Irish Medical Journal
Established 1867

Issue: Ir Med J; Vol 114; No. 2; P261

Intra-dialytic Exercise for Haemodialysis Patients: A Pilot Program

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Abstract

Aim

Intra-dialytic exercise is associated with many clinical benefits but has not been widely adopted in routine practice. An intra-dialytic exercise program was piloted to investigate patient adherence and early clinical benefits in an Irish haemodialysis cohort.

Methods

An 8-week exercise program was conducted in six patients. The primary outcome was patient adherence. Secondary outcomes included physical functionality, quality of life and dialysis adequacy. Physical functionality was assessed by hand-grip strength, the sit-to-stand test and the Duke Activity Status Index (DASI). Patients partook in 45-minute exercise classes twice-weekly, which included resistance training and aerobic training.

Results

The mean age of the patients was 58.2years (SD 18.2), with a mean dialysis vintage of 24.3 months (SD 30.8). Adherence was high, with 5 of 6 patients completing >75% of sessions. There was a significant increase in physical functionality, as measured by the sit-to-stand test, from a mean of 21.1 (in 1 minute) to 27.3 (in 1 minute) following the program (Z=-3.29, p=0.001). There was no significant change noted in the other secondary outcomes. No safety concerns were encountered.

Conclusion

Structured, physiotherapy-led, intra-dialytic exercise can be safely and effectively introduced to Irish haemodialysis units, associated with a high level of adherence and early physical gains.

Introduction

Exercise training is known to be beneficial for adult patients with chronic kidney disease.[1] There is a growing body of evidence that providing a structured exercise programme to haemodialysis patients during their routine dialysis treatment has significant benefits, including increased exercise tolerance, improved mobility and functional status, improved muscle strength and improved quality of life.[2-6] These programmes are also associated with improvement in other clinical parameters such as blood pressure control, arterial stiffness and small solute clearance.[2,4,7] Exercise programmes typically combine aerobic (endurance) and resistance training and are carried out under the supervision of exercise specialists or physiotherapists, while the patients are undergoing their routine haemodialysis session.[8] These programmes are reportedly well tolerated by the participants, with no significant patient safety concerns evident.[8-10]

Unlike successful cardiac and pulmonary exercise programs established throughout the Irish healthcare system, exercise programs for haemodialysis patients have not become established routine practice and may represent a missed opportunity to improve outcomes for both patients and healthcare economics. Adjusted for co-morbidities and socio-economic confounders, data from the DOPPS cohort demonstrate reduced mortality risk among patients who exercised regularly and also at facilities that provide exercise programs.[11] A reduced inpatient length of stay has also been reported in haemodialysis patients undertaking an exercise program, which could have major cost-saving implications in this cohort of patients with frequent, and often prolonged, hospitalisations.[12]

Here, we report the first pilot study of patient adherence and early clinical benefits in an exercise program for chronic haemodialysis patients in an Irish setting.

Methods

Participants were recruited from a single-centre haemodialysis cohort, being eligible for inclusion if they were chronically undergoing haemodialysis (for at least 3 months) and were in a stable medical condition. Patient selection was opportunistic to coincide with limited physiotherapy availability and a logistical requirement that participants be suitable to dialyse in a single 6-patient bay without need for isolation precautions. Patients suffering from advanced cognitive impairment, symptomatic ischemic heart disease, orthopaedic or musculoskeletal problems interfering with exercise training or those who could not give informed consent were ineligible.

The pilot cohort consisted of 6 patients, who underwent intra-dialytic exercise sessions twice weekly for an 8-week period. Each exercise session consisted of approximately 45 minutes exercise, under the direct supervision of a physiotherapist, to include aerobic exercise (stationary cycle ergometer for 10-15minutes, at low to moderate intensity based on the patient's ability) and resistance training with weights and elastic bands, focusing on 10 specific exercises (2 sets of 8 repetitions for each exercise). The exercises included were the shoulder press, shoulder abduction, external shoulder rotation, biceps curls, triceps extension, hip flexion, hip abduction, straight leg raise, hamstring curl and inner-range quadriceps exercise.

Our study protocol allowed for inclusion of participants who were undergoing dialysis via an upper limb AV fistula, with the fistula arm not being exercised during dialysis in those patients.

