Cardiology Diagnoses, Tests, and Procedures Primer

Diagnoses

Myocardial infarction (MI): Damage to the cardiac muscle due to lack of blood (and therefore oxygen) supply. Without access to oxygen and nutrients, the cardiac cells begin to die. MI usually occurs from a blood clot or blockage in one of the coronary arteries. This is also commonly known as a heart attack. MIs can cause lasting damage or death.

Stroke: Loss of blood flow (and thus oxygen) to part of the brain, often by a clot (ischemic stroke) or a ruptured blood vessel in the brain (hemorrhagic stroke). Without oxygen and nutrients, the brain cells start to die. Strokes can cause lasting brain damage, disability, or death.

Cardiac arrest: This is an arrythmia (irregular heart rhythm) that causes the heart to stop beating. Death occurs within a few minutes if there is no intervention. It is also called sudden cardiac death. Note, this is not the same as an MI.

Takotsubo cardiomyopathy: Also known as *broken heart syndrome* or *apical ballooning syndrome*. This condition is triggered by an emotionally or physically stressful event. Although it is still not completely clear, it is thought that takotsubo cardiomyopathy is caused by an influx of adrenaline (epinephrine) into the blood stream, which can temporarily weaken the heart. This condition has similar symptoms to a heart attack and can be misdiagnosed if proper tests are not administered.

Tests and Procedures

Creatine phosphokinase test (CPK): CPK, also known as creatine kinase (CK) or phosphocreatine kinase, is an enzyme found in the skeletal muscle, the brain, and the heart. When a tissue is damaged, this enzyme is leaked into the blood. Elevated blood levels of CPK indicate that there has been a stress or injury to the tissue. CPK elevation in the blood is detectable 12–24 hours after injury. Specific isoforms of this enzyme, or isoenzymes, MM (muscle), BB (brain), or MB (heart), can help determine which tissue was injured. This test is sometimes used to determine if a heart attack has occurred. CK-MB levels typically rise 2–4 hours after an MI, peak around 24 hours, and return to normal by about 48 hours. CK-MB is used as a cardiac biomarker and is sometimes broadly referred to as part of a cardiac isoenzyme panel, or cardiac isos for short.

Troponin test: Troponin is a protein found in muscle cells; it is not typically found in the blood stream. This test measures the concentration of cardiac specific troponin (cTN) isoforms, cardiac troponin I (cTnI), and cardiac troponin T (cTnC), in the blood stream as their presence indicates damage to the heart muscle. This test is routinely done to determine if a MI has occurred. Troponin I and T typically increase 2–4 hours after an MI, peak around 48 hours, and can stay elevated for 7–10 days. These are used as cardiac biomarkers and are sometimes broadly referred to as part of a cardiac isoenzyme panel, or cardiac isos for short.

Electrocardiogram: This test evaluates the electrical activity of the heart. Electrodes, typically 12 of them, are placed onto the body in specific locations to provide information about the heart's electrical activity. The read out from the electrodes (leads) shows the timing, rhythm, and strength of electrical impulses. This test can be used to diagnose heart rhythm anomalies and other cardiac issues and can be performed in clinical settings and in ambulances. If longer-term (e.g., a couple days or even a month) monitoring of heart activity is needed, a Holter monitor (a type of wearable heart monitor) or cardiac event monitor can be used.

Cardiac catheterization: In this procedure a catheter (thin tube) is inserted into an artery, typically at the groin, neck, or arm, and then fed to the heart. This procedure is often used along with other procedures (e.g., angiogram; angioplasty). Catheters can be used for a variety of procedures but the one described here pertains specifically to a cardiac procedure.

Coronary angiogram: This test can be done to look for blockages in the arteries. It is a procedure that uses X-ray and contrast (X-ray detectable dye, also called tracer) to determine blood flow through the heart. The dye is injected into the blood stream and the movement of that dye can be followed through the coronary arteries. This procedure is done

in a clinical setting and is performed with cardiac catheterization. The procedure takes 30–60 minutes. See a brief video of the procedure here:

- NEJMvideo. (2017). Coronary angiography [video]. Running time: 0:07 min. <https://youtu.be/HKXTZUYTxkA>

Coronary angioplasty: Also known as percutaneous coronary intervention (PCI), is a procedure to open blocked arteries in the heart. (Angioplasty can be done in any part of the body, but coronary angioplasty pertains specifically to the arteries feeding the heart.) Typically, a balloon-tipped catheter is guided to the heart and the balloon is inflated at the site of blockage. This balloon widens the artery to restore blood flow back to the damaged heart muscle. Once the artery has been opened, a stent (a tiny mesh coil) can be inserted to keep the vessel open (coronary stent placement), the area inside the artery can be shaved away (atherectomy), or a laser can be used to remove blockage (laser angioplasty).

Fibrinolytic or thrombolytic therapy: In the case of suspected MI or stroke, a clot-busting drug can be administered. These are not always used but work best if they are given within 30 minutes of symptoms. The goal of these drugs is to dissolve the clot and restore blood flow. The patient must be thoroughly screened prior to administration. The most serious possible complication is intracranial bleeding resulting in death.

Echocardiogram: This procedure uses sound waves to determine functionality of the heart in motion. It shows movement of the valves and chambers, and when used with Doppler can show blood flow. There are two types of this test: transthoracic echocardiogram (TTE), which is the most common, and transesophageal echocardiogram (TEE). The types differ in where the transducer is placed. The transducer releases high-frequency sound waves and then records the echoes of those waves. The information is then converted into a moving image of the heart. This test takes place in a clinical setting and can be done during rest, during activity (stress echocardiogram), or during simulated activity (via injection of a drug that increases heart rate and pumping action) to determine how the heart performs under different scenarios. A video with a few short echocardiogram images can be found here:

- NEJMvideo. (2010). Transthoracic echocardiogram showing akinesis on apical four-chamber view [video]. Running time: 0:31 min. <https://youtu.be/CM9TmiHpKMA>

Exercise stress test: This test determines how the heart works during physical activity (stress). Due to the increased cardiovascular demands of exercise, this test can reveal issues with blood flow, cardiac ability, and exercise capacity. The procedure requires the person to exercise, usually on a treadmill or bike. If one cannot exercise, drugs are used to increase heart rate and pumping action. The nurse or technician hooks up the ECG wires to the patient's chest. Next, a baseline ECG recording of the person at rest, both while they are lying down and standing, is determined. The patient then begins to walk slowly on the treadmill with gradual increases in speed and elevation via a set protocol. ECGs are continuously recorded throughout the exercise test and into recovery to monitor for any ECG changes or arrythmias the patient may exhibit during exercise. Blood pressure is also monitored, as are any symptoms the patient experiences. Depending on the issue and what type of information is needed, this test may be done as described above or may be combined with imaging technology (nuclear stress test or echocardiographic stress test).

Primer References

- National Institutes of Health Medline
- Harvard Health
- Mayo Clinic
- University of Rochester Medical Center
- AACC Lab Tests Online