Intradialytic exercise: A feasibility study

Angela Henson, Brigid Gillespie, Alexandra McCarthy, Lisa Finch, Sharon Chatterton, Jan Devlin, Carmel Hawley and Linda Orazio

Henson, A., Gillespie, B., McCarthy, A., Finch, L., Chatterton, S., Devlin, J., Hawley, C. & Orazio, L. (2010). Intradialytic exercise: A feasibility study Ren Soc Aust J, 6(1), 11-15.

Submitted July 2009 Accepted January 2010

Abstract

Background: Exercise is known to improve mental and physical functioning and to improve quality of life. The obstacles faced by individuals with chronic kidney disease on maintenance haemodialysis include increased levels of fatigue, decreased motivation, and the inability to schedule exercise around daily activities and dialysis schedules.

Aim: This pilot study was undertaken to determine the feasibility and potential efficacy of an individually-tailored exercise program for in-centre haemodialysis patients.

Method: A 16 week program was designed and evaluated in relation to changes in physical capacity, the extent of exercise undertaken, and quality of life indicators.

Results and Conclusion: The resultant recommendations regarding the level of motivational support, the time and physical requirements in implementing an exercise program will provide useful information for others embarking on similar studies.

Key Words
haemodialysis, exercise, renal, chronic kidney disease, nursing

Introduction

Haemodialysis (HD) patients' quality of life (QoL) is significantly impaired in comparison to the healthy population, and those who have received a renal transplant (Cheema & Singh, 2005). This is often attributed to high levels of fatigue, which encompasses physical and mental exhaustion, reduced motivation and reduced activity (McCann & Boore, 2000 & Kutner, 2007). Despite patients commonly having poor exercise tolerance, some form of exercise is believed to improve physical and mental functioning in dialysis patients and thereby enhance their QoL (Moug et al, 2003; Painter et al 2004; Bennett et al, 2007).

The physiological benefits and the QoL impact of intra-dialytic exercise are still a matter of debate. Some authors suggest no changes result after commencing an intra-dialytic exercise program (Parsons et al, 2004) whilst others note improvements (Cheema & Singh, 2005; Painter et al, 2000). At a minimum, it appears that intra-dialytic exercise may provide a supportive supervised environment where additional encouragement and counselling are available (Painter et al, 2000). Unfortunately there are difficulties involved in implementing and sustaining exercise programs (White & Grenyer, 2006), with the greatest challenges pertaining to the maintenance of an 'exercise culture' (Bennett et al, 2007). It is also difficult to maintain patient motivation in the longer term, given the known link between fatigue, motivation and depression (Kutner, 2007; Molsted et al., 2004).

It has been demonstrated that intra-dialytic exercise can be effective in people with chronic kidney disease (CKD) (Bennett et al, 2007; McMurray et al, 2008). We examined these studies to inform the development of an exercise intervention in HD patients. Specifically, this current study was to determine the feasibility of implementing a 16 week exercise intervention for haemodialysis patients in our setting, and to determine if the chosen tools were sensitive to the detection of fatigue and QoL in this group of patients. Our experiences in implementing an intra-dialytic exercise program in a large tertiary hospital are discussed, identifying strategies for success and pitfalls to avoid. If such programs are to succeed, they need to be well planned and extensively resourced in order to support long-term sustainability.

Author Details: Angela Henson, RN, Grad Cert Hlth Mgt, Grad Dip Women's Hlth, Grad Dip Nephrology, MN, is a Renal Educator – Staff Education (Clinical Nurse Consultant) at the Princess Alexandra Hospital, Brisbane. Brigid Gillespie RN BHlth Sc (Hons) PhD is a Visiting Research Fellow, Princess Alexandra Hospital & Lecturer & Research Ethics Adviser (REA) School of Nursing & Midwifery, Griffith University, Gold Coast Campus. Alexandra McCarthy RN, BN, MN, PhD is a Senior Lecturer, Queensland University of Technology, Kelvin Grove. Lisa Finch RN, is a Clinical Nurse, Haemodialysis Unit, Redlands Hospital, Cleveland. Sharon Chatterton B. Phys is a Senior Physiotherapist, Princess Alexandra Hospital, Brisbane. Jan Devlin RN. is a Clinical Nurse, Haemodialysis Unit, Redlands Hospital, Brisbane. Carmel Hawley MB.BS (Hons.), M Med.Sci., FRACP is a Renal Consultant, Department of Nephrology, Princess Alexandra Hospital, Brisbane. Linda Orazio B. Hlth Sc. (Nutrition & Dietetics) (Hons.) is a Renal Dietician, Princess Alexandra Hospital, Brisbane

