If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the powerpoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
Cardiovascular PT Intervention: Stay or Go and What to Do if You Stay!

Physical Therapy.com

Bini Litwin PT DPT PhD MBA
March 2016

Physical Therapy

The overall **short** term goal of physical therapy for patients with cardiovascular compromise is to:

- increase O₂ delivery
- while decreasing relative functional demands on the patient
Physical Therapy

- The overall long term goal of physical therapy for patients with cardiovascular and pulmonary compromise is to:
  - interrupt the downward spiral of physical ability
  - improve functional capacity
  - increase endurance
  - improve the quality of life

Intervention: Benefits

- VO2 and CO improves; RPP decreases
- Threshold for cardiac symptoms increases
- Loss of body weight/fat
- Decrease in lipid levels; increase in HDL levels
- Decrease in BP
- Improve glucose insulin levels
- Cardiac mortality decreased*

*Taylor, Brown, et al., ACP Journal Club, Nov-Dec, 2004; AHA, 2005
Exercise Training Effect on Pulmonary Function

- ↑ Vital capacity
  - Respiratory muscle strength improved
- ↓ Respiratory rate at submax exercise
  - ↑ Tidal volume
  - ADL’s considered submaximal work
- > O2 cellular extraction
- ↓ work required by respiratory system

PT Treatment Consideration

- Pre-existing diagnoses
- Determine acuity of patient
  - Ventricular tachycardia
  - Ventricular fibrillation
  - AV blocks
  - Sinus tachycardia
  - Pulmonary edema
  - Heart Failure
  - Cardiogenic shock
Treatment Parameters: Risk Stratification (AACVPR)

<table>
<thead>
<tr>
<th>Low</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ischemia</td>
<td>ST segment depression &gt; 1-2 mm w/ exercise</td>
<td>Marked ST (&gt;2mm) segment depression w/ ex</td>
</tr>
<tr>
<td>EF &gt;= 50%</td>
<td>EF = 31-49%</td>
<td>EF &lt;= 30%</td>
</tr>
<tr>
<td>&gt;= 6 METS- 3 wks. post event</td>
<td>&lt;5-6 METS- 3 wks. post event</td>
<td>Complicated cardiac incident</td>
</tr>
<tr>
<td>Uncomplicated cardiac event</td>
<td>Failure to comply w/ exercise rx</td>
<td>Survivor of cardiac arrest</td>
</tr>
</tbody>
</table>

Treatment Goals/POC

- Will depend on setting and acuity of patient
  - Acute
  - Acute Inpatient Rehabilitation
  - Sub Acute Rehab
  - Nursing Home
  - Home Health Care
  - Outpatient Rehabilitation
  - Independent Maintenance
Cardiac Intervention: Goals

- Improve CV fitness level within safe limits
  - Supply able to meet demand
- Restore ability of patient to work at functional levels of activity
- Promote lifestyle changes through patient education and behavior modification
- Prevent new or recurrent CV complications
- Promote return to prior IADL level

Treatment Goals

- Prevent airway obstruction
- Prevent accumulation of secretions
- Improve endurance & exhalation tolerance
  - Work move efficiently
- Maintain/improve physiological responses to activity
  - VO2 uptake, RPE, HR, RR, SV
- Reduce energy costs during respiration
- Improve O2 transport, promote ventilation
- Improve airway clearance
- Promote relaxation
- Improve cough
- Maintain or improve chest mobility
- Improve breathing pattern
- Prevent/limit systemic effects of immobilization
- Restore/improve function
- Effect behavioral/lifestyle changes
- Provide patient/family education
Treatment Choices*

Oxygen Delivery  
(Supply: DO₂)  
- Breathing retraining  
- Body positioning  
- Airway Clearance

Oxygen Utilization  
(Demand: VO₂)  
- Conditioning  
- Strengthening  
- Functional Training  
- Energy Cost – Devices/Energy conservation techniques

Role of Physical Therapy

- Assess O₂ delivery with each change in metabolic demand

- Metabolic demand (MET level)  
  - Estimated to assist in determining safe levels of participation

AT HOME ACTIVITIES

- Sweeping gardens: 30-55 cal / 30 sec
- Gardening: 40 cal / 30 min
- Playing with dog: 85-100 cal
- Wash & wax car: 100-120 cal
- Playing with kids (ages 2-5): 50-60 cal
- Moving furniture: 150-200 cal

**CONTINUED**
Progression of Care

- What is priority?
  - Medical survival
  - Oxygen recovery
  - Mobility
- How well is oxygen transport system able to meet demand?

