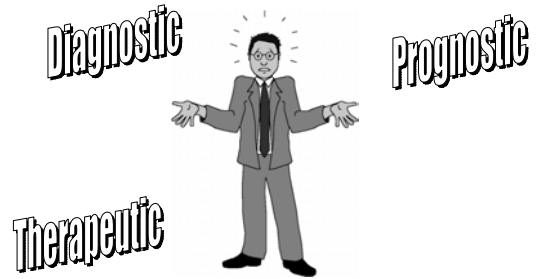**Clincal Exercise Testing**

- ❖ Purposes of clinical exercise testing
- ❖ Types of exercise testing
- ❖ Other stress testing procedures

What are the purposes of a clinical exercise test?

Diagnostic   Prognostic

Therapeutic

Diagnostic Testing for CAD

● **Most useful in persons with an "intermediate" probability of CAD**

○ Asymptomatic, <10% will have positive result

○ Symptomatic, assesses extent of disease

TABLE 5-1. Pretest Likelihood of Coronary Artery Disease*,†					
Age	Gender	Typical Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain	Asymptomatic
30–39	Men	Intermediate	Intermediate	Low	Very low
	Women	Intermediate	Very low	Very low	Very low
40–49	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Low	Very low	Very low
50–59	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Intermediate	Low	Very low
60–69	Men	High	Intermediate	Intermediate	Low
	Women	High	Intermediate	Intermediate	Low

*No data exist for patients who are <30 or >69 years, but it can be assumed that prevalence of CAD increases with age. In a few cases, patients with ages at the extremes of the decades listed may have probabilities slightly outside the high or low range. High indicates >90%; intermediate, 10–90%; low, <10%; and very low, <5%.

†Reprinted with permission from Gibbons RA, Balady GJ, Beasely JW, et al. ACC/AHA guidelines for exercise testing. J Am Coll Cardiol 1997;30:260–315.

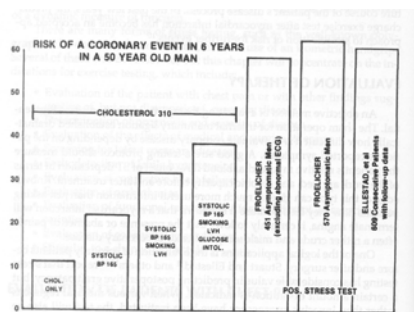CAD Risk Factors and Stress Testing

FIGURE 5–1. Graph of the relative capacity to predict coronary events among the various risk factors used in the Framingham study as compared with the stress test.

Am Coll. Cardiol. and AHA guidelines for exercise testing: rating scale (1993)

Class 1 = consensus exercise is necessary

Class 2 = frequently used but divergence of opinion regarding justification for exercise testing

Class 3 = agreement that exercise testing is of little value, inappropriate, or contraindicated.

Guidelines for Exercise Testing, cont.

- **Class 1**
  - Diagnosis of men with signs/symptoms of CAD
  - To evaluate functional capacity
  - To assess prognosis
  - To evaluate patients with suspected exercise-induced arrhythmias

- **Class 2**
  - Diagnosis of women with chest pain
  - Diagnosis of patients on digoxin or right bundle branch block
  - To evaluate functional capacity and response to drugs
  - To evaluate variant angina
  - To serially follow patients with CAD

When not to Exercise Test

- **Class 3**
  - To evaluate patients with PVCs
  - To diagnose CAD in patients with WPW syndrome or left bundle branch block

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Exercise Testing in Apparently Healthy Individuals

- **Class 1**
  - None

- **Class 2**
  - To evaluate symptomatic males over 40 (special occupations, > 2 risk factors, start vig. exercise)

- **Class 3**
  - Asymptomatic men and women with no risk factors or chest discomfort not thought to be cardiac

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Other diagnostic conditions for exercise testing

- To assess children for congenital heart disease
- Early detection of labile hypertension
- Evaluation of arrhythmias that occur only during exercise
- Determination of when to replace damaged valves
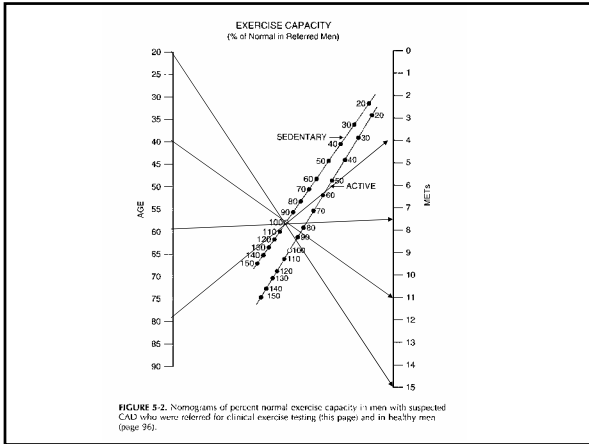

Exercise Testing to Assess Prognosis

Prognosis = the probable outcome of an attack of a disease

(Dorland's Medical Dictionary)