Correspondence to: Angela Henson, c/- ARTS Building, Princess Alexandra Hospital, Ipswich Road, Woolloongabba 4102 Angela_Henson@health.qld.gov.au

Method

Participants

The population of interest for this study were medically stable haemodialysis (HD) patients from a chronic dialysis unit in Queensland, Australia. Our sample was drawn from an in-center HD unit in Brisbane which currently treats a total of 110-115 chronic dialysis patients, and equates to approximately 50-55 patients per day. In keeping with the feasibility focus of the study, the aim was to recruit only a relatively small sample of 15 participants. All patients who met the following inclusion criteria were invited to participate: attending in-centre haemodialysis three times per week; had been treated with haemodialysis for more than three months (Cheema & Singh, 2005); received medical clearance by the Renal Consultant to participate; able to read and write English to complete questionnaires; and had a serum phosphate level greater than 1.6mmol/litre on three consecutive occasions. It was initially proposed these patients may benefit the most from exercising, and would provide a feasible workable number for this pilot study, considering resource and equipment restrictions. Patients were excluded if they had evidence of recent myocardial infarction, uncontrolled hypertension, unstable angina, severe uncontrolled diabetes, symptomatic left ventricular fibrillation, neurological or cognitive disorders with functional deficits, musculoskeletal problems, in line with previously published criteria (Cheema & Singh, 2005). The study was approved by the Human Research Ethics Committee of the facility, and informed consent was obtained from all participants.

Intervention

All participants underwent an individualized tri-weekly intra-dialytic timed pedal exercise program using a bicycle ergometer for 16 weeks. Several bicycles were already present within the unit but were not being utilised, for economic and practical reasons it was considered more feasible to continue with this type of equipment. Participants were assessed four weeks prior to, prior to and immediately following the exercise intervention. Participants were reviewed weekly by a physiotherapist to individualize the exercise program.

Exercise was scheduled within the first two hours of dialysis in order to encourage motivation and prevent hypotension (Parsons, 2004; Martin & Gaffney, 2003). Most participants exercised between 2 and 15 minutes, had a 5-10 minute rest, and then exercised for another 2 to 15 minutes dependent on their individualised program, while some exercised for 30 minutes continuously. An 'exercise nurse' familiar with the proposed trial was allocated to exercising patients on each shift and participants were verbally reminded at commencement of dialysis regarding their exercise program, and an alarm clock was used to time the exercise period.

Outcome measures

The feasibility of conducting an intra-dialytic exercise program was determined by ease of recruitment and completion rates. The effect of the intra-dialytic exercise program was measured using fatigue, QoL and functional capacity [six minute walk test (American Thoracic Society, 2002) and timed sit-to-stand (Csuka & McCarthy, 1985)]. In addition, certain measures were undertaken throughout the study period to monitor progress. In this study, the MFI-20 was administered fortnightly, and the EQ-5D monthly. These time frames were chosen in order to achieve a balance between an adequate number of time points needed to provide valid longitudinal data whilst maintaining patient interest.

(i) Fatigue was measured using the multi-dimensional fatigue inventory (MFI-20) prior to the commencement of the exercise program, to determine the patient's baseline fatigue level, and fortnightly during the exercise program to determine the impact of exercise on perceived levels of fatigue. The MFI-20 has a five-point response Likert scale ('1 – yes that is true' through to '5 – no, that is not true') to indicate the degree of agreement to each of the nine statements with higher scores indicating greater fatigue levels. Fatigue was categorised into the following components: general fatigue, physical, reduced motivation and mental. The scale is parsimonious and simple to complete. The MFI-20 has been used across diverse population groups, and has established reliabilities of 0.86 (group level) to 0.90 (individual variations) (Smets et al,1995).