Role of Physical Therapy

- When medical priority is **survival**
  - ROM
    - Passive, AA, Active
  - Splinting
  - Pain management
  - Pressure sore prevention
  - Positioning
  - Supportive airway clearance techniques
    - Cough production, positioning, bronchial hygiene, chest expansion
- Must address pulmonary needs of patient as priority
Role of Physical Therapy

- When medical priority is **O2 recovery**
  - **SUPPORTED BODY POSITIONING**
    - Observe breathing strategy
    - Promote O2 delivery
    - Limit myocardial work
  - **BREATHING RETRAINING**
    - Can be done while patient is on ventilator
    - Determine which interventions are needed
  - **EARLY MOBILIZATION**
    - 2-3 METS
    - Low intensity, increase duration and/or frequency

Role of Physical Therapy

- When medical priority is **mobility**
  - **EVALUATE MEDICAL MANAGEMENT**
    - Consider timing of mobility regime
    - Communicate plan/measures
    - Seek guidelines
    - (usually MD limited endpoints)
  - **FUNCTIONAL TRAINING**
    - O2 delivery adequate?
      - W/ or w/out techniques, adjuncts
    - Quantify workload and measures
Role of Physical Therapy

- When medical priority is primary prevention/risk reduction/wellness
  - Education
    - Risk factor reduction
  - Life style assessment/quality of life
    - Gear to lifestyle to increase compliance
    - Prioritize outcomes-keep patient’s goals in mind
  - Endurance training/gait speed/function
  - Muscle conditioning/strengthening
  - Flexibility

Treatment Continuum

- Positioning and splinting
- Airway clearance
  - Percussion and vibration
  - Postural drainage
  - Cough maneuvers/enhancement/huffing
  - Suctioning
- Oxygen supplementation
- Exercises
  - ROM, flexibility
  - Passive, active assistive, active
    - Progress to resistive
Treatment Continuum cont’d

- Breathing Strategies
  - IMT/Spirometry
  - Expiratory techniques
  - Chest wall stretching
  - Diaphragmatic, segmental, pursed lip, stacking breaths
  - Thoracic mobility exercises
  - Paced breathing
- Relaxation techniques
- Energy conservation/work simplification

Treatment Continuum cont’d

- Functional training/mobility
  - Bed, chair, upright
  - Family: Home environment
  - Community/IADL’s
- Graded endurance exercises:
  - Intensity, Duration, Frequency, Mode
    - Vary-adjust to patient acuity
    - Gait speed- distance/time
- Patient education
  - Lifestyle modifications
  - Psychosocial issues
- Discharge planning
PT Treatment Monitors

- Monitor during treatment:
  - Exercise intensity/RPE
  - Blood pressure
    - Before, during, 1-5 min. post
  - Heart rate
    - Before, during, 1-5 min. post
  - Respiratory rate (dyspnea scale)
  - O2 saturation
  - General appearance: color, perspiration
  - ECG/Heart sounds
  - Anginal pain (angina scale)
    - Decrease activity 10-15 beats below level where pain started

PT Treatment: Issues of Concern

- Patient in danger of arrest if:
  - Don’t warm up/cool down be/f & after exercise
  - Exercise above safe limits
  - Has high or low serum K+ values
    - Effect polarization of heart
    - Watch if on K+ depleting diuretics
  - Monitor CBC (infection), thyroid values (metabolic rate)
Cardiothoracic Surgical Considerations

FACTORS that threaten O2 transport
- Anesthesia
- Muscle relaxants and n-m blocks
- Static body position
- Duration of surgery
- Incisions
- Use of bypass machine
- Pain
- Fluid imbalance
- Dressings and binders

Role of Physical Therapy: Documentation

- The physical therapist should document factors that demonstrate how well the patient’s O2 delivery system supports metabolic demand imposed by functional training.
Cardiac Intervention: Parameters

Cardiac Intervention Acute: Considerations

- Must be medically stable
  - Hemodynamics, ECG, response to mobility activities
- Evaluate physiological response to activities
- Support psychological recovery following cardiac event
  - High incidence of depression**
    - Contributes to non-compliance

** Sanko et al. Platform presentation CSM 2016
Cardiac Intervention: Acute

- Initiate day 1 post-op; 3-5 days post MI
  - When patient medically stable
  - Several times/day; short duration
    - Increase freq/duration as tolerated
  - Progression dependent on physiological response to activity
- ALOS < 5-6 days
  - Dependent on patient PMH, acuity, age, etc.
  - STG = 1-3 days
  - LTG = 4-6 days

Cardiac Intervention Acute: Program Components

- Functional graded (endurance) activities
  - Monitored ambulation, ADLs; Get Up and Go
  - Goal is 3-5 METs at discharge
    - Equivalent to 3.0 MPH on TM
  - Passive, active assistive, active exercises, ankle pumps, light resistive, UE within limits
    - No WB on UE
      - Rolling walker ok for balance
    - Monitor isometrics (avoid valsalva)
    - Consider sternal precautions
      - No scapular add, shoulder flex > 90, scaption >90
      - < 5-10 pounds 4-6 weeks after surgery
      - No driving 4-6 wks
      - Varies by facility
      - No evidence to support sternotomy precautions**