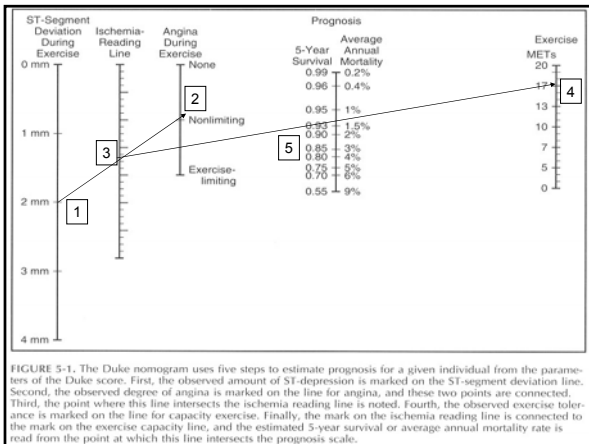## Exercise Functional Capacity as a Prognostic Predictor

- Symptoms, functional capacity, and myocardial ischemia considered together are useful in the evaluation of persons with known or suspected CAD.

  - Symptoms: recorded at rest and during exercise
  - Functional capacity = METs achieved before symptoms appear
  - Myocardial ischemia = assessed by ST segment changes and symptoms

FIGURE 5-2. Nomograms of percent normal exercise capacity in men with suspected CAD who were referred for clinical exercise testing (this page) and in healthy men (page 96).

Clinically Significant METs for Maximal Exercise Capacity

< 5 METS = poor prognosis

10 METS = prognosis with medical therapy as good as coronary bypass surgery

13 METS = excellent prognosis regardless of other exercise responses

18 METS = elite endurance athletes

20 METS = world class athletes

Robergs et al. 97

FIGURE 5-1. The Duke nomogram uses five steps to estimate prognosis for a given individual from the parameters of the Duke score. First, the observed amount of ST-depression is marked on the ST-segment deviation line. Second, the observed degree of angina is marked on the line for angina, and these two points are connected. Third, the point where this line intersects the ischemia reading line is noted. Fourth, the observed exercise tolerance is marked on the line for capacity exercise. Finally, the mark on the ischemia reading line is connected to the mark on the exercise capacity line, and the estimated 5-year survival or average annual mortality rate is read from the point at which this line intersects the prognosis scale.

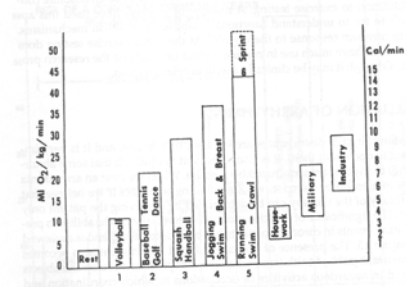## Exercise testing to assess when to return to work

FIGURE 5-2. Various types of exercise presented in relation to oxygen uptake in milliliters per kilogram of body weight and calories expended per minute. (Adapted from classification schema of Wells, Balke, and Van Fossan by Falls, HB. In J SC Med Assoc [suppl], December 1969.)

Occupational Testing

● **Used to help assess when patients can return to work or perform strenuous activities**

  ○ 8-hr energy expenditure requires $\leq$ 50% peak METs

  ○ Peak energy expenditure < 80% peak METs (brief exposures)

Therapeutic Exercise Testing

Therapeutic = pertaining to or effective in the treatment of disease

Dorland's Medical Dictionary

Exercise Testing is sometimes used to assess the effectiveness of various medical therapies:

• **drug interventions**
• **dietary interventions**
• **surgical interventions**

Therapeutic Conditions for Exercise Testing

- To evaluate prognosis and functional capacity in uncomplicated MIs

- To evaluate coronary artery bypass graft and percutaneous transluminal **coronary angioplasty** patients

Types of Stress Testing

- GXT (treadmill, cycle)
- Upper body testing
- Pharmacological testing

FIGURE 5-3. Common exercise protocols. Stage I of the conventional Bruce treadmill protocol starts at 1.7 mph, 10% grade. The "modified" Bruce protocol may start at 1.7 mph, 0% grade, or 1.7 mph, 5% grade, as shown here.

Arm Ergometry

- **patients who can't exercise with legs**

- **Patients with symptoms only during arm work**

- **Arm ergometer GXT**
  - Work increments of ~ 10 W
  - $\geq$60 rpm

- **> HR, BP, Ve, lactate**

- **VO_2pk ~ 20-35% lower than leg ergometery**

- **poor correlation with leg VO_2pk**

Air Force Research Laboratory
Brooks AFB, Texas

Dual-Cycle Ergometer used for Exercise-Enhanced Prebreathe

Exercise Testing Special Cases

• **Modified stress testing to simulate work conditions**

if work requires weight-carrying or lifting, assess EKG during a similar activity

Pharmacological Stress Tests

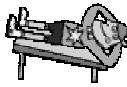- **Used for patients who cannot exercise**

- **Dobutamine: stimulates cardiac b-receptors and increases NE release from sympathetic nerve endings in the heart.**
  - Simulates exercise response
  - Used with echocardiography to assess cardiac wall motion

- **Adenosine: coronary vasodilator**
  - Used with coronary imaging to locate blocked arteries

Summary

- **Why do you perform clinical exercise testing?**
  - ○ diagnosis, prognosis, therapeutic
- **How do you perform clinical exercise testing?**
  - ○ standard procedures, special cases
- **What if you can't exercise a patient?**
  - ○ pharmacological stress test