mortality [7]. However, conclusions related to low intensity exercise interventions such as yoga remain unclear as only one study that used yoga as an exercise intervention was included in this review [8].

Despite the reported beneficial effects of exercise in the general population, exercise training may increase risk in patients on HD as they are predisposed to cardiovascular disease. Yoga is categorized as a low intensity form of exercise which may be ideal for patients on HD who have low physical function and exercise capacity. In addition, the cognitive component of attention and focus on relaxation, may have additional beneficial effects in patients on HD [3]. Research has also found that adherence to exercise training regimens was increased with supervision and decreased when individuals continued to exercise on their own [7,9]. These findings further reinforce the need to conduct exercise interventions during HD in order to improve adherence to exercise regimens.

Cardiovascular disease is the most common cause of death in patients on HD [1]. Patients on HD are 10–30 times more likely to die from a cardiac event than the general population and the likelihood is even greater in diabetic patients [10]. Patients on chronic HD have both traditional and non-traditional risk factors which include, anemia, bone mineral disease, hyperhomocysteinemia, inflammation, hypercoagulability and left ventricular hypertrophy that explain the increase cardiovascular mortality rate in this population [11].

A systematic review was conducted in healthy adults or adults (n = 800) at risk for CVD to determine the effect of yoga on cardiovascular risk [12]. The review found that yoga had favorable effects on diastolic blood pressure, HDL cholesterol triglycerides and uncertain effects on LDL cholesterol. However, the evidence from this review came from small, short term, low quality studies and should be considered exploratory and interpreted with caution. No RCTs have been conducted to determine the effectiveness of yoga for secondary prevention in coronary heart disease [13]. Although data demonstrates positive effects of yoga on primary prevention of cardiovascular disease, further studies should be conducted in patients with coronary heart disease and in the HD population.

4. Psychological health

In addition to physiological benefits, exercise has been shown to improve health related quality of life in patients on HD. Depression is the most common psychiatric illness among patients on HD, and the risk of depression among patients with end-stage renal disease (ESRD) was found to be four times higher than that in the general population [14] and it has been linked to increased morbidity and mortality in this population. Heiwi and Jacobson [15] found that 3–10 months of supervised exercise interventions (whether it be high or low intensity) can be used when attempting to decrease depression in this chronic kidney disease population. In a systematic review of 12 RCTs of 619 participants, Cramer, Lauceh, Langhorst and Dobos [16]; found that yoga could be considered an complimentary treatment option for patients with depressive disorders and individuals with elevated levels of depression. To date, no studies have been conducted that examine the effect of yoga on depression in the HD population.

Anxiety rates for patients on HD have also been reported to be high ranging from 30% to 50% [17,18].) Li and Goldsmith [19] conducted a systematic review of the literature to determine the role of yoga in reducing anxiety and stress and found benefits of yoga in relieving stress and anxiety in 25 out of 35 trials. Limitations of the study included small samples, lack of randomization and lack of control group. Further investigation into this relationship using large, well-defined populations, adequate controls, randomization and longer intervention duration was recommended before yoga is recommended as a treatment option. To date the effect of yoga on anxiety has not been examined in patients on HD.

Studies have demonstrated that 40–80% of patients undergoing HD suffer from poor sleep quality associated with a poor quality of life [20,21]. No studies were found to investigate the effect of yoga on sleep quality in patients on chronic HD. Studies have been conducted to explore the effects of yoga on sleep in other populations. Cramer, Lauche, Klose, Lange, Langhorst and Dobos [22] conducted a systematic review and found moderate-quality evidence to support yoga as a supportive intervention for reducing fatigue and sleep disturbances when compared with no therapy, as well as for reducing depression, anxiety and fatigue, when compared with psychosocial/educational interventions in women with breast cancer (n = 2166). A positive effect of mind body interventions such as yoga on sleep quality in adults was also found in a systematic review conducted by Neuendorf, Wahbeh, Chamine, Yu, Hutchinson and Oken [23].

Thus, we can conclude that yoga has been found to have positive effects on a number of physical and psychological outcomes in the general population and patients with chronic disease. The aim of this integrative review is to determine the effectiveness of yoga interventions on physical and psychological outcomes in patients on chronic HD.

5. Methods

5.1. Databases and search terms

A systematic search was conducted in the following data bases: CINAHL, Pubmed-Medline, and PsychINFO. Subject headings included “hemodialysis” OR “dialysis” and “yoga”. The search resulted in 23 citations. After removing duplicates, 18 were reviewed by title and abstract.