**Tuyl, Mackney, Johnston, PT Journal, January 2012
MET Intensity as % of 5 MET Max

<table>
<thead>
<tr>
<th>Task</th>
<th>MET</th>
<th>% of 5 METS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking</td>
<td>2.1</td>
<td>42</td>
</tr>
<tr>
<td>Cleaning</td>
<td>3.6</td>
<td>72</td>
</tr>
<tr>
<td>Eating</td>
<td>1.4</td>
<td>28</td>
</tr>
<tr>
<td>Food shopping</td>
<td>3.5</td>
<td>70</td>
</tr>
<tr>
<td>Card play</td>
<td>1.4</td>
<td>28</td>
</tr>
<tr>
<td>Walk 2.5mph</td>
<td>2.5</td>
<td>50</td>
</tr>
</tbody>
</table>

Cardiac Intervention  Acute: Program Components

- Breathing exercises/cough production
- Energy conservation/work simplification
- Balance assessment/training as indicated**
- Patient/family education
  - Self monitoring
  - Follow up activities
- Risk factor behavior modification
  - Smoking
  - Stress reduction/relaxation; hostility management; depression
- Diet
- Controlled substances

**Appel et al. Poster Presentation, CSM 2016
Cardiac Intervention: Acute

- Pharmacological management
- HR \( \leq 120 \text{ bpm or 20-30 bpm over resting rate w/ activity} \)
- RHR 95-100 bpm
  - Doesn't consider rate limiting medications
- RPE 11-14
  - Lower range with post MI
- Must consider ECG reading, hemodynamics, symptoms

Cardiac Considerations: Acute

- MI’s:
  - 7 day window of greatest risk
  - Avoid isometrics, Valsalva
- CABG:
  - Pain/anxiety of intubation, insertion/removal of tubes
  - Post anesthesia effects
    - Hypoxia (heart/lung);
    - Memory, personality
- Pacemakers:
  - Ltd. movement for 4 wks
Contraindications to Continuing Treatment: Acute

- Excessive heart rate increase
  - >50bpm
- Hypertensive response to activity
  - >210mmHG SBP
  - >100mm HG DBP
- Drop in SBP >10 mmHG w/ low level exercise
- Signs of pallor, cold sweat, ataxia

Contraindications to Continuing Treatment: Acute

- Symptoms w/ activity
  - Angina 1+/4
  - Dyspnea 2+/4
  - Excessive fatigue
  - Mental confusion/dizziness
  - Severe leg claudication 8/10
  - Changing heart sounds e.g. new murmurs
  - ECG abnormality
    - ST segment changes
    - Coupled/ectopic PVCs
Cardiac Intervention: Acute Post Surgical Issues

- **Head and Neck Pain**
  - Cervical-intubation, cervical extension
  - Headaches-drug induced (NTG, heparin)
  - Headaches- occipital n. irritation or trapezius spasm
  - Headaches- decreased visual acuity

- **UE**
  - Brachial plexus (8% of pts.) injury from clavicle & 1st rib depression (chest cracked), lat deviation/ext of neck
  - Peripheral neuropathies (6-13% of pts)

- **Balance Issues***
  - LVAD placement, premorbid deconditioning, hospital complications can impact balance

---

Cardiac Intervention: Acute Post Surgical Issues

- **Thorax:**
  - Unstable sternum
  - Asymmetric sternum
  - Non-union of sternum-
    - watch for purulent drainage
  - Costal cartilage pain (ribs 2-5)

- **LE:**
  - Nerve injuries (3% of pts.)
    - Saphenous or peroneal
  - Incisional pain/swelling in knee joint

---

CONTINUED
Part II: Sub-Acute/SNF/OP

Cardiac Intervention Progression: Sub-Acute/Conditioning

- Upon discharge from IP acute
- Home (HHA), OP, community setting
  - May not start formal program until 6 weeks post incident
    - Many start 24-72 hrs. post discharge**
  - Follows low-level monitored stress test & progresses to monitored maximal stress test
  - Monitored/supervised ambulatory phase
  - 3-7 times/wk
  - Generally lasts 6-12 wks*
  - Progress to 1/week

*Newer AACVPR guidelines combine Phase II and III as conditioning/training phase—lasts 3-6 months

Cardiac Intervention: Sub-acute

- **Endurance/conditioning**
  - Establish mode, frequency, duration, intensity
    - Progressive (graded activity) exercise
    - Be/g 15 min/session, progress to 45-60 min/session
    - Specific to patient response e.g. dyspnea, angina, RPE scales, physiological signs
  - Use interval (5 min on; 5 min off) with deconditioned to increase work loads

