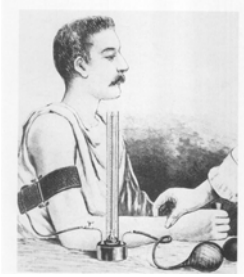
Blood Pressure during Exercise

- 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?

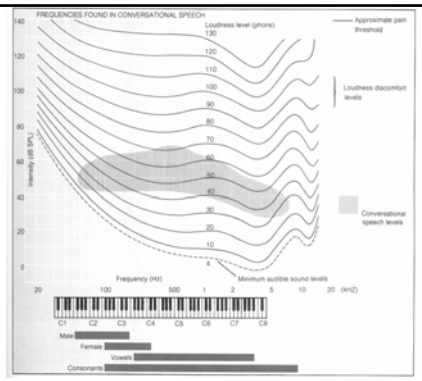
- Lower edge at least 1 inch above the antecubital space
- bladder width at least 40% of the circumference, centered over the brachial artery
  - too small will over-estimate bp
  - too large will under-estimate bp
    - 5 inch wide for normal adults
    - 1.5 inches (infants) to 8 inches (obese)

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



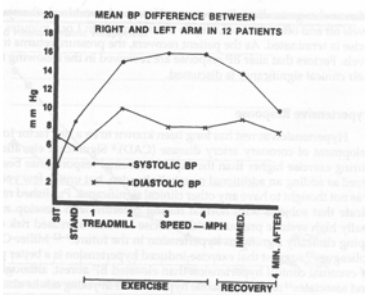
Systolic 18-26 Hz
Diastolic 5-50 Hz

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

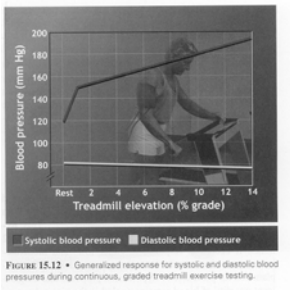


FIGURE 15.12 • Generalized response for systolic and diastolic blood pressures during continuous, graded treadmill exercise testing.

McArdle, Katch, Katch

Normal BP Response

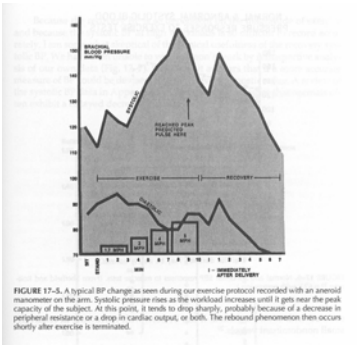


FIGURE 17–5. A typical BP change as seen during our exercise protocol recorded with an aneroid manometer on the arm. Systolic pressure rises as the workload increases until it gets near the peak capacity of the subject. At this point, it tends to drop sharply, probably because of a decrease in peripheral resistance or a drop in cardiac output, or both. The rebound phenomenon then occurs shortly after exercise is terminated.

Ellstad

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 <u>not</u> 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

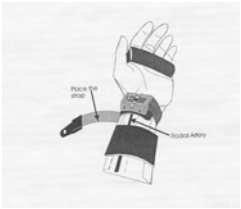
- **Compare manual bp readings on the right and left arm**
- **Compare resting bp readings--brachial manual and finger finapres**
- **Measure manual and continuous bp readings during recovery and look for the over-shoot response**
- **Compare bp response to resistive exercise –normal breathing and breathe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

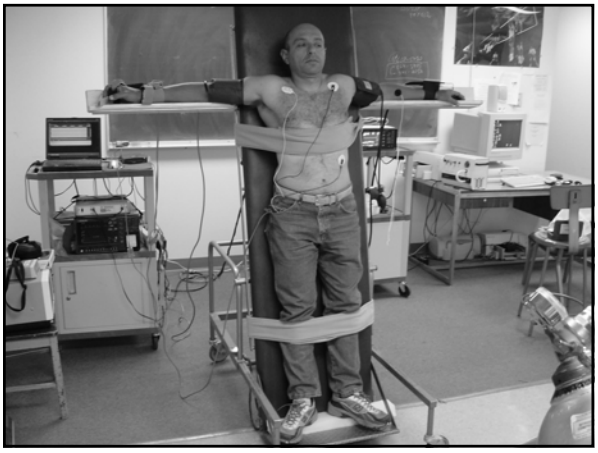
Finapres (Portapres)

- **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**