ii) Quality of life was measured using the EQ-5D Health Questionnaire (2006) prior to and monthly during the intervention period. This tool measures quality of life across five dimensions including mobility, self-care, usual activities, pain and discomfort, and anxiety and depression. For each dimension participants selected from the following response options; "no problems", "moderate problems" or "severe problems". This results in a possible 243 various combinations with pre-determined weightings. Additionally, the questionnaire contains a visual analogue scale (VAS) that asks participants to indicate how "good" or "bad" their health is 'today'. The anchors for the VAS are "0" (worst imaginable health state) to "100" (best imaginable health state). This scale has been used extensively in patients with CKD as a measure of general health and generic health-related QoL (Gerard et al, 2004). The EQ-5D is well suited to patients with major morbidity, despite its relative insensitivity to variations in well-being at the upper ends of the health continuum (McDowell, 2006). Higher response rates and less missing data has been seen with EQ-5D than other QoL tools, and hence our rationale for inclusion (Gerard et al, 2004).

iii) Functional ability was measured using the six minute walk test (American Thoracic Society, 2002) and timed sit-to-stand (Csuka & McCarthy, 1985) by the physiotherapist prior to, and immediately following the exercise program in line with like studies (Painter et al, 2000; Headley et al, 2002).

iv) The dietary assessment was undertaken prior to, mid-way, and immediately following the intervention to assess variances in nutritional intake and status.

Data Analysis

Recruitment and completion rates were calculated to determine the feasibility of the study, and the exercise intervention was evaluated based on response rates, scale scores, means and standard deviations of chosen tools.

Results

Feasibility of intra-dialytic exercise

The study was expected to take 6 months to complete; however, it took more than 6 months to recruit participants. We expected a manageable 'pool' of 15 participants; however, only a small percentage of the total patients of the unit had consistently elevated phosphate levels (greater than 1.6mmol/L). Thirteen participants were recruited to the study, two of whom withdrew from the study after completing several weeks of the exercise program for personal reasons. Of the group 58% were male, with an average age of 54 yrs (SD 21.6), Demographics are outlined in Table 1. Of the remaining 11 (85%) participants who completed the exercise program, two were unable to complete the post program assessment due to medical reasons. In addition, one participant was transferred to peritoneal dialysis after completing 10 weeks of the exercise program. This participant's post program assessment was undertaken at this stage and included in the analysis. During the recruiting period, two patients met the inclusion criteria but declined to be involved, five additional patients consented but later declined to commence exercise program, three for personal reasons and two as they received renal transplants.

Effect of intra-dialytic exercise

Only data from pre and post assessments for fatigue and QOL have been included as there were numerous missing data points from the planned fortnightly collection points. Mean (MFI scores at baseline ranged from 8 (SD 5) for mental fatigue to 13 (SD 5) for reduced motivation, indicating that a moderate degree of perception of fatigue was experienced by most participants across all components. There was no difference in MFI 20 scores following the exercise intervention for any fatigue component ($p > 0.11$). The EQ5D again showed a 73% complete response rate (8/11), with 4 participants showing improvements, 2 showing nil changes and 2 participants noting a decreased quality of life. The VAS noted a 64% complete response rate (7/11), with 5 showing improvement, 1 nil change and 1 decreased (participant who withdrew because of a declining medical condition). Due to the small sample size and lack of completeness in survey returns, no trends can be verified from our data.

Of those recruited ($n = 13$), the overall compliance rate with the exercise program was 73%. In other words, 73% of the prescribed exercise sessions (13 x 3 sessions/ week x 16 weeks) were completed. However, with consistent support of physiotherapist and nursing staff, 85% of participants completed the exercise program. One patient experienced thigh cramps and required to change to elastic band stretching exercises instead of the bicycle ergometer. Reasons for missed sessions include medical reasons, equipment being unavailable, cramps (which may be related to dialysis [Daugirdas et al, 2007]) and other musculoskeletal soreness, and inadequate reporting of completed exercise sessions. No other adverse effects were reported by patients or were physically evident during the trial. The average (SD) time spent exercising in each session increased from 9.9 mins (4.4) in Week 1 to 29.2 mins (7.4) in Week 16.