Cardiac Intervention: Sub-acute

- Determine baseline intensity from GXT by
  - THR
    - \( 220 - \text{age} \times \% = \text{THR} \)
    - High error rate (10-15 beats); use as estimate with young healthy, no cardiac hx
    - \( (\text{MHR}-\text{RHR}) \times \% + \text{RHR} = \text{THR} \)
  - Karvonen formula
  - Estimate at 60-70% for subacute; 70-85% for Intensive/Independent

- MET’s
  - 1-3 Acute
  - 3-6 Subacute
  - 7-12 Intensive/Independent

- RPE
  - 60-70% subacute
  - 70-85% Intensive/Independent

- VO2 max
- Ventilatory threshold

- Medication effects
- Use warm-up/cool down
Cardiac Intervention: Sub-acute

- Relaxation, energy conservation
  - Yoga, TM, biofeedback
- Breathing exercises
- Flexibility
- Family/patient education
  - Self monitoring
  - Risk factors

Cardiac Intervention: Intensive

- Progress to training/intensive rehab program
- Performed under supervised conditions i.e. 1/wk for 6-12 months
  - Progress to 1x mo
  - 30-50 min session
  - High level exercise conditioning phase
  - Initiate resistance training
  - Exercise at 60-85% of MHR, obtained via max stress (symptom limited) test results
Cardiac Intervention: Intensive

- Interval vs. circuit training
  - Can increase work loads w/ interval
  - Encourage camaraderie/social aspects of training
- Functional activities
- Strength training w/ aerobic exercise
  - Large muscle groups vs. small muscle groups
  - 3 sets; 12-15 reps; 3xwk.
  - 12-16 on RPE scale
  - ↑ peripheral m. strength/endurance, ex tolerance, cardiopulmonary function & ↓ symptoms
- 5 weeks post MI
- 8 weeks post CABG

Cardiac Intervention: Maintenance/Prevention Program

- High risk individuals
- Continuation of Phase II/III patients
  - >12 months
- Preventive program pre-morbidity
- Life long commitment to exercise
  - Improved compliance with life style modifications including diet, exercise, stress reduction, substance abuse
- PT practice pattern A, B
Re-Assessment: What Would You Do? Stay or Go?

**Case Scenario:**
Hy Risky: 72 year old male, 7 days post valve replacement
Discharged home with home health
Lives at home with wife who is primary caretaker
PMH: HTN, diabetes
Medications: Glipizide, glucophage, ace inhibitor, diuretic
PT POC: Mobility, gait, progress to resistive exercises

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Rest</th>
<th>Ambulation 5 feet without assistive device</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>130/85</td>
<td>150/95</td>
</tr>
<tr>
<td>Pulse rate</td>
<td>95</td>
<td>105</td>
</tr>
<tr>
<td>RR</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>O2 saturation</td>
<td>92%</td>
<td>88%</td>
</tr>
</tbody>
</table>

What should be done?
What other information do you need?
Should treatment be continued/discontinued?
Should treatment be modified?

Graded (Aerobic) Exercise
**Graded Exercise**

- Walking
- Arm Ergometry
- Leg Ergometry
- Combined Arm and Leg
- Treadmill
- Stair Climbing/Stairmaster
- Rower
- Elliptical

---

**Treadmill: Protocol Selection**

- TM, cycle, seated, pharmacological
  - TM 12x more predictive of CAD than resting ECG
  - 9X more predictive than STEP tests
- Usually lasts 8-12 minutes
  - Can be maximal or submaximal
- Intensity increased in steps
- Type of test determined by age, physical condition, health status, risk factors eg balance
- TM gives the best estimate of VO$_2$ max in fitness testing for healthy subjects
- Patients get more CV stress with supported combined arm and leg activity (Gappmaier E et al. MSSE 33:S130 #740)
Treadmill Protocols

- **Bruce**
  - Most commonly used with younger, fitter pops
  - Lower extremity strain is due to grade

- **Modified Bruce**
  - VO₂ prediction
  - Lower grade inclines

- **Naughton**
  - Better for diseased pops - more gradual in intensity
  - Starts at 0 grade

- **Balke**
  - Starts at 3.3 mph
  - Slowest/lowest incline increase

- **Ramp vs. Staged**
  - Myocardial ischemia attenuated (onset delayed) w/ ramp vs. standard Bruce protocol (staged)