The primary outcome measure was individual patient participation in each exercise session and the proportion of training sessions completed in the 8-week programme. The supervising physiotherapist adjudicated whether an individual session was completed satisfactorily. For the secondary outcome measures, subjective physical functionality was measured by Duke's Activity Stats Index (DASI), a 12-item questionnaire used to assess functional capacity.[13] Objective physical functionality was measured by a timed sit-to-stand test (for 1 minute) and hand-grip strength dynamometer. Patient quality of life (QOL) was measured by the SF-36 survey. Dialysis clearance was measured by the urea reduction ratio (URR). Outcome measures were assessed at baseline and after completion of the 8-week programme.

Study participants' demographic and clinical data were gathered from medical and/or electronic charts, including age, gender, aetiology of endstage kidney disease, diabetes status, cardiovascular comorbidity and dialysis vintage. Biochemical parameters were collected from the patient's routine monthly bloodwork before and after the programme was been completed. Participant clinical and demographic details were reported using descriptive statistics. The number of successfully completed exercise sessions for each patient was reported as a percentage of the total scheduled sessions. Continuous outcome variables measured before and after the exercise programme were compared by the Wilcoxon rank test. The alpha level of significance was set at <0.05. All participants provided written consent prior to commencement of the exercise program. The pilot study was approved by the local ethics review committee.

Results

The mean age of the six patients was 58.2years (SD 18.2), with a mean dialysis vintage of 24.3 months (SD 30.8) and most of the participants were male (n=5). All patients were undergoing dialysis via a tunnelled central venous catheter. The aetiology of end-stage kidney disease was ischaemic nephropathy (n=2), chronic glomerulonephritis (n=1) and unknown aetiology (n=3) in the included patients.

Exercise Adherence

The observed adherence with scheduled intra-dialytic exercise sessions was perceived to be high in 5 out of the six patients, who completed more than 75% of sessions (Fig 1). One patient had low adherence with the program due to an unanticipated departure from the dialysis centre for personal reasons during the program, although the patient had completed all scheduled sessions prior to departure and following return to the unit. Reasons cited for incomplete sessions in the remaining patients included intra-dialytic hypotension (n=2), patient fatigue (n=7) and an intercurrent viral illness (n=2).

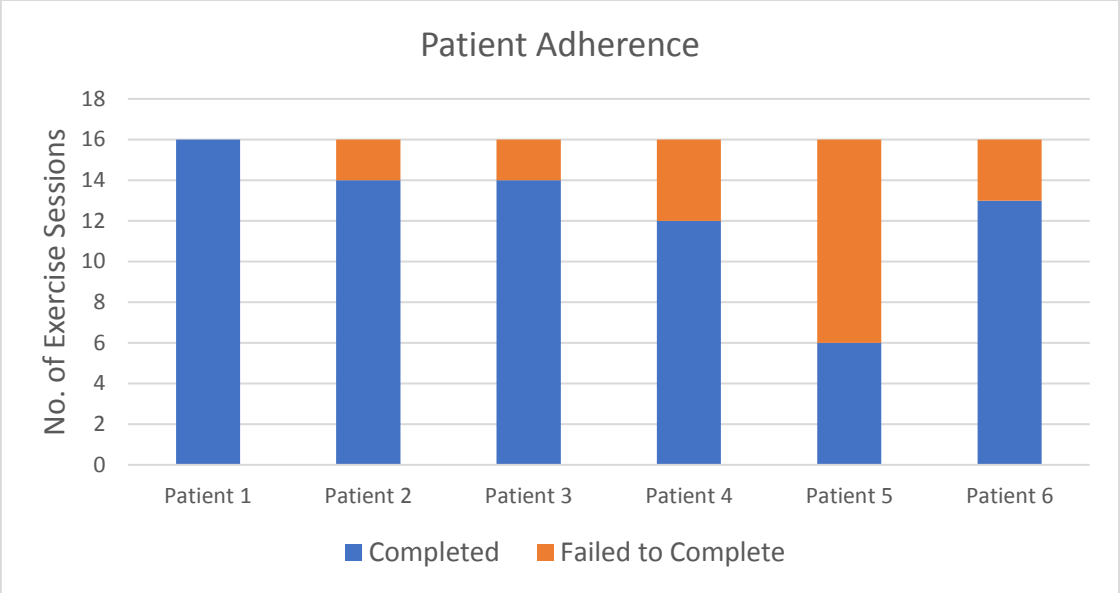

Figure 1. Patient Adherence with scheduled intra-dialytic exercise sessions.