Intra-dialytic exercise has been shown to increase exercise capacity including distance covered and sit to stand ability (Painter et al, 2000; Headley et al, 2002). In the current study 5 participants showed an increase in exercise capacity, 3 remained unchanged, and 1 decreased. The distance walked in 6 minutes improved by an average of 20 metres (95% CI -5 to -31) following the completion of the exercise program. There was no significant difference in the time required to complete 5 sit-to-stands.

Discussion

This study endeavoured to determine the logistics and feasibility of implementing an exercise program, and found there were significant challenges. This included time constraints, difficultly in maintaining participant motivation, and length of data collection. Most intra-dialytic exercise programs ranged from three to six months, with positive effects after 12 weeks, and a peak effect at 16 weeks, hence the reason for chosen program length (Cheema & Singh, 2005). Anecdotally, the participants were very positive to other patients about the trial but this dwindled as time progressed and the perceived benefits of exercise were not evident on a personal basis.

Despite the small sample size, 76% of the recruited participants completed the program which was extremely positive considering the literature identifies compliance rates ranging from 43% to 99% (Cheema & Singh, 2005; van Vilsteren et al, 2004), however, these figures were only reported in 31% of studies on this topic (Cheema & Singh, 2005; Koufaki et al, 2002). The drop out rate was 15%, which

Table 1 Demographic data

Characteristic	
Gender	
Male n (%)	10 (75)
Age (yrs), mean (SD)	54 (21.6)
Co-morbidities n (%)	
Diabetes Type 2 Insulin Dependant	2 (17)
Cardiovascular Disease	3 (25)
Peripheral vascular Disease	1 (8)
Cerebral Vascular Disease	2 (17)

Table 2 Scale scores

Scale	Pre Test	Post test
	Mean (SD)	Mean (SD)
MFI	58.0 (18.2)	53.0 (21.6)
In text written		
Mental	8 (5)	8 (5)
Motivation	13 (13)	13 (13)
EQ5D	0.758 (0.18)	0.930 (0.12)
VAS	59.25 (21.01)	78.12 (21.65)
Sit to Stand, n	12 (4)	11 (4)
6 min walk, m	438 (109)	457 (98)
Time spent exercising (mins)	9.9 (4.4)	29.2 (7.4)

was a significant decrease from the drop out rates of 51% that had previously been reported (Cheema & Singh, 2005).

Equipment cost and availability meant that only three participants could be actively exercising at any one time, and scheduling of equipment dependent on dialysis session times, meant that participants had to commence the study in scheduled intakes. This sample size was congruent with previous studies with 45% containing up to 20 patients (Cheema & Singh, 2005).

In-centre exercise programs are recommended because of the available support, the ability to integrate exercise whilst otherwise "occupied" and by reducing the period in "forced inactivity" (Kutner, 2007). To support this on a weekly basis, patients were reviewed and motivated by the physiotherapist, whilst the nurse investigators also discussed patient progress on a bi-weekly basis as well as individual staff members prompting exercise commencement at each visit. Patients appeared to enjoy the novelty of the 'bicycles' and additional attention and reviews from nursing and physiotherapy staff, which provided distraction from routine dialysis regimes. Recruitment and support updates were promoted in a patient newsletter, as a strategy to prevent inactivity due to the possible negative influence of others that were not participating as advocated by Painter et al (2004).

The Pedal exercise programs have been shown to increase exercise capacity, measured by distance walked and functional ability (sit-to-stand movement speed) (Cheema & Singh, 2005; Painter et al, 2000; Headley et al, 2002). The amount of change observed in exercise capacity was not dependent on the average session duration ($p = 0.57$) or total numbers of sessions completed ($p = 0.17$). Tailoring programs to patient preferences and capabilities is seen as a method of recruitment (McMurray et al, 2008) and also has been reported to be useful for providing additional motivation (Painter et al, 2000, Molsted et al, 2004). Greater improvements in physical functioning and possible higher levels of participation have been noted in programs that have frequent interaction with exercise professionals rather than programs solely monitored by dialysis staff (Painter et al, 2000; Oh-Park et al, 2002; Goodman & Ballou, 2004; van Vilsteren et al, 2004). To establish feasibility of an ongoing exercise program, visiting support by the physiotherapist was considered the most physically and financially sustainable approach. Involvement of exercise experts with skills and experience to motivate and coach patients and staff have been noted as being highly beneficial in successfully adopting an exercise programme (Bennett et al, 2007). Whilst the allocated exercise nurse provided additional support and encouragement during exercises, their roles were prioritized related to clinical needs of the unit and patients were more likely to view the nurse in that role than purely as an exercise motivator.