5.2. Inclusion criteria

Studies that were retained for review were articles that reported results of yoga interventions in patients on chronic HD, who used a randomized controlled trial or comparative quasi experimental design, measured physical or psychosocial outcomes and were published in English. After reviewing articles using inclusion, exclusion criteria two RCTs articles were identified as relevant and were included in the review.

6. Results

Yurtkuran et al. [8], conducted a RCT study (randomized by shift) in Turkey to determine the effect of a yoga-based exercise program on pain, fatigue, sleep disturbance and biochemical markers in patients on hemodialysis. The study was conducted at a Nephrology department affiliated with Uludag University in Turkey in 2004. The study was approved by the ethics committee of the university hospital and informed consent was obtained from each patient. There were 157 potential subjects in the HD unit. Sample randomization was conducted by a physician using a computer generated table of random numbers and 40 participants were randomized to one of two groups. This was a single blind study as the intervention was concealed from the evaluating physician.

Three participants were removed from the study due to poor adherence Thirty-seven clinically stable patients on HD were included and were randomized to one of two groups: the modified yoga based exercise group (n = 19) and the control group (n = 18). The patients had to be clinically stable and were on dialysis for at least 6 months prior to the study. Exclusion criteria included: use of analgesic or non-steroid

anti-inflammatory drugs, an average score of at least two out of ten on a visual analogue musculoskeletal pain scale. Unstable angina, congestive heart failure (grade II), significant cardiac valvular disease and conduction abnormalities, cerebrovascular disease, electrolyte imbalance, persistent hyperkalemia before dialysis, diabetes mellitus, active liver disease, arthritic or orthopedic problems limiting exercise and peripheral vascular disease.

The study was conducted over three months. Participants in the intervention group received the yoga intervention by a certified yoga teacher twice weekly. The duration of the yoga intervention started at 15 min/session and increased to 30 min/session by the end of the study. Exercises were done in the standing, sitting and lying position and modifications of various poses were made based on participant abilities. The intervention included a relaxation technique which involved standing and breathing exercises. The following postures were introduced: chest expansion, triangle, complete breathing, side bend, standing abdominal lift, back strength and half locust. Every session ended with relaxation using the corpse pose. Meditation was not included in this intervention. Participants in the control group did not receive the yoga intervention and were instructed not to change their life style for the duration of the study. In addition, participants in both groups were instructed by a physiotherapist to do active range of motion exercises for 10 min daily at home for upper-lower extremities and the spine.

At baseline, the following variables were collected: age, duration on hemodialysis, gender, BMI. Pain intensity, fatigue and sleep disturbance were measured using visual analogue scales at baseline and at the end of the study. Grip strength was measured in the non-dominant hand using a hand-held dynamometer and blood pressure was measured before and after exercises. The following biochemical variables were also collected at baseline and the end of the study: plasma urea and creatinine, plasma calcium, plasma alkaline phosphatase, phosphorous, plasma cholesterol, plasma HDL-cholesterol, plasma triglyceride, hematocrit and erythrocyte values.

The average age of the sample was 39.5 years, with the majority of the sample being female (60%) and average time on HD for the sample was 21.9 months. Most of the sample (91%) had hypertension and 80% had cardiovascular disease. According to the authors, baseline values between the two groups were statistically similar at baseline, although there were no statistical data to confirm this statement. At the completion of the study, there was a significant difference in pain intensity score ($p = .03$), fatigue ($p = .008$), sleep disturbance ($p = .04$) and grip strength ($p = .006$), plasma levels of urea ($p = .02$), creatinine ($p = .007$), cholesterol ($p = .02$) and hematocrit ($p = .03$) between the two groups. There were no significant changes in calcium, phosphorus, HDL-cholesterol and triglycerides between the two groups.

The study had a number of strengths. This was one of the first studies ever conducted that tested whether a modified yoga-based exercise regimen for 30 min twice weekly could improve pain, fatigue, sleep disturbances and grip strength as well as measure a number of biochemical variables in a chronic HD population over a 12-week period. The study also used both self-report and physiologic outcomes to test the hypothesis.

Limitations of the study included, lack of measurement of dialysis dose and adherence rates to yoga intervention, lack of quality of life assessment, and mood and cognitive measures. Also, it was not clear if the two groups were different at baseline as there was no statistical data to confirm. Generalizability of findings are limited due to small sample size, majority of the sample being female, and the study was conducted in Turkey. It is also difficult to confirm whether this difference in the findings was from the yoga intervention itself or indirect socialization from being part of a group. It is also difficult to determine if the effect in outcomes were due in part to the daily active range of motion exercises the participants were instructed to do.