Treadmill: Monitored/Unmonitored

http://www.youtube.com/watch?v=x_Z0GF6AuTw
Unweighted Treadmill Walking

http://www.youtube.com/watch?v=yYtey0TeoZ0

Standard Cycle Ergometry: YMCA Sub-Maximal Protocol

- 3 minute stages of continuous exercise
  - 2-3 minutes per stage
- 50 RPMs maintained throughout
- 25 watts - 1st stage
  - 10-15 watts for older individuals
- Seat adjusted with 10° knee flexion

continued
Supported Cycling

Advantages – Cycle

- BP, EKG or Pulse accurately monitored
- Can estimate VO2
  - Less precise than TM
- Patient feels safe/balance relative to TM
- Less compensatory movement
- Portable
- Use w/ musculoskeletal problems that don’t allow weight bearing
Disadvantages - Cycle

- 25% lower VO$_2$ max than TM
- Seat pain/leg pain may limit activity
- MS fatigue faster than on TM

Walking

- Timed walk tests
  - 12 minute walk test
  - 6 minute walk test
  - 2 minute walk test
  - TUG**
    - Field endurance tests (1 mile walk; shuttle run)
- Defines patient’s ability to exercise
  - Intensity performed or to where symptoms begin
- Improved results w/ 2nd test d/t learning effect
  - Demonstration prior to test
- Described differently in different references
  - Studies use walk distance, walk time, walk work as outcomes***

** Ashmont, et al. CSM Platform, 2016
***Smith, et al. CSM Poster, 2016
Six Minute Walk Test (6MWT)

- Patient walks at fastest pace possible
  - Record distance, time and rests taken
  - Calculate walking speed and compute METs
  - 100’ course
  - Circular vs. straight
- Monitor BP/HR, pt. hx sitting
- Instruct in RPE, scales, etc.
- Monitor and record responses pre, during, after
  - Chairs placed periodically for rests if needed
- Stop based on patient’s S/S
- Valid, reliable measure
  - Correlates with VO2 max for elderly, COPD, CHF
  - Predictive of death w/ mild to moderate CHF
  - http://www.youtube.com/watch?v=5YF8afmGzgM

Physiological Cost Index (PCI)

- Measures relative cost of walking/unit of distance walked
- Compares energy costs between different conditions
  - Pre/post intervention
    - Walking vs. wheelchair propulsion
    - Canes vs. crutches
    - With vs. without assistive device
- PCI = \( \frac{\text{HR}_{\text{walking}} - \text{HR}_{\text{rest}}}{\text{Average speed}} \) = _____ beats/meter
Metronome Protocols: Step Test

- Set at 96 beat/min; 24 steps/min
  - 2 METS: 2” step
  - 3 METS: 4” step
  - 4 METS: 7” step
- Needs to be reproducible

Chair Step Test

Stage 1. Touch the 6” bar with alternating feet 60x/min for 3 full min. Record HR. VO₂ = 8 ml/kg/min - 2.3 METS

Stage 2. Move the bar height to 12”. Repeat touching the bar with alternating feet. Do the task for 3 minutes and record HR. VO₂ = 10 ml/kg/min - 2.9 METS

Stage 3. Move the bar height to 18”. Do alternating foot touches, one/second, for three full minutes or fatigue. Take HR. VO₂ = 12.3 ml/kg/min. - 3.5 METS

Stage 4. The bar remains at 18 inches. Arm activity is added to the leg activity. So, while patients are reaching with one leg toward the bar, they are simultaneously raising the arm on the same side to shoulder height. Take HR. VO₂ = 13.7 ml/kg/min. - 3.9 METS
Clinic Protocols: Restorators

- Positions
  - Supine – LEs
  - Sitting – UEs; LEs
  - Standing – UEs

Standard Arm Ergometry  

- 10-15 watts
- 60 RPM
- Fulcrum of handle-shoulder height
- Discontinuous/continuous
  - 1-2 min rest between stages
### Advantages of Arm Ergometry

- Use w/ patients having LE impairments
  - Ortho/musculoskeletal, amputation, vascular insufficiency, neurological injuries
- Diagnostic for assessing CAD
- May increase work to diaphragm in COPD

---

### Disadvantages of Arm Ergometry

- Poor BP & ECG monitoring
- Lower VO₂ max/more variable
  - Reach max threshold faster
  - ↑ Efficiency w/ ↑ workload
  - ↑ RPP
- Local ms fatigue before CV stress
Upper Extremity Functional Activities

Elevated Arm work
Submaximal Work: Arm vs. Leg

At the same power output (watts) arm vs. leg, arm will to a greater extent:
■ ↑HR
■ ↑SV (decreased filling)
■ ↑VO₂ (reach threshold faster)
■ ↑Ventilation (Ve)
■ ↑BP or Mean Art Press
■ ↑RPP

