Update 3

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1 Diagnosis, Imaging and Instrumentation

Cardiac single photon emission computed tomography (SPECT) and positron emission tomography (PET) are increasingly being utilised to detect myocardial viability and perfusion in patients with suspected or known coronary artery disease, giving useful diagnostic and prognostic information. These myocardial perfusion imaging techniques are superior to existing approaches for the diagnosis of multi-vessel coronary artery disease and potentially for risk assessment and prediction of cardiac events since they can evaluate left ventricular function as well as coronary flow reserve. Flow-limiting coronary lesions can be identified using hybrid SPECT/CT and PET/CT scanners, which has enormous potential for both diagnosis and management. Advances in cardiovascular molecular biology have aided in the development of molecular imaging, which may be beneficial in the future for evaluating specific molecular and cellular disorders[4]. Planar perfusion imaging has been replaced by SPECT imaging. By spinning detector heads around the patient, multiple planar images of the heart using photons (gamma rays) generated by radiopharmaceuticals are recorded, and myocardial perfusion images are reconstructed using concepts similar to CT imaging. It's widely available and used to check myocardial perfusion and ventricular function in those who have been diagnosed with IHD. The idea has remained the same since its inception in the late 1980s for everyday clinical practise; nevertheless, there have been some substantial adjustments for improved and optimal imaging of the heart,180° acquisitions, for example, have nearly completely supplanted 360° acquisitions. Faster acquisition times have resulted as a result of this, particularly when using two-headed cameras at a 90° angle. Iterative reconstruction has mostly superseded back-projection reconstruction of pictures. Because it is a calculation-intensive technique, it necessitates a lot of computing power[1]. Although it has been frequently available in nuclear medicine since the 1990s, it has only recently become widely used. Due to the increased computational power necessary for higher quality CT pictures, this technology is currently being used in CT imaging. The first-pass extraction of 13NH3 is 80%, and myocardial absorption demands energy. Uptake is linear throughout a large range of cardiac blood flow rates, except at very high flow rates, as with SPECT myocardial perfusion agents. An on-site cyclotron

or proximity to a regional positron radiopharmaceutical source facility are required for imaging with 13NH3. 82RbCl is a potassium analogue that requires energy for myocardial absorption and has a first-pass extraction of 65 percent. Because of its short half-life, it is possible to repeat investigations. 82RbCl has an advantage over 13NH3 in that it can be generated without a cyclotron using a strontium-82/82Rb generator[5].

FDG is utilised to assess glucose utilisation in ischemic myocardium with impaired mitochondrial fatty acid oxidation. Insulin infusion in the fasted state reduced myocardial extraction of free fatty acids by 85% and accelerated myocardial absorption of both FDG and glucose, according to Ng et al. In diabetic individuals as well as those with normal glucose tolerance, FDG absorption is diverse in normal myocardium in the fasting state. Ischemic tissue has increased FDG uptake, whereas scar tissue has significantly reduced or nonexistent uptake[2]. To increase myocardial FDG uptake, researchers used oral glucose loading and continuous insulin, potassium, and glucose infusions. Images produced in non-diabetic patients following insulin infusion were of higher quality than those obtained after oral glucose loading, according to Knuuti et al. Similar findings were found by Ohtake et al in patients with non-insulin-dependent diabetes. Insulin infusion has been considered by several researchers as inconvenient for routine clinical use. Alternatives such as oral glucose loading and insulin bolus injections have been recommended[6].

Carbon-11 acetate, C-11 palmitate, and oxygen-15 water are less widely used PET radiotracers for monitoring regional myocardial oxygen consumption, fatty acid metabolism, and myocardial blood flow[3].