Current Status and Progress of Cardiac Rehabilitation in the U.S.A

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Disclosures

- I have no significant conflict of interest related to this talk
- Disclosures:
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Background and Significance

• Cardiac Rehabilitation is an important treatment for all stages of cardiac disease
  – Has role in less severe disease as well as prevention for those at risk
• Primary and secondary prevention
  – Multifaceted/multidisciplinary approach
  – Must use in combination with medical management and behavioral modification
• Proven to prolong life and improve outcomes
Benefits of Aerobic Training

- Angina decreases – Class A
- Reversal of lesions – Class B
- Blood pressure decreases – Class A
- Exercise tolerance increases – Class A
- Decreased depression/anxiety – Class B
- Resting heart rate decreases – Class A
- Improved quality of life – Class A
- Decreased Mortality and Morbidity – Class A
Basic Terms

- Aerobic Capacity
- Cardiac Output
- Heart Rate
- Stroke Volume
- Myocardial Oxygen Consumption
Is CR pertinent to KSA?

• Significant risks exist
• Need for intervention
• Primary and secondary prevention
  — Some Good News
  — Some not so Good
Prevalence of raised blood cholesterol*, ages 25+, age standardized
Both sexes, 2008

Prevalence of raised cholesterol (%)

- <30
- 30–39.9
- 40–49.9
- 50–59.9
- ≥60
- Data not available
- Not applicable

* ≥5.0 mmol/L

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Data Source: World Health Organization
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Prevalence of raised blood pressure*, ages 25+, age standardized
Both sexes, 2008

Prevalence of raised blood pressure (%)

- <35
- 35–39.9
- 40–44.9
- 45–49.9
- ≥50

Data not available
Not applicable

* SBP ≥140 and/or DBP ≥90 or using medication to lower blood pressure

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Prevalence of raised fasting blood glucose*, ages 25+, age standardized
Both sexes, 2008

Prevalence of raised blood glucose (%)

- <5
- 5-7.4
- 7.5-9.9
- 10-12.4
- ≥12.5
- Data not available
- Not applicable

* ≥7.0 mmol/L or on medication for raised blood glucose

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Prevalence of insufficient physical activity*, ages 15+, age standardized
Both sexes, 2008

Prevalence of insufficient physical activity (%)

- <20
- 20–29.9
- 30–39.9
- 40–49.9
- 50–59.9
- ≥60

Data not available
Not applicable

* Less than 5 times 30 minutes of moderate activity per week, or less than 3 times 20 minutes of vigorous activity per week, or equivalent

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Data Source: World Health Organization
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Prevalence of overweight*, ages 20+, age standardized
Both sexes, 2008

Prevalence of overweight (%)
- <20
- 20–39.9
- 40–59.9
- ≥60
- Data not available
- Not applicable

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Other Diagnostic Studies for CR

- Baseline cardiogram
- Assessment of ischemia for those with CAD
- Arrhythmia risk assessment
- Consideration of PVD
  - Can seriously limit progress in a conditioning program
- Management of CHF
Role of Exercise Tolerance Testing

- Functional testing (CPET) better than pharmacologic
  - Gives exercise parameters
  - Better safety assessment
- Functional assessment
- Exercise prescription writing
- Safety
Exercise Prescription

- Use of CPET for safe HR/capacity determination, oxygen use, endpoints
- Can allow for most efficient program of exercise
- Allows method of tracking improvement
Exercise Prescription

- Four Components need to be present
  - Diagnosis
  - Prescription
  - Types of exercise
    (strengthening/stretching/aerobic)
  - Education/Special needs
    (nutrition/psychosocial/etc.)
- Duration and intensity of program
  - How many times a week/ how long
- Precautions
  - HR/BP, O2 Sat levels, Oxygen Needs
Principles of Aerobic Training

• Intensity
  – 85% Max HR is a target in normal individuals
  – 60% Max HR is a target in diseased individuals

• Duration
  – 20–30 minutes of aerobic exercise
  – HIIT - can be shorter, but with more intense intervals => in CAD, up to 95% for 1–2 minutes, with rest intervals at 60% for 2–3 minutes

• Frequency
  – 3 to 5 times/week (minimum)

• Specificity
  – Should be task specific
Effects of Aerobic Training

- Increased
  - Aerobic Capacity
  - Cardiac Output
  - Stroke Volume
- Decreased
  - Heart Rate
  - Myocardial Oxygen Consumption
Classical Rehabilitation Post MI

• Classical program designed by Wenger
  – Historically important, no longer used
  – 14 day in hospital program after acute MI
  – Current programs shorter – 3–5 days

• Overall program divided into four phases
  – Acute – I
  – Convalescent – II
  – Training – III
  – Maintenance – IV
Current Cardiac Rehab Schema