Collett & Liljestrand 1924; Miles DS et al. JAP 57:366-70, 1984

PT Intervention: UE vs. LE Exercise

■ UE = greater demand on heart (increased work)
■ More readily symptomatic
■ Smaller muscles
■ Greater energy expenditure
■ SBP & HR greater at same work loads
■ Work both UE & LE for max benefit
Combined Arm and Leg Work

PT Intervention: UE vs. LE Exercise

Perform approximately 40% work with LE to:

- VASCULAR RESISTANCE
- MAINTAIN VENOUS RETURN
- RELATIVE MYOCARDIAL DEMAND

Sawka MN. Ex Sport Science Reviews vol 14, 1986
Toner MM et al. MSSE 22:773-778. 1990
Cardiac: Normal vs. Abnormal Response to Exercise

**Normal Responses:**
- CO x HR increases linearly as the workload & O2 consumption demands increase
- Max HR decreases w/ age
- Blood pressure: systolic will rise but diastolic will remain level or increase slightly
- BP affected by body position; cuff size; acute pain presence

**Abnormal Responses:**
- HR does not increase linearly w/ increased workloads
- On ECG the ST segment will depress (ischemia) or elevate (heart injury)
  - 1mm depression may be normal at high intensity exercise
- Blood Pressure:
  - Systolic: remains level during ex or stays high after ex
  - Diastolic: increases >/=20 mm Hg or decreases after ex
  - >240 SBP with exercise
  - >110 DBP with exercise

"Strain" Ischemia
Abnormal Responses cont’d

- Angina symptoms appear, escalate, change in intensity during exercise.
  - Can “work through” angina if no change from “normal” level
  - Lower intensity of exercise-monitor symptoms
- Abnormal heart rate: bradycardia, tachycardia
  - May relate to meds
- RR > 25 bpm (with pathology);
  - > 40 bpm (healthy)
- Irregular pulse
- O2 saturation < 85
  - Sign of desaturation

Normal vs. Abnormal Responses

- Note the effects that would occur in the following scenario:
  - Healthy, untrained 20 year-old male exercising his LE’s for 5 min. at a level of 60% of max HR
    - HR
    - BP
    - CO (HR x SV)
    - RR
    - O2 saturation
  - What would be the effect if he were exercising his UE’s?
Aging Changes: Implications for Exercise

- Need to exercise to maintain function
- Variety of assessment tools used
  - Bike ergometer for those with poor balance
  - Treadmill
    - Can ↑ grade instead of speed for older patients
  - 6 minute walk test-most commonly used
- Exercise prescription
  - Must relate and adapt to individual’s interests, lifestyle

Respiratory Response to Exercise with Aging

- Functional changes
  - Increased work of breathing
  - Increased expiratory flow limitation
  - Increased respiratory m's oxygen consumption
  - Decreased MVV
  - Inefficient mix of alveolar and inspired air
  - Decreased diffusing capacity
- Exercise ↑ aerobic capacity and submax work capacity in older adult
  - Need to perform ‘work’ to maintain function
Criteria for Termination of Treatment

- Fatigue
- Light headedness, confusion
- Ataxia
- Pallor, cyanosis, dyspnea, nausea
- Excessive sweating, flushing
- Angina onset w/ activity
- Decreased HR w/ increase or no change in work load (> 10bpm)
- DBP =/>110 mm Hg
- Decrease in SBP > 10mm Hg during exercise

---

Criteria for Termination of Treatment

- Maximal SOB/reaching ventilatory maximum (RPE/RR)
- Fall in PaO2 of > 20 mmHg or PaO2 < 55 mmHg
- Rise in PaCO2 > 10 mmHg or PaCO2 > 65 mmHg
- Cardiac ischemia or dysrhythmias
  - Frequent PVC’s
  - Ventricular arrhythmias
- Leg Pain
  - Check for DVT; color, temp, pulses
- Signs of insufficient cardiac output
Cardiac Intervention: Absolute Contraindications

- Acute/severe congestive heart failure
- Unstable angina
- Unstable hemodynamics
  - Falling BP w/ exercise
  - Persistent hypotension
    - <90 mmHg SBP
- 2nd/3rd degree heart block (leads to sudden death)
- Rapid atrial rhythm
- Serious arrhythmias, conduction defects
- Organ system failure
- Uncontrolled hypertension
- Other disease/illness that precludes exercise
- Active inflammatory conditions

Precautions & Contraindications to Exercise or Exertion *

- Increased HR over prescribed limit
  - Don’t start if >120 at rest
  - HR> 20 over RHR w/ post MI
  - HR > 30 over RHR w/ post CABG
- Significant dyspnea
- Excessive fatigue
- Resting systolic> 200 or diastolic>110
- Marked change in BP w/ exertion
  - Orthostatic drop SBP =>20mm Hg
  - ↑ DBP of >10-20 mm Hg
  - Decrease in BP w/ increasing workloads