Evaluation measures

Despite strategies to ensure surveys were completed and returned, missing data throughout the study period seem to be unusually high in this population. Therefore a reduction of collection points to monthly or at commencement and completion of study is recommenced. If data periods were reduced to take into consideration only pre and post results, response rates are predicted to be to 58 to 67%, although previously noted response rates with questionnaires have been as high as 75% (Painter et al, 2004). Reasons for poor response rates in this population are uncertain but may be attributed to the increased likelihood of being surveyed as part of a teaching hospital. Completion time was also longer than the anticipated 10 minutes, as some patients required information to be read to them or required assistance to complete due to having restricted hand movement during dialysis.

Participants were already on a high protein high energy diet, were not malnourished and dietary intake remained stable. Little change was expected; therefore dietician assessments are not routinely required when active exercise programs are in place, unless malnutrition is suspected.

Limitations

We acknowledge that this study has several limitations, particularly in relation to sample size and required resources. Small sample size was utilised to address the initial purpose in establishing the feasibility of implementing an in-centre exercise program. As our sample was drawn from an in-centre site, participants were likely to be 'sicker' and more debilitated, which may have influenced their level of participation. In relation to resource availability, budget constraints limited allocated research nurses' time to one day/fortnight after initial planning and patient identification. This was not a sustainable method of ensuring timelines and project goals.

Recommendations

The fiscal, environmental and time constraints evident in a large tertiary hospital make the addition of a patient focussed physical activity program very challenging. Although authors such as Bennett et al. (2007) found that exercise programmes can be adapted to HD settings, this is highly variable dependent on the capacity and workload of the unit, with our unit finding evaluating and sustaining a program over the longer term, unachievable. Larger multi site studies are recommended to establish the on-going feasibility of individualised exercise programmes.

Future research should include the allocation of physiotherapy services and the appointment of a daily exercise nurse, as weekly "in-depth" attention, that was able to be provided is not enough to sustain motivation. The initiation of physiotherapy services for outpatients receiving dialysis was a positive endeavour, and assisted in providing a perspective of additional health promotion and professional advice that was previously unavailable. The in-centre dialysis population typically are faced with physical or social challenges that prevent them from undertaking home-based therapy – the effect of this additional support cannot be underestimated. An environment conducive to self-care, independence and, active participation is seen as the ideal place to instigate in-centre exercise programs.

Conclusion

Exercise has been established as a vital component of health promotion activities for all, especially those with renal disease. Short-term exercise programs show varying results dependent on the extent of fatigue, quality of life and impact of disease. The culminating effects of these is difficulty in maintaining motivation in the medium to long-term, especially when faced with a chronic disease and benefits may not become evident. Structured and supported exercise programs require a committed team, resources and appropriate environment to foster a shift in thinking towards self-care and activity.

Acknowledgements

The Office of the Chief Nursing Officer, Queensland Health, provided financial assistance for this research.

The researchers also acknowledge the Haemodialysis Unit nursing team members and patients, physiotherapy researcher Suzanne Kuys, dietician Eryn Murray, research assistant Judy Batkin and data manager Kylie Hurst who gave of their time to assist in the study.

References

American Thoracic Society. (2002) ATS Statement: Guidelines for the Six-Minute Walk Test. Am J Respir Crit Care Med Vol 166. pp 111–117.

Bennett, P., Breugelmans, L., Agius, M., Simpson-Gore, K. & Barnard, B. (2007). A Haemodialysis exercise programme using novel exercise equipment: A pilot study. *Journal of Renal Care, 33* (4), 153-158.

Cheema, B., & Fiatarone Singh, M. (2005). Exercise training in patient receiving maintenance hemodialysis: a systematic review of clinical trials. *Am J Nephrol , 25,* 353-364.

Csuka M, McCarthy DJ (1985) Simple method for measurement of lower extremity muscle strength. *Am J Med* 78:77-81.

