1. Overview of Cardiac Stress Testing

A cardiac stress test evaluates how the heart performs when its workload is increased. Stress (exercise or medication) increases oxygen demand, and the test determines whether the coronary arteries can meet that demand.

It also identifies:
Myocardial ischemia
Arrhythmias induced by stress
Exercise tolerance
Effectiveness of cardiac interventions (medications, stents, CABG)

Stress tests are commonly ordered for patients to experience:
Chest pain
Shortness of breath
Abnormal resting EKG
Family history of CAD
Post–cardiac treatment follow-up

2. Types of Cardiac Stress Tests

A. Exercise Stress Test (Treadmill or Bicycle)

Most common method.
Physiological effects of exercise:
↑ Heart rate
↑ Blood pressure
↑ Myocardial oxygen demand
↑ Cardiac output

Exercise Protocols Used:
1. Bruce Protocol (Most widely used)
Stages increase every 3 minutes
Each stage increases both speed AND incline
Suitable for average, ambulatory patients

2. Modified Bruce Protocol
Has two lower-intensity warm-up stages
Ideal for elderly or deconditioned patients

3. Naughton Protocol
Low-intensity with small, gradual workload increases
Used in patients with limited ability

B. Pharmacologic Stress Testing
Used when patients cannot physically exercise due to:
Age
Injury
Severe obesity
Heart failure
Orthopedic limitations

Medications Used:
1. Adenosine / Lexiscan (Regadenoson)
Causes coronary vasodilation
Healthy coronary arteries dilate more than diseased ones
Helps identify perfusion defects
Side effects: flushing, chest pressure, dizziness, shortness of breath
Reversal: Aminophylline

2. Dobutamine
Increases heart rate and myocardial contractility similar to exercise
Used when vasodilators are contraindicated (ex: asthma, COPD)

3. Patient Preparation
Diet & Medications
No caffeine (coffee, chocolate, soda, tea) for 4–12 hours
Light meal allowed 2 hours before (unless instructed NPO)
Avoid beta blockers, calcium channel blockers, or nitrates if ordered (they slow HR response)
Wear appropriate clothing and shoes
Avoid smoking or alcohol prior to test

Safety Checklist
Obtain informed consent
Obtain history of:
Chest pain
Dyspnea
HTN
Medications
Recent surgeries
Cardiac conditions
Verify emergency equipment is available:
Crash cart
Oxygen
AED
Medications (nitroglycerin, aspirin, aminophylline)

4. Contraindications
Absolute Contraindications
Test must NOT be performed if present:
Acute MI (within 48 hours)
Unstable angina
Uncontrolled arrhythmias
Severe symptomatic aortic stenosis
Decompensated heart failure
Acute aortic dissection
Acute pulmonary embolism
Severe hypertension (≥180/110 or as per protocol)
Relative Contraindications
Perform only if benefits outweigh risks:
Electrolyte imbalances
Tachyarrhythmias
Mental or physical limitations preventing safe performance
Moderate valvular disease

5. Monitoring During the Test
Continuous Monitoring Required
12-lead EKG (modified lead placement for exercise)
Heart rate (looking for target HR response)
Blood pressure at each stage
Patient symptoms (chest pain scale, dyspnea, dizziness, fatigue)
Technician Responsibilities
Stop the test for any abnormal or concerning symptoms
Watch for changes in:
ST segment
T-wave abnormalities
PVCs or runs of VT
Atrial arrhythmias
Drop in HR or BP

6. Test Termination Criteria
Immediate Stop If:
Severe chest pain
ST elevation or significant ST depression
Drop in systolic BP ≥ 10 mmHg
Dangerous arrhythmias (VT, bigeminy, multifocal PVCs)
Cyanosis or pallor
Patient requests to stop
Ataxia or signs of poor perfusion

Other Reasons to Stop:
Extreme fatigue
Reaching target heart rate (if protocol calls for termination at THR)

7. Target Heart Rate (THR)
Formula:
THR = (220 − age) × 85%

Resting HR, medications, and patient conditioning may influence the ability to reach this goal.

8. EKG Findings in Ischemia and Stress Testing
Ischemic Indicators:
ST segment depression
Horizontal or downsloping is most concerning
≥1 mm lasting 0.08 seconds after J-point

Injury Indicators:
ST elevation (rare during stress test → emergency)
Arrhythmias Seen:
PVCs
PACs
Atrial tachycardia
Ventricular tachycardia (STOP immediately)

Other Abnormalities:
Decreasing R-wave amplitude
Worsening conduction blocks (ex: new LBBB)

9. Recovery / Cool-Down Phase
After stopping exercise:
Patient walks slowly for 2–3 minutes
Continue EKG monitoring for 5+ minutes
BP should gradually return to baseline

Watch for:
Hypotension
Syncope
Delayed arrhythmias
Serious complications can appear after the test, which is why monitoring cannot stop immediately.

10. Stress Testing with Imaging

A. Stress Echocardiography

Compares resting vs. post-exercise ultrasound images

Looks for:

Wall motion abnormalities

Poor contractility in ischemic areas

B. Nuclear Stress Testing

Uses radioactive tracer (ex: Thallium or Technetium)

Shows areas of decreased blood flow ("cold spots")

More accurate for diagnosing coronary artery disease

C. CT Stress Test / MRI Stress Test

Less common but used for advanced imaging

Helps visualize coronary arteries and perfusion

11. Potential Complications

Although rare, complications include:

Myocardial infarction

Dangerous arrhythmias

Hypotension

Stroke

Syncope

Cardiac arrest

Emergency equipment must always be ready.