Physical/Functional Gains

Subjective physical functional status, as measured by the DASI questionnaire, remained unchanged at the pre- and post-program assessments, with a mean score of 31 (SD=16.5) vs 32.1 (SD=12.8), respectively (z=-0.2, p=0.8). Objective physical functionality based on the timed sit-to-stand test improved significantly from a mean of 22.1 repetitions (SD=6.5) in 1 minute to 27.3 (SD=10.9) repetitions following completion of the program (z=-3.29, p=0.001), with all patients showing a nominal improvement (Fig. 2). There was non-significant trend towards improvement in mean hand grip strength, 24.8kg (SD=10.9) versus 27.5kg (SD=7.4), equating to a mean increase in grip strength of 2.6kg (95% CI -2.1 – 7.5, p=0.2). Of note, different participants demonstrated the most improvement in the sit-to-stand test and hand grip strength outcomes, suggesting a possible differential benefit for individual patients.

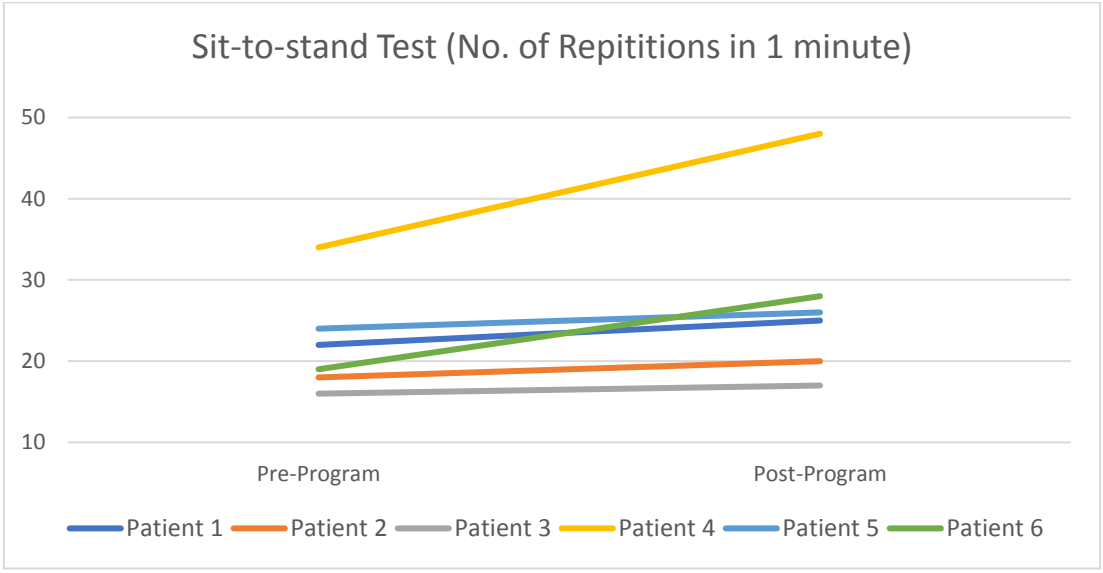

Figure 2. Sit-to-stand Test Outcomes pre- and post-program (Number of Repetitions in 1 minute).

Other Outcomes

There was no significant change in self-reported QoL as assessed by the SF-36 questionnaire when compared pre- and post-program, with mean scores of 2194 (SD=309) versus 2180 (SD=619), respectively (z=0.08, p=0.9). There was also no significant change noted in dialysis adequacy over the 8-week program in terms of the recorded mean urea reduction ratio, 65% versus 68.2% (z=-1.64, p=0.1).

