CARDIAC PHANTOM

Phantoms for cardiac (heart) phantom imaging within the Clinical Trials Network use designs by Medical Designs, Inc that have been previously used for myocardial perfusion testing with SPECT systems. As shown below the phantom consists of a body cavity into which myocardial inserts are placed that can simulate stress and rest imaging. The myocardial inserts may be custom designed to simulate a wide variety of myocardial perfusion defects for infarction, ischemia, reversible defects or other clinical scenarios for PET or SPECT imaging.

Listed below are descriptions of the three different scenarios that have been used in multicenter testing at 130 VA Medical Centers in the years 2000, 2003 and 2009.

Scenario 1:
There exists two regions of myocardial ischemia. The cardiac simulator contains two simulated areas of diminished perfusion to be imaged in both stress and rest myocardial perfusion studies. Both of two areas show a reduction in volume between the stress and rest studies, although the clinical significance of these reductions varies. Dimensions and locations of the defects are as follows: One defect is located in the mid-apical area of the anterior and antero-septal segments. It measures $12.5 \times 12.5 \times 10$ mm in the stress images, and $9.9 \times 9.5 \times 9$ mm in the rest images, a reduction in volume of approximately 48%. The other defect is located in the mid-basal area of the lateral and infero-lateral segments. The dimensions in the stress simulator are $16 \times 16 \times 10$ mm. The rest simulator dimensions are $14 \times 14 \times 10$ mm, which implies a volume reduction of 23 percent.

Scenario 2-clinical exercise:
The patient is a 55 year-old male with a smoking history, hyperlipidemia, and sedentary life-style. He had chest pain 2 years ago, lasting 2-3 hours, which resolved and was ignored. The patient now presents with typical angina worsening over the last month. Stress was administered by having him run on a treadmill using a standard Bruce Protocol. He exercised for 9 minutes and reached a heart rate of 155 beats per minute at which time he had some chest pressure. His ECG showed no baseline abnormalities and had non-specific ST-T wave changes at peak stress. This phantom contains three defects, two completely fixed defects and one partially reversible defect. Lesion A is $16 \times 16 \times 10$ mm located in the apical anterior region and is partially reversible as represented by a resting defect in the same location as $12.5 \times 12.5 \times 10$ mm. Lesion B is a fixed defect in the mid infero-lateral area that is $16.0 \times 16.0 \times 10.0$ mm in size on both stress and rest. There is a partially reversible “bonus” defect abnormality that is smaller and is located in the mid inferior region and is smaller ($12.5 \times 12.5 \times 10.0$ mm) and is harder to detect.

Scenario 3-clinical exercise:
The patient is a 65 year-old male who presents with substernal chest pressure that radiates to his left arm during mild exertion; he also describes mild dyspnea associated with the chest pressure. His history includes hypertension for which he takes medication, hyperlipidemia, which he attempts to control with diet, and a 50 pack-year smoking history. He had a 2-3 hour episode of sharp chest pain 2 years ago, which resolved and was ignored by the patient. He underwent a two-day rest-stress SPECT myocardial perfusion study. He underwent exercise treadmill stress using a standard Bruce Protocol. He exercised for 5 minutes and 40 seconds and reached a heart rate of 141 beats per minute, during which he had some moderate left chest pressure and dyspnea. The ventricle chambers were different in size and participants should have determined that there is transient ischemic dilatation (TID). The correct answer was at least a 20% increase in size of the ventricular cavity on stress as compared to rest. There was an area of infarction with a fixed defect in the inferobasal region. In addition there was anteroseptal and apical ischemia.