- Overall program divided into three phases
  - Acute – Phase 1
  - Training – Phase 2
  - Maintenance – Phase 3
Phase 1: Acute

- Begins in coronary care unit (CCU)
- Early Mobilization
  - CCU to 2 flights of stairs in 3 days
- Telemetry monitoring at each stage of increased activity
- Begin patient education at this time
- Ends at discharge from hospital
- Low level stress test prior to discharge
Extended Phase 1: Phase 1B

- Continued Inpatient hospitalization for rehab
- Acute or subacute rehab settings
- Usually in patients with advanced needs
- Goals
  - Safe independent function at home
  - Preparation for phase 2 rehab program
Phase 2: Training

- Classically (phase III) 6 weeks post MI, Symptom limited full level ETT performed
  - Screen out arrhythmias, ischemia
  - Set target heart rate
- Now with revascularization, start as soon as possible
- Monitoring with each increase in level
- Patient self monitoring
  - Borg Scale
  - Heart rate
Phase 2: Training

• Usual program as outpatient
  – 3 sessions a week minimum
  – 6–8 weeks in duration, can be longer
  – Up to 4 hours per session
  – Cross training
  – Always start with warm up/cool down
  – 20–30 minutes on each piece of apparatus
Phase 3: Maintenance

• Most important phase
• Benefits of training can be lost in a few weeks of being sedentary
• Regular exercise necessary
  – Minimum of 2 to 3 times a week
  – At least 30 minutes of exercise per session excluding warm up and cool down
  – Role for maintenance/wellness program
Secondary Prevention Goals in CR

- Tobacco cessation
- BP Control: <140/90 mmHg or <130/80 in DM or renal disease
- Lipid control: LDL-C <100 mg/Dl for TG >200, non HDL-C <130 mg/Dl
- Physical activity: 30+ minutes for at least 5 days a week
Secondary Prevention Goals in CR

• Weight management: BMI 18.5 to 24.9
  — and waist <40 inches (100 cm) in men and <35 (89 cm) inches in women
• DM: HgbA1c <7%
• Depression: Evaluate for depression
  — If present => treat
• Exercise capacity: Assess with ETT
  — Develop individual training program
Secondary Prevention Goals in CR

• Medications: Assess current meds
  - Assure beta blockade
  - Assure antiplatelet agent
  - Assure cholesterol lowering agent
  - Assess BP control medications

• Assess medication adherence and knowledge
Elements of an Outpatient Program

• Medical supervision
• Trained staff — Physiologists/nurses/PT’s
• Mixed strength/endurance/flexibility training
• Education components must be present
  – Nutritional counseling
  – Smoking cessation
  – Support groups
  – Maintenance support
Basic Observations on Exercise

If exercise was a medication, it would be the highest selling pharmaceutical of all time.

However, since exercise is work, it is grossly underutilized for almost every condition for which it would be appropriate.
Rehabilitation in Special Situations

• Angina Pectoris
  – Begin once medical management optional
  – Includes training and maintenance phases

• Cardiac arrhythmias
  – Use limits set by ETT
  – Proceed normally in patients with AICD
  • Avoid AICD firing rate with stress testing and exercise program
Rehabilitation After Bypass Surgery

• Immediate post op period
  – Mobilize starting POD #1
  – Progressive mobilization POD 2–5
  – Discharge planning and exercise prescription

• Symptom limited ETT 3 to 4 weeks post surgery

• Phase 2 when healing complete

• Maintenance Phase 3
  – Three types of programs
    • Low, moderate, high intensity
Cardiomyopathy: Physiology

- Heart Failure is now the new frontier
  - Patients with ejection fraction < 30%
- Multiple medical problems
  - High risk of sudden death
  - Deconditioned
  - Depressed
  - Low endurance
  - Fatigue
Cardiomyopathy: Is it OK?

• Yes to Heart Failure rehabilitation
  – Several recent studies - the HF Action trial
    • Established safety - less than 1 event per 20,000 rehab hours
    • Improved outcomes and QOL
    • Survival increase may be present short term - still being evaluated long term
• Multiple benefits via peripheral changes
Cardiomyopathy: Physiology

- Altered physiology
- Lack of normal response to exercise
  - Possible decrease in ejection fraction, stroke volume, and blood pressure
  - Cardiac output may not increase sufficiently to generate a dynamic exercise response
  - Can have prolonged fatigue post exertion
Cardiomyopathy: Benefits of Rehabilitation

- Increased peripheral oxygen extraction
- Lower heart rate at submaximal exercise
- Increased maximum workload
- Can improve functional level by 1 NYHA class
Cardiomyopathy: Rehabilitation Program