Birdee and colleagues [3] conducted a RCT to assess the feasibility and safety of a 12 week intradialysis yoga intervention compared to a kidney educational intervention on promotion of physical activity in a sample of patients on chronic HD. Patients were recruited from an academic dialysis center in the U.S. between October 2012 to October 2013. Eligibility criteria included: on HD for ≥ 3 months, $Kt/V \geq 1.2$, age ≥ 18 years. Exclusion criteria included unstable cardiac disease, chronic lung disease requiring oxygen supplementation at rest or with exercises, active cerebrovascular disease, major depression, cognitive impairment and current participation in a mind body program. Each dialysis shift was randomized to either intradialysis yoga or the educational program using block randomization with varying block sizes. The study was approved by the institutional review board and signed informed consents were obtained from all patients.

Seventy-three possible participants from one chronic outpatient HD unit were screened for eligibility to participate and 56 (77%) were eligible for participate. A total of 31 (55%) consented to participate. Eighteen participants were randomized to the intradialyisis yoga intervention and 13 were randomized to the educational program. Five participants withdrew from the intradialyisis yoga group; two of the participants had no further interest in continuing and three withdrew due to a change in dialysis shift/time. The median age of the sample was 48 years, with equal representation of men and females in the sample. The majority of the sample (90%) were African American, overweight or obese and had hypertension (90%).

The intervention occurred three times weekly for 12 weeks. Participants had the opportunity to participate in 30–60 min of yoga during each session. Sessions were conducted during the first and second hour of dialysis. The yoga intervention consisted of slow body movements coordinated with breathing within the patient's comfortable range of motion. Examples of movement included ankle flexion or extension, knee flexion or extension, hip flexion or extension, hip abduction or adduction and arm flexion or extension. The chair was reclined for some exercises and upright for others. Participants were also encouraged to use meditation and visualization techniques to enhance relaxation. The yoga program progressed in a gradual sequence over 12 weeks. Participants were provided with modified practices if they were unable to perform a given exercise. When possible, participants were taught together as a group or in specific areas of the dialysis unit individually when not feasible. The yoga intervention was designed not to interfere with the regular HD routine. The protocol was developed by three yoga therapists. All yoga sessions were taught by four certified yoga teachers with close supervision by the principal investigator (PI). The PI provided guidance to yoga teachers to develop and maintain fidelity of the yoga intervention. Fidelity of yoga teaching was assessed using a checklist.

Participants randomized to the educational intervention comparison group were provided with a 12-week module educational course based on “Kidney School” which is a comprehensive free, educational curriculum for people with kidney disease and is available in printed and online formats (www.kidneyschool.org). Participants in this group received printed materials in binders and were able to complete 30–60 min of the educational curriculum during the first two hours of dialysis. Modules were divided across 12 weeks in an attempt to match the duration of the yoga session. A research assistant met with the participants at least weekly during the 12 weeks to answer questions and offer guidance on the modules.

Baseline and 12-week outcome measures were collected from the participants. The primary outcome measured during this study was the feasibility and safety of implementing intradialysis yoga among patients on chronic HD. Feasibility was determined through recruitment and adherence to the yoga session and was measured as frequency and duration (minutes) of participation in the yoga session. Yoga teachers recorded adherence during dialysis sessions. Feasibility of the educational program in the comparison group was also measured through measurement of the number of participants recruited and adherence to the curriculum based on number of modules completed and frequency and duration of participation (minutes). Adherence was reported by

educational program participants through self-report in a personal log.

The following outcomes and measurements were also measured in the study: health related quality of life (Kidney Disease Quality of Life (KDQOL) −36), fatigue (Functional Assessment of Chronic Illness-Fatigue), mood (Profile of Mood States, Center for Epidemiological Studies Depression Scale), satisfaction with dialysis treatment (ESRD: Patient Satisfaction), sleep quality (Pittsburg Sleep Quality Index) and disease-related self-efficacy (modified version of Perceived Diabetes Self-Efficacy Scale for patients on maintenance HD). Demographic and clinical variables that were collected included: age, gender, race, BMI and comorbidities. Biochemical variables that were collected included Albumin, Calcium, Kt/V, Potassium, Urea, Creatinine, Hgb, Phosphorous, PTH and Transferrin saturation.

Seventy two percent of the patients completed the 12-week yoga intervention and 100% completed the educational program. No adverse events related to the intradialytic yoga intervention occurred. Excluding absences from dialysis, 60% of participants practiced yoga at least twice weekly. Participants in the educational program completed a median of 30 sessions (83% participant frequency).