Daugirdas, J., Blake, P. & Ing, T. (2007) *Handbook of Dialysis*, Wolters Kluwer / Lippincott, Willaims & Wilkins, Philadelphia

EQ-5D. (2006). A standardised instrument for use as a measure of health outcome. Retrieved October 13, 2006, from www.euroqol.org

Gerard, K., Nicholson, T., Mullee, M., Mehta, R. & Roderick, P. (2004). EQ-5D versus SF-6D in an older chronically ill patient group. *Applied Economics and Health Policy, 3* (2), 91-102.

Goodman, E & Ballou, M. (2004). Perceived barriers and motivators to exercise in Haemodialysis Patients. *Nephrology Nursing Journal, 31* (1), 23-29

Headley, S., Germain, M. Mailloux, P., Mulhern, J., Ashworth, B., Burris, J., Brewer, B., Nindl, B., Coughlin, M., Welles, R. & Jones, M. (2002). Resistance training improves strength and functional measures in patients with end-stage renal disease. *Am J Kidney Dis, 40* (2), 355-364.

Koufaki, P., Mercer, T. & Naish, P. (2002). Effects of exercise training on aerobic and functional capacity on end-stage renal disease patients. *Clin Physiol & Func Im, 22* (2), 115-124.

Kutner, N. (2007). How can exercise be incorporated into the routine care of patients on dialysis? *Int Urol Nephrol, 39*, 1281-1285.

McCann, K. & Boore, J. (2000). Fatigue in person with renal failure who require maintenance haemodialysis. *Journal of Advanced Nursing, 32* (5), 1132-1142.

McDowell, I. (2006). *Measuring Health: A Guide to Rating Scales and Questionnaires* (3rd ed.). New York: Oxford University Press.

McMurray, A., Blazey, L. & Fetherston, C. (2008). The effect of intradialytic foot pedal exercise on blood pressure phosphate removal efficiency and health related quality of life in haemodialysis patients. *Ren Soc Aust J, 4* (2), 38-45.

Martin, C. & Gaffney, S. (2003). Exercise in dialysis: magic bullet or unnecessary risk? Nephrology *Nursing Journal, 30* (5), 580-581.

Molsted, S., Eidemak, I., Sorensen, H., Kristensen, J. (2004). Five Months of physical exercise in haemodialysis patients: effects on aerobic capacity, physical function and self-rated health. *Nephron, 96* (3), 76-81.

Moug, S., Grant, S., Creed., G. & Boulton Jones, M. (2003). Exercise during Haemodialysis: *West of Scotland Pilot Study. SMJ, 49* (1), 14-17.

Oh-Park, M., Fast, A., Gopal, S., Lynn, R., Frei, G., Drenth, R. & Zohman, L. (2002). Exercise for the Dialyzed: Aerobic and Strength Training During Hemodialysis. *American Journal of Physical Medicine & Rehabilitation, 81* (11), 814-821.

Painter, P., Carlson, L., Carey, S., Paul, S., Myll, J. (2000). Physical Functioning and health-related quality-of-life changes with exercise training in haemodialysis patients. *Am J Kidney Dis, 35,* 482-492.

Painter, P., Carlson, L. Carey, S., Paul, S., Myll, J, Paul, S. (2004). Determinants of Exercise Encouragement Practices in Hemodilaysis Staff. *Nephrology Nursing Journal, 31* (1), 67 -74.

Parsons, T, Tollelmire, E., & King-VanVlack, C. (2004). The effect of an exercise program during hemodialysis on dialysis efficacy, blood pressure and quality of life in end-stage renal disease (ESRD) patients. *Clinical Nephrology, 61* (4), 261-274.

Smets, E., Garssen, B., Bonker, B., & De Haes, JCJM. (1995). The Multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue, *J Psychosom Res, 39* (3), 315-325.

van Vilsteren, M., de Greef, M., Huisman, R. (2004). The effects of a low-to-moderate intensity pre-conditioning exercise programme linked with exercise counselling for the sedentary haemodialysis patients in The Netherlands: results of a randomized clinical trial. *Nephrol Dial Transplant, 20* (1), 141-146.

White, Y. & Grenyer, B. (2006). Do we encourage health of illness? A survey of exercise rehabilitation practices for patients in Australian Renal Units. *Ren Soc Aust J, 2* (1), 5-15.