Specifics

• Prolonged warm ups and cool downs
• Dynamic exercise preferred over isometrics
• Target heart rate 10 bpm below any significant endpoint ⇒ CPET is important in this group
• Start and advance under close supervision
• Continuous telemetry for severe left ventricular dysfunction
Rehabilitation in Cardiomyopathy

- Graded exercise tolerance test for all patients before starting exercise program
  - Rule out arrhythmias, angina, or atypical exercise response
- Contraindications to rehabilitation
  - Unstable angina
  - Decompensated CHF
  - Unstable arrhythmias
Pre-Heart Transplant CR is Essentially CHF Rehabilitation

- Poor correlation with LV EF
- Assessed with VO2max
- VO2max reduced in CHF due to:
  - ↓CO response
  - ↓Skeletal muscle blood flow
  - Skeletal muscle abnormalities:
    - ↓type I fibers
    - ↓oxidative capacity
    - ↓capillary density
  - Metabolic abnormalities:
    - early dependence on anaerobic metabolism
    - excess intramuscular acidification
Rehabilitation of the LVAD Patient

- Usually a full comprehensive program
- Often easier to manage than severe CHF or CAD
- Have a baseline safe fallback cardiac output
- Most patients with portable devices go home without inpatient rehab
- Patients with complications (stroke, etc.) do well on rehab
- Exercise precautions based on the device limitations
LVAD Device Itself

- Many types available
- All similar principles, standard is laminar flow devices
- Maximum flow 10–12 lpm
- Must make precautions based on device limitations - cardiac output based on device
- Must have adequate staff comfort levels
HeartMate 1 and 2
Current State of the Art in LVAD

- LVAD as destination device
- Most go home without inpatient rehab
- Inpatient rehab in select cases
  - Neurologic complications
  - Severe debility
  - Pre-existing physical limitations
Physiology of the Post Cardiac Transplant Patient at Rest

- Heart rate typically high (100 bpm)
  - Loss of vagal inhibition
  - Decreased stroke volume
  - Increased sensitivity to plasma catecholamines

- Resting hypertension
  - Renal effect of cyclosporine
  - Effect of corticosteroids
Physiology of the Post Cardiac Transplant Patient at Rest

- Diastolic dysfunction
  - Increased myocardial stiffness
  - Possible myocardial ischemia from accelerated coronary artery disease
  - Side effect of immunosuppressive medications
  - Prolonged ischemic time of donor heart
- Near normal resting cardiac output
- Increased A-V oxygen difference
Physiology of the Post Cardiac Transplant Patient with Exercise

- Delayed onset of increased heart rate
  - Response to systemic catecholamines
- Lower maximal heart rate
  - Effect of denervation
- Slower recovery to resting heart rate
  - Loss of vagal tone
- Lower maximal cardiac output
Physiology of the Post Cardiac Transplant Patient with Exercise

- Increased maximum A-V oxygen difference
- Decreased maximal voluntary oxygen consumption
- Higher minute ventilation at a given level of VCO₂
Post-Operative Rehabilitative Treatment Approaches

• Graded aerobic conditioning program
  – Begin as soon as possible post-operatively
  – Early program at low levels of intensity
  – Progress to an aerobic program by discharge

• Post transplant exercise tolerance test
  – Allows estimation of aerobic capacity
  – Goal is aerobic exercise for 30–60 minutes/day at least three to five times per week
Shameless Self Promotion

Transplant Excellence

Montefiore’s Survival Rates Exceed National Outcomes

<table>
<thead>
<tr>
<th>Heart Transplant [3-Year Survival Rate]</th>
<th>CHILDREN</th>
<th>ADULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montefiore</td>
<td>100%</td>
<td>91.5%</td>
</tr>
<tr>
<td>National</td>
<td>92.4%</td>
<td>83.6%</td>
</tr>
</tbody>
</table>
Post-Operative Rehabilitative Treatment Approaches

• Consider inpatient rehabilitation
  - For patients with complications or concomitant disability (e.g. post operative stroke, PVD, etc.)
  - Severe deconditioning
• Address self care needs
  - Taking medications
  - Address patient education about rejection
  - Difficulties due to side effects of medications
Areas for Investigation

• Precise cardiac effect of exercise training
  – Cardiac parameters
  – Cardiovascular risk factors
  – Functional capacity
  – Incidence of cardiac events

• Precise vascular effect of exercise training
  – Mechanisms of increased ambulation
  – Effects in heart failure
Areas for Development

- Increased availability of cardiac rehabilitation
- Increased coordination of in-patient and out-patient services
- Improved community education programs
- Improved aftercare and compliance with stage 3 (IV) rehabilitation
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and the American Association of Cardiovascular and Pulmonary Rehabilitation

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