Rehabilitative Exercise in Chronic Renal Failure

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QuickTime™ and a decompressor are needed to see this picture.

Johansen, 2007
Exercise in Chronic Renal Failure

- Responses to Exercise Training
- Responses to Anabolic Interventions
- Principles of Exercise Prescription
Exercise Training in Hemodialysis Patients

• 29 trials
  – 9 uncontrolled trials
  – 7 controlled, non-randomized trials
  – 13 randomized controlled trials

Useful to divide between pre- and post-erythropoietin era
Exercise Training for Dialysis Patients in the Pre-Erythropoietin Era
- Subject Characteristics -

- 7 studies; 1980-1993
- Total subjects = 81
- Average age = 45 years
- Average hematocrit = 26%
- Initial VO$_2$max = 18.5 mL/kg/min
Exercise Training for Dialysis Patients in the Pre-Erythropoietin Era
- Program Descriptions -

• Program duration: 8 weeks - 12 months
• 3 sessions/week
• Session duration: 25-60 minutes
• Intensity prescription basis: %VO$_2$max(3), %HR$max(2), LAT(1), perceived exertion(2)
• 5 supervised, 2 unsupervised exercise programs
Exercise Training for Dialysis Patients in the Pre-Erythropoietin Era

- Outcomes -

- In supervised programs, 13-42% increase in VO$_2$max
- No physiologic benefit in unsupervised programs
- Other reported benefits: better blood pressure control, better lipid profile, less depression
Exercise Training for Dialysis Patients in the Erythropoietin Era
- Painter et al., 2000 -

• 286 hemodialysis patients, 57% women, average age=56 years
• Hematocrit = 34%
• 8 weeks of in-dialysis center cycle exercise
• Outcomes
  – gait speed ↑ 4.5%
  – 6 minute walk distance ↑ 7.7%
  – physical scale scores on SF36 improved mildly
Exercise Training for Dialysis Patients in the Erythropoetin Era
- Kouidi et al., 1998 -

- 7 patients
- 90 minute sessions, 3/week for 6 months, aerobic exercise
- $\text{VO}_2\text{max}$ increased 18→26ml/kg/min (48%)
- Vastus lateralis muscle biopsy
  - ↑ fiber areas: type I, 26%; type II, 24%
  - improvement in mitochondrial abnormalities
  - increase in type II fiber proportion
  - increase in capillarity
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO$_2$
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life
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<th>Post-EPO</th>
<th>Pre-EPO</th>
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Improvement in VO$_2$peak with exercise training in dialysis patients

Johansen, 2007
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO$_2$
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Better LV function
Decreased arrhythmias
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO$_2$
- Cardiac function
- **Muscle architecture**
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

From combined aerobic and strength training: fiber hypertrophy; more normal capillarity and mitochondria
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO₂
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Improved habitual walking speed, sit-to-stand times
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO₂
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Better hypertension, lipid and glucose control
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO$_2$
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Improved dialysis adequacy
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO₂
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Decreased depression scores
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO$_2$
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life

Improved SF-36 subscale scores
Reported Benefits of Exercise Training in Hemodialysis Patients

- Peak VO₂
- Cardiac function
- Muscle architecture
- Functional performance
- Metabolic syndrome
- Dialysis efficiency
- Depression
- Quality of life
Exercise in Chronic Renal Failure

- Responses to Exercise Training
- Responses to Anabolic Interventions
- Principles of Exercise Prescription
• 29 patients; age = 44 years
• 6 month intervention
• Muscle mass ↑, fat mass ↓
• No significant VO₂max increase
• Decreased fatigue in QOL questionnaire
Effect of Nandrolone on Weight and Body Composition in Dialysis Patients
- Johansen et al., 1999 -
Anabolic Effects of Nandrolone Decanoate in Patients Receiving Dialysis
- Johansen et al., 1999 -

- 29 patients; age = 44 years
- 6 month intervention
- Muscle mass ↑, fat mass ↓
- No significant VO₂max increase
- Decreased fatigue in QOL questionnaire
Anabolic Effects of Growth Hormone in Patients Receiving Dialysis
- Johannsson et al., 1999 -

- 10 subjects; average age=73 years
- GH administered 3 times/wk subcutaneously for 6 months
- IGF1 levels ↑ 59%
- Fat-free mass ↑ 3.9 kg
- Leg muscle cross-sectional area ↑ 8.3%
- Handgrip strength ↑ 20%
Exercise in Chronic Renal Failure

• Responses to Exercise Training
• Responses to Anabolic Interventions
• Principles of Exercise Prescription
Exercise Prescription in Dialysis Patients

- Prior to initiating a vigorous exercise program, patients should undergo formal exercise testing, preferably featuring gas exchange measurements and 12 lead ECG monitoring to rule out severe cardiovascular disease and serve as the basis for exercise intensity prescription.

- If an exercise program directed at achieving physiological benefit is not possible, a less formal program should be pursued. Encouraging a less sedentary lifestyle can be beneficial.
Exercise Prescription in Dialysis Patients

- In a formal program, exercise sessions can be scheduled either during or near the time of dialysis. Exercise sessions should be held in group settings, preferably supervised by a rehabilitation therapist.

- The principal exercise mode should involve large muscle groups. Cycle ergometer and treadmill exercise are suitable indoor activities. Rapid walking, running, bicycling and swimming can be pursued if outdoor activities are practical.
Exercise Prescription in Dialysis Patients

- Exercise intensity recommendations are tentative. An intensity moderately above the lactic acidosis threshold might be a practical target. If exercise is performed on a calibrated ergometer, this target can be expressed as a work rate. If not, then the heart rate corresponding to this intensity target can be utilized, although changes in autonomic and volume status, cardiovascular disease and certain medications can alter the relation between exercise intensity and heart rate. Training intensities based on perceived exertion alone are likely suboptimal. Exercise targets should be progressively advanced by the rehabilitation therapist as the program proceeds.
Exercise Prescription in Dialysis Patients

• A reasonable design is to hold sessions three times per week and to have sessions feature 45 minutes of exercise. The formal exercise program should be at least 5 to 8 weeks in duration.

• The formal exercise training program should be followed by a maintenance program, preferably in a group setting.
Exercise Prescription in Dialysis Patients

• Although strength training programs are of value in other chronic diseases, little information is available concerning dialysis patients. Presumably, strength training can improve muscle mass and strength in patients receiving dialysis therapy, but exercise prescription guidelines cannot be specified at this time. In designing strength training programs, risk factors for bone fracture (e.g., osteoporosis) and tendon rupture should be considered.
Exercise in Chronic Renal Failure

• Responses to Exercise Training
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