TABLE 293-2 RELATION OF METABOLIC EQUIVALENT TASKS (METs) TO STAGES IN VARIOUS TESTING PROTOCOLS

Functional Class	Clinical Status	O_2 Cost mL/kg/min	METs	Treadmill Protocols			
				BRUCE Modified 3 min Stages		BRUCE 3 min Stages	
				MPH	%GR	MPH	%GR
NORMAL AND I	HEALTHY, DEPENDENT ON AGE, ACTIVITY			6.0	22	6.0	22
				5.5	20	5.2	20
				5.0	18	5.0	18
		56.0	16				
		52.5	15				
		49.0	14				
		45.5	13	4.2	16	4.2	16
		42.0	12				
		38.5	11	3.4	14	3.4	14
	SEDENTARY HEALTHY	35.0	10				
		31.5	9				
		28.0	8				
	LIMITED	24.5	7	2.5	12	2.5	12
II	SYMPTOMATIC	21.0	6				
		17.5	5	1.7	10	1.7	10
III		14.0	4				
		10.5	3	1.7	5		
		7.0	2	1.7	0		
IV		3.5	1				

Abbreviations: GR, grade; MPH, miles per hour.

Source: Modified from GF Fletcher et al: Circulation 104:1694, 2001.

segments of the coronary vasculature at the expense of diseased segments. Alternatively, a graded incremental infusion of dobutamine may be administered to increase MVO_2. A variety of imaging options are available to accompany these pharmacologic stressors (Fig. 293-2). The development of a transient perfusion defect with a tracer such as thallium-201 or 99m-technetium sestamibi is used to detect myocardial ischemia.

Echocardiography is used to assess left ventricular function in patients with chronic stable angina and patients with a history of a prior myocardial infarction, pathologic Q waves, or clinical evidence of heart failure. Two-dimensional echocardiography can assess both global and regional wall motion abnormalities of the left ventricle that are transient when due to ischemia. Stress (exercise or dobutamine) echocardiography may cause the emergence of regions of akinesis or dyskinesis that are not present at rest. Stress echocardiography, like stress myocardial perfusion imaging, is more sensitive than exercise electrocardiography in the diagnosis of IHD. Cardiac magnetic resonance (CMR) stress testing is also evolving as an alternative to radionuclide, PET, or echocardiographic stress imaging. CMR stress testing performed with dobutamine infusion can be used to assess wall motion abnormalities accompanying ischemia, as well as myocardial perfusion. CMR can be used to provide more complete ventricular evaluation using multislice magnetic resonance imaging (MRI) studies.

Atherosclerotic plaques become progressively calcified over time, and coronary calcification in general increases with age. For this reason, methods for detecting coronary calcium have been developed as a measure of the presence of coronary atherosclerosis. These methods involve computed tomography (CT) applications that achieve rapid acquisition of images (electron beam [EBCT] and multidetector [MDCT] detection). Coronary calcium detected by these imaging techniques most commonly is quantified by using the Agatston score, which is based on the area and density of calcification. Although the diagnostic accuracy of this imaging method is high (sensitivity, 90–94%; specificity, 95–97%; negative predictive value, 93–99%), its prognostic utility has not been defined. Thus, its role in CT, EBCT, and MDCT scans for the detection and management of patients with IHD has not been clarified.

CORONARY ARTERIOGRAPHY

(See also Chap. 272) This diagnostic method outlines the lumina of the coronary arteries and can be used to detect or exclude serious coronary obstruction. However, coronary arteriography provides no information about the arterial wall, and severe atherosclerosis that does not encroach on the lumen may go undetected. Of note, atherosclerotic plaques characteristically are scattered throughout the coronary tree, tend to occur more frequently at branch points, and grow progressively in the intima and media of an epicardial coronary artery at first without encroaching on the lumen, causing an outward bulging of the artery—a process referred to as remodeling (Chap. 291e). Later in the course of the disease, further growth causes luminal narrowing.

Indications Coronary arteriography is indicated in (1) patients with chronic stable angina pectoris who are severely symptomatic despite medical therapy and are being considered for revascularization, i.e., a percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG); (2) patients with troublesome symptoms that present diagnostic difficulties in whom there is a need to confirm or rule out the diagnosis of IHD; (3) patients with known or possible angina pectoris who have survived cardiac arrest; (4) patients with angina or evidence of ischemia on noninvasive testing with clinical or laboratory evidence of ventricular dysfunction; and (5) patients judged to be at high risk of sustaining coronary events based on signs of severe ischemia on noninvasive testing, regardless of the presence or severity of symptoms (see below).

Examples of other indications for coronary arteriography include the following:

1. Patients with chest discomfort suggestive of angina pectoris but a negative or nondiagnostic stress test who require a definitive diagnosis for guiding medical management, alleviating psychological stress, career or family planning, or insurance purposes.
2. Patients who have been admitted repeatedly to the hospital for a suspected acute coronary syndrome (Chaps. 294 and 295), but in whom this diagnosis has not been established and in whom the presence or absence of CAD should be determined.