*ACSM & AACVPR Guidelines
Precautions/Contraindications to PT Intervention

- Moderate to severe aortic stenosis
- Medications effect on response: beta blockers, diuretics
- Uncontrolled diabetes
  - Blood sugar > 300
- Symptomatic CHF/pulmonary edema
- Resting ST displacement > 2 mm
- Post ‘long bone’ surgery

Precautions/Contraindications to PT Intervention

- Incisional pain
- Dissecting aneurysm*
- Uncontrolled hypertension
- Persistent hypotension
- Acute fever/infection
- Thrombophlebitis

* Indicative of potential complication or condition that may contraindicate PT intervention.
General Red Flags: Contraindications/Precautions

- Acute/recent MI
- Angina
- Thrombus
- Pericarditis
- Rapid weight gain or edema
- Etoh hangover
- Sunburn
- Heavy food intake

Exercise Training Prescription

Mobilization and exercise prescription

1. Type of mobilization or exercise (mode)
2. Specific intensity
3. Duration
4. Frequency
5. Course of prescription
   a. Time TX will provide maximum benefit
6. Progression
Exercise Training Prescription

Mobilization and exercise prescription

- Identify all factors contributing to deficits in oxygen transport
- Determine whether mobilization and exercise are indicated, and how they affect factors in step 1
- Match appropriate mobilization or exercise to the patient’s oxygen transport capacity
- Set the intensity within therapeutic and safe limits, monitor for change
- Combine various body positions with progressively more challenging activities
- Set the duration of the mobilization sessions according to patient responses rather than time
- Repeat mobilization sessions as often appropriate to their beneficial effects

Increase intensity of mobilization, duration or both, monitoring responses to activity

Progress program until

- Functional status allows resumption of activities and full participation in life
- Threat to oxygen transport is minimized

FITT Principle
Frequency: 3-5 time per week
Intensity: RPE 11/16
Time: up to 60 min session
Type: Circuit Training, Theratube Resistive Exercise
Case Study

68 year old female
- CABG procedure 2 days prior located in CCU
- CHF due to significant myocardial damage of 2 anterior wall MIs’
- Poor ventricular function: EF <35
- Atrial fibrillation
- No angina, significant SOB, leg fatigue
- Resting HR: 60 bpm
- Resting blood pressure: 108/64 mmHg
- Medications: Coumadin HCT Metoprolol Digoxin Lipitor (statin), Norvasc
- Body Composition: BMI 33, WG: 112 cm
- Quit smoking 2 months ago
- No history of exercise
- Reports feeling easily fatigued doing housework, sore left knee due to osteoarthritis

Case Study

Considerations in Treatment planning

Disease status
1. Cardiac Output?—
Case Study

Case Study Considerations in Treatment planning
Disease status
1. Cardiac Output? – ↓ in cardiac output (low EF, poor contractility, atrial arrhythmia)

Case Study

Case Study Considerations in Treatment planning
Disease status
1. Cardiac Output? – ↓ in cardiac output (low EF, poor contractility, atrial arrhythmia)
2. O2 Delivery? –

continued
Case Study Considerations in Treatment planning

Disease status
1. Cardiac Output?– ↓ in cardiac output (low EF, poor contractility, atrial arrhythmia)
2. O2 Delivery? – poor delivery system plus poor O2 utilization
3. Physical Condition? –
Case Study

Case Study Considerations in Treatment planning

Disease status
1. Cardiac Output? – ↓ in cardiac output (low EF, poor contractility, atrial arrhythmia)
2. O2 Delivery? – poor delivery system plus poor O2 utilization
3. Physical Condition? – General deconditioning
4. Presence of other risk factors?
Case Study

Considerations in Treatment Planning

Disease status
1. Cardiac Output? – ↓ in cardiac output (low EF, poor contractility, atrial arrhythmia)
2. O2 Delivery? – poor delivery system plus poor O2 utilization
3. Physical Condition? – General deconditioning
4. Presence of other risk factors?
5. Overweight, abdominal adiposity
6. History of smoking (high risk for relapse)
7. Unfamiliar with exercise
8. Osteoarthritic knee – limits walking tolerance
9. Symptoms of fatigue & SOB due to her reluctance to exercise

Case Study

Medication Considerations
1. Metoprolol
   – Category –
Case Study

Medication Considerations
1. Metoprolol
   - Category – beta blocker
   - Effect – Lowers HR & BP @ rest & exercise