Discussion

We present the first report of a structured, intra-dialytic, physiotherapy-supervised exercise program in an Irish haemodialysis unit. The pilot program was well-adhered to and well-tolerated, with no negative impact on quality of life or dialysis adequacy noted. After a relatively short 8-week program, an early and significant improvement in physical functionality, as measured by the sit-to-stand test, was recorded. Although it is possible that results may be skewed by individual performance in such a small cohort, all participants showed some degree of measured improvement and the overall finding is consistent with previous reports of the benefits of exercise therapy in this cohort.[8] A trend towards improved hand-grip strength was also noted, although it is likely that insufficient study power excluded the possibility of demonstrating a more robust outcome response after exercise training, as has been demonstrated in previous controlled clinical trials.[14]

Physical frailty and reduced functional status are common in haemodialysis cohorts, and are associated with reduced quality of life, increased risk of hospitalization and increased mortality. Current guidelines recommend regular exercise for patients with CKD, although evidence suggests that <50% of dialysis patients exercise at least once per week. Observational evidence from the Dialysis Morbidity and Mortality Study demonstrated an association between more regular exercise and reduced mortality.[15,16] Our findings are consistent with previously reported systematic reviews regarding haemodialysis patients and exercise therapy, with multiple studies reporting high adherence rates and improvement in physical fitness and muscle strength. Unfortunately, the literature to date is of mostly low to moderate quality RCTs with a high risk of bias.[17, 18]

Despite reports published over the last three decades supporting the benefits of exercise therapy in dialysis patients, the nephrology community has been slow to actively endorse the practice, with only a small minority of dialysis units internationally routinely providing this service. Other medical specialities in Ireland have successfully introduced exercise programs, such as cardiac rehabilitation, which is backed at a national policy-level and based on reported clinical benefits for patients and favourable cost-effectiveness for healthcare providers.[19, 20] We believe that there is currently a missed opportunity in this regard in the haemodialysis cohort, at whom a very significant proportion of the annual healthcare budgets are directed. March et al. reported on a subset of patients enrolled in the CYCLE-HD study, demonstrating a 3-day reduction in hospital length of stay in dialysis patients enrolled on an exercise program compared to controls, which would equate to an estimated annual cost saving of £25.7million related to inpatient stays.[12] This is consistent with other reports of reducing inpatient hospital length of stay through structured exercise therapy.[21, 22]

The reasons for inertia in the field of nephrology are not clear but are likely influenced by cost and resource issues surrounding physiotherapy personnel and equipment.

Jhamb et al. described barriers to intra-dialytic exercise including patient concerns over the safety and type of exercise and staff concerns over the impact on workload and resistance to changing dialysis routine.[23] Our data, in conjunction with other reports, indicates that it is safe and feasible to introduce exercise programs in this setting of the dialysis unit and can be used to reassure potential participants. Regarding participation in exercise therapy while dialysing via an AV fistula, the majority of previous trials have focused resistance training on lower limbs only to avoid any interference with the fistula arm.[24] However, there is evidence available that the non-fistula arm can be included in exercise without any significant safety concerns.[4] A lack of high-quality clinical trial evidence is also a barrier to more widespread use of intra-dialytic exercise programs, which may be soon addressed by CYCLE-HD (ISRCTN11299707) and PEDAL (NCT02222402) clinical trials. A lack of clarity on the best modality in which to implement exercise therapy (daily, intra-dialytic, non-dialysis day, home or in-centre) also acts as a barrier, with most literature focusing on supervised, intra-dialytic programs. The EXCITE study reported improved physical performance and quality of life with a personalized, low-intensity, home-based exercise program managed by dialysis staff.[25]

The limitations of the current pilot study are linked primarily to available resources which allowed for a single iteration of the program for 6 patients over an 8-week period, due to limited physiotherapy personnel. The small cohort size precludes any definitive statement regarding the potential benefit in terms of the study's clinical outcomes. A 6-minute walk tests was considered as another physical performance outcome but was not possible due to the logistical need to conduct the test on a non-dialysis day which would have required additional visits to the dialysis unit for participants. The program duration was relatively short, and we hypothesis that significant improvement in secondary outcomes would be encountered in a more prolonged program. Through a more sustained introduction and expansion of this program, the available evidence suggests that significant cost savings could be made into the future through reduction of inpatient length of stays, which provides a business case for resource allocation at individual centres.

The introduction of an intra-dialytic, physiotherapy-supervised, structured exercise program is a feasible undertaking in an Irish haemodialysis unit, is well-tolerated and adhered to, and is associated with early physical gains. The findings of this pilot study are consistent with international findings. More widespread introduction and expansion of such programs across the national chain of dialysis units would be expected to result in significant clinical benefits for patients and potentially significant cost-savings for healthcare providers.

Declaration of Conflicts of Interest:
None to declare.

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