Overall, both interventions reached recruitment goals, with less than targeted goals for completion of study and adherence to intervention rates. As the major intent of the study was to determine feasibility and safety of the 12-week intradialysis yoga intervention. The study was not powered to detect a difference in outcomes between the two groups, and results should be analyzed with caution [3]. The intradialysis yoga group had positive changes in the physical component summary of the KDQOL (18% improvement), effects of Kidney Disease, Burden of Kidney disease and minimal change in mental component summary and symptoms subscales. The educational group had positive changes in the Mental Component Summary and Symptoms, negative changes in the Effects of Kidney disease and minimal to no changes in the Physical Component Summary of and Burden of kidney Disease subscales. There was no significant difference in KDQOL between the two groups. It also appeared that participants in the yoga intervention group indicated an increase in Burden of Kidney Disease compared to the educational group.

This study suggested that the Kidney School intervention provided a reasonable comparison group to intradialysis yoga with respect to matching the time and attention of the yoga group. Overall, the study provided feasibility data to increase follow-up and adherence for future studies. Based on the findings, adherence to intradialysis yoga was below the goal of 66% with only 60% practicing at least twice weekly. Findings from this study revealed that chronic nausea and vomiting limited participation in the study. The authors recommend excluding participants with chronic nausea and vomiting in future studies to increase participation. Also, many patients missed participation in a yoga session due to being sleepy or sleeping. The authors recommend offering the intervention immediately at the beginning of the HD session before the patient falls asleep or becomes drowsy.

Limitations of the study included variability in yoga teacher intervention. Some of the participants were taught yoga in groups and some were taught individually, which may have resulted in variability in attention from yoga instructors or between research participants. The small sample size lacked power to measure differences in outcomes between the two groups. The study also lacks generalizability as it was conducted in a single dialysis unit. The study did not assess nutritional status which may have affected outcomes as well. Results from the Birdee and colleagues study [3] were difficult to analyze as outcomes were not reported individually as originally outlined (depression, patient satisfaction with dialysis treatment, sleep quality and disease related self-efficacy). The outcome variables were summarized together under the headings of Burden of Kidney disease, Symptoms and Effects of Kidney Disease, however there was no explanation of how these categories were developed.

7. Discussion

Patients on chronic HD suffer from many physical and psychological disorders associated with HD. Yoga is an intervention that has been found to be effective in improving outcomes in many comorbid diseases. In this integrative review, it was found that there were very few studies that investigated the effect of yoga in patients on chronic HD. Although there were limitations to both studies, the findings do lend support that yoga can improve physical and psychological outcomes in patients on chronic HD.

Yoga is considered a low intensity exercise that has been found to be ideal for patients on dialysis. Studies have found that even low intensity exercises can improve functional capacity, muscular functioning and health related quality of life in patients in all stages of CKD including HD [7]. The two studies reviewed for this review indicated that a yoga intervention was feasible and improved a number of physical outcomes: pain intensity, fatigue, grip strength and the physical component of the KDQOL scale [3,8]. Positive results for the physical component summary of the KDQOL show promise and need further exploration as a 5 point increase in the physical component summary has been correlated to a 10% increase in survival in patients on chronic HD [24].

Yurkuran and colleagues [8] found beneficial effects on the fatigue and sleep disturbance outcomes, however Birdee and colleagues [3] did not find significant changes in the mental component summary and symptoms subscales. Results from the Birdee and colleagues study need to be reviewed with caution, as the study was underpowered to detect differences between groups. Since depression and anxiety are so prevalent in patients on HD, and positive effects of yoga on these outcomes have been found in other populations [16,19], future studies should be conducted to determine the effect of yoga on depression and anxiety in patients on HD.

There was also improvement in cholesterol levels that were observed in the study conducted by Yurtkuran and colleagues [8] which could show promise for possibly decreasing cardiac risk in this population. Studies have found that yoga reduced diastolic blood pressure, triglycerides, high-density lipoprotein (HDL), cholesterol in healthy adults or those at high risk of CVD [12]. Since patients on HD are at a very high risk for CVD, further research investigating the effect of yoga on cardiovascular risk factors such as cholesterol, heart rate, blood pressure should be conducted.

8. Conclusion

Results from this present study indicate insufficient research data from randomized controlled trials data about the effect of yoga on physical and psychological outcomes in patients on HD. Findings from these studies suggest that yoga might benefit patients on HD by improving physical and psychological outcomes. Yoga has potential utility as a complementary and alternative therapy for chronic diseases and can help patients on HD improve a number of health outcomes. A more detailed investigation of the effects of yoga in patients on HD is warranted.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2018.11.004.

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