2. Digoxin
   - Category – 
Case Study

Medication Considerations

1. Metoprolol
   - Category – beta blocker
   - Effect – Lowers HR & BP @ rest & exercise

2. Digoxin
   - Category – controls atrial fibrillation
   - Effect –

3. HydroChloroThiazide
   - Category –

continued
Case Study

Medication Considerations
1. Metoprolol
   - Category – beta blocker
   - Effect – Lowers HR & BP @ rest & exercise
2. Digoxin
   - Category – controls atrial fibrillation
   - Effect – Lowers HR @ rest & exercise
3. HydroChloroThiazide
   - Category – diuretic
   - Effect – Little effect on HR but increases urination frequency
4. Norvasc
   - Category –
Case Study

Medication Considerations

1. Metoprolol
   - Category – beta blocker
   - Effect – Lowers HR & BP @ rest & exercise

2. Digoxin
   - Category – controls atrial fibrillation
   - Effect – Lowers HR @ rest & exercise

3. HydroChloroThiazide
   - Category – diuretic
   - Effect – Little effect on HR but increases urination frequency

4. Norvasc
   - Category – Calcium Channel Blocker
   - Effect – Lowers Heart Rate, Dilates Arterial Vessels
Case Study

Short Term Goals
1. Recitation and use of sternal precautions 1X with verbal cueing
2. Minimal assistance of 1 person with bed mobility with RPE of <6/10
3. Minimal assistance with transfers with 1 person with RPE of <6/10
4. Minimal assistance with ambulation for 250 ft within 5 minutes at 2 mph with 3 rest periods with RPE of <6/10
5. Ascend/descend 6 steps with handrail with RPE of <6/10
6. Supervision with ADLS (hygiene, dressing) at 2-3 MET level
7. Family assistance with proper patient handling with verbal cueing 2X/4X

LTG’s to be achieved in acute care environment (3-5 days duration)
1. Independent recitation and application of sternal precautions x 2 repetitions without verbal assistance
2. Independent for bed mobility maneuvers with RPE < 4/10
3. Independent transfers (to stand, to sit, to chair, to toilet) with RPE < 4/10
4. Independent ambulation x500’ within 3 minutes at 3 mph with 2 or less rest periods with RPE ≤ 4/10
5. Independent ascent/descent 12 steps with handrail, light finger tip pressure with RPE ≤ 4/10
6. Independent in essential ADLs (hygiene, dressing) at 3-5 met level
7. Family will demonstrate appropriate and safe patient handling as required x 2 sessions and verbalize precautions x 2 sessions independently
Case Study Treatment Plan

1. Patient instruction in sternal precautions, energy conservation, self monitoring
2.
Case Study

Treatment Plan
1. Patient instruction in sternal precautions, energy conservation, self monitoring
2. Inspiratory Muscle Training (segmental breathing, diaphragmatic)
3. Progressive therapeutic exercise
   a.
Case Study

Treatment Plan

1. Patient instruction in sternal precautions, energy conservation, self monitoring
2. Inspiratory Muscle Training (segmental breathing, diaphragmatic)
3. Progressive therapeutic exercise
   a. General LE (AAROM, progress to Resistive)
   b. UEs within limits of sternal precautions, resistance up to 5# unilaterally
4.
Case Study

Treatment Plan
1. Patient instruction in sternal precautions, energy conservation, self monitoring
2. Inspiratory Muscle Training (segmental breathing, diaphragmatic)
   a. General LE (AAROM, Resistive and IEP)
   b. UEs within limits of sternal precautions, resistance up to 5# unilaterally
3. Progressive therapeutic exercise
   a. General LE (AAROM, Resistive and IEP)
   b. UEs within limits of sternal precautions, resistance up to 5# unilaterally
4. Bed Mobility
5. Transfer Training
   a. Mobility training
6.
Case Study

**Treatment Plan**
1. Patient instruction in sternal precautions, energy conservation, self monitoring
2. Inspiratory Muscle Training (segmental breathing, diaphragmatic)
3. Progressive therapeutic exercise
   a. General LE (AAROM, Resistive and IEP)
   b. UEs within limits of sternal precautions, resistance up to 5# unilaterally
4. Bed Mobility
5. Transfer Training
   a. Mobility training
6. Gait Training
   a. Progressive ambulation as tolerated
7. Family training (sternal precautions, mobility assist techniques, safe exercise practice)

*continued*
Case Study

Treatment Plan
1. Patient instruction in sternal precautions, energy conservation, self monitoring
2. Inspiratory Muscle Training (segmental breathing, diaphragmatic)
3. Progressive therapeutic exercise
   a. General LE (AAROM, Resistive and IEP)
   b. UEs within limits of sternal precautions, resistance up to 5# unilaterally
4. Bed Mobility
5. Transfer Training
   a. Mobility training
6. Gait Training
   a. Progressive ambulation as tolerated
7. Family training (stenal precautions, mobility assist techniques, safe exercise practice)
   * Monitoring patient response to activity (rating of perceived exertion, vital signs, oxygenation, cardiac rhythm)

Questions
References