Blood Pressure during Exercise
- Sources of Error
- Normal response
- Hypertensive response
- Hypotensive response
- Recovery blood pressures

Guidelines for accurate manual blood pressure
- subject sitting quietly at least 5 min
- no caffeine (1 hr), no smoking (15 m)
- arm muscle relaxed and flexed slightly
- inflate cuff 20-30 mmHg above SBP
- deflate slowly (3mmHg/s)
- record 1st and 5th sounds
- do not re-measure for a full minute

What if you can't hear Korotkoff sounds?
- Have the subject raise their arm and open and close their hand 5-10 times
  - this dilates the blood vessels of the deeper extremities
- Try again

BP cuff size and placement?
- Lower edge at least 1 inch above the antecubital space
- bladder width at least 40% of the circumference, centered over the brachial artery
  - too small will over-estimate bp
  - too large will under-estimate bp
    - 5 inch wide for normal adults
    - 1.5 inches (infants) to 8 inches (obese)

Korotkov Sounds
- Phase 1
  - appearance of a clear tapping sound
- Phase 2
  - soft murmurs
- Phase 3
  - louder murmurs as blood flow increases
- Phase 4
  - sound is suddenly muffled
- Phase 5
  - sounds disappear

Human Hearing and BP
- Auscultation Method
  - Korotkoff sounds
    - 18-26 Hz for systole
    - 5-50 Hz for diastole
- Human ear
  - lowest intensity, 16 Hz
  - best range, 200-4000 Hz
  - human speech, 12-250 Hz
Systolic 18-26 Hz
Diastolic 5-50 Hz

3 Sources of Error
- Observer bias
  - habitually record the pressure higher or lower
  - round to nearest 0 or 5 digit
- Faulty equipment
  - cuff size
  - calibration
- Poor technique
  - deflation rate (3-5 mm/s)

Measurement Site
- R or L arm
- central, brachial, radial, finger

“Normal” BP response

Normal BP Response

Resting Hypertension Type 1
- hypertension at rest
- bp increases at same rate or faster than normals
- higher peak systolic bp
- pressure may continue to rise after exercise and stay high
- failure to reduce TPR
- exercise may not be a good treatment
Resting Hypertension Type 2
• Second case
  – hypertension at rest
  – less rise in bp
  – normal peak systolic bp
  – normal decrease in TPR
  – exercise may be a good therapeutic measure

Labile Hypertension Response
• Normal resting blood pressure
• higher than expected rise in bp with exercise
  – increased risk of hypertension
  – in older men, a predictor of mortality from CAD

BP response in CAD patients
• A rise in sbp with exercise is a good sign
• Failure to increase sbp indicates ischemia and decreased ventricular function
• A rise in dbp of > 20% is a sign of ischemia, occlusion, lower ejection fraction

Hypotensive Exercise Response
• Systolic hypotension, cause?
  – severe ischemia, decreased ventricular function
  – activation of ventricular mechanoreceptors, a vasovagal reflex?
• Exertional hypotension (bp < resting)
  – as reliable as ST depression in predicting severe CAD

Recovery Blood Pressure
• Normal responses
  – rapid fall in bp
  – temporary rebound (1 min) then a rapid fall
• CAD
  – fails to fall as fast as normal subjects
  – 20% had an increase in SBP

Drugs that may alter the blood pressure response
• Antihypertensives
  – can significantly reduce exercise bp response
    • ace inhibitors (A-II converting enzyme)
    • angiotensin II receptor blockers
    • beta blockers
• Diuretics
  – usually affect resting bp but not exercise
• Psychoactive drugs (tranquilizers)
  – moderate bp changes during exercise
**Blood Pressure Lab**

- Compare manual bp readings on the right and left arm
- Compare resting bp readings--brachial manual and finger finapres
- Measure manual and continuous bp readings during recovery and look for the over-shoot response
- Compare bp response to resistive exercise--normal breathing and breathe holding

**Finapres (Portapres)**

- A beat-to-beat blood pressure measurement
- Measures pulse pressure from the middle finger

**Tonometer**

- Measures pressure pulse over the radial artery
- Beat by beat blood pressures

**Conclusions**

- Blood pressure readings during exercise provide information about
  - Vasoconstriction (DBP)
  - ventricular function (SBP)
  - future hypertension