PET/CT in diagnosing cardiovascular disease

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Committee to Revise the 1995 Guidelines For imaging in cardiology: is the total greater than corowvascular angiography. Am Heart J 2006;

Protocols for assessment of viability analysis of hybrid PET/CT cardiac imaging: is the total greater than diseases from diagnosis and prognosis of coronary artery disease (CAD) to evaluation of ischaemic cardiomyopathy is challenging. The downside of noninvasive imaging combines morphological and functional imaging techniques that illustrate plaque anatomy and tissue properties.

Estimated time to complete this activity should not exceed 1.0 hour.

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The patient

Patient preparation for the PET/CT study should yield a sensitivity and specificity rate of 90% and 98% respectively for the identification of myocardial perfusion abnormalities.

The concept was evaluated in patients with suspected CAD in a study by Namdar and colleagues, yielding a sensitivity and specificity of 90% and 98% respectively for the detection of hemodynamically important coronary lesions.

A recent study using PET/CT systems with a 64-slice CT scanner found that CT's positive predictive value for stenosis was lower than PET's for predicting stress-inducible perfusion abnormalities but that the negative predictive value was high.

The high negative predictive value of CT means that only a fraction of patients with suspicious findings on CT will need PET perfusion imaging. Depending on the selected patient population, this fraction is 25% to 50%, thus, only one PET perfusion session is needed for each three patients on average.

The positioning of the patient on the scanner bed is important. It is strongly recommended that the patient's hands be supported upright and not within the field-of-view. It is important that the patient's heart rate is controlled for CT and that caffeine-containing drinks are avoided during the preceding 12 hours. The protocol can start with either study.

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Recent studies have found that the negative predictive value of CT was higher than that from PET (dose 4 mSv compared to 50 mSv). Thus, one PET perfusion study is that it permits the acquisition of functional and anatomical information and data on the hemodynamic consequences is needed. The high negative predictive value of CT means that only a fraction of patients with suspicious findings on CT will need PET perfusion imaging. Depending on the selected patient population, this fraction is 25% to 50%, thus, only one PET perfusion session is needed for each three patients, on average.

The orientation of the patient on the scanner bed is important, because per fusion imaging provides useful complimentary information. As mentioned above, O-15 water and N-13 ammonia offer unique possibilities for assessing functional consequences of coronary stenoses. The limitation of a hybrid study is very similar to that for the individual scan.

The advantage of using PET/CT is that it permits the acquisition of co-registered anatomical and functional images. From a computational perspective, one of the major benefits of hardware-based image fusion is that it permits the acquisition of co-registered anatomical and functional images. From a hardware perspective, the benefits of hybrid imaging systems include the following: the ability to fuse data from different imaging modalities, the ability to perform quantitative analysis, and the ability to perform functional and anatomical imaging in a single session.
PET/CT in Diagnosing Cardiovascular Disease

available, a second low-dose CT scan for attenuation correction is needed. However, to realize the true power of hybrid imaging, an analysis system that is able to handle fused images and data should also be used. This enables accurate association between coronary anatomy and perfusion.

Future Perspectives

The position of PET in cardiac research and patient care is based on its capacity to image perfusion and glucose metabolism. However, because of its excellent image quality, it allows for imaging and quantification of molecular interactions and pathways with picomolar sensitivity, and a number of cellular processes can be studied: e.g., receptor density, enzyme activity, inflammatory processes, and gene expression. In particular, a number of postmortem labelled tracers for imaging cardiac sympathetic and parasympathetic receptors with PET have been developed and validated. These include the catecholamine analogue C11-hydroxyphenylethylamine and tracers for the measurement of both adrenergic and muscarinic receptors. These ligands allow the demonstration of abnormal autonomic function and the differences in diabetic and non-diabetic patients in relation to both cardiac function and metabolic rate. In the future, this system may also make it possible to carry out studies of metabolic changes in disease and to test interventions in the clinical setting.

PET/CT in the Assessment of Coronary Artery Disease

PET/CT allows noninvasive quantification of myocardial blood flow and metabolism. However, to realize the true power of hybrid imaging, an analysis system that is able to handle fused images and data should also be used. This enables accurate association between coronary anatomy and perfusion.

Rupture of vulnerable coronary atheromatous lesions accounts for one-third of all deaths worldwide and constitutes a major source of disability and healthcare costs. Therefore, identifying individual patients at high risk for rupture is an important challenge in clinical medicine. Noninvasive techniques such as multislice CT can characterize morphologic criteria associated with this risk. In contrast, the cardiac molecules used by PET are designed to specifically target individual inflammatory and metabolic activities in atherosclerotic lesions. Platelet rupture is usually a consequence of such inflammatory cell activity. Techniques that visualize plaque appearance and composition do not provide information on plaque inflammation. In patients with symptomatic coronary atheromatosis, FDG PET/CT has been used to identify inflammation within plaques. A variety of cellular molecular characteristics involved in the progression and potential rupture of vulnerable plaques have been identified, including macrophage density, apoptosis, and protease ligands. For these targets, current development is focused on high-performance PET techniques. This approach is possible only with high-performance PET/CT hybrid systems, which allow the simultaneous assessment of coronary arteries using PET/CT methods. These are the only systems that are able to correct for patient movement and cardiac and respiratory motion and are needed and are under development.

Imaging the entire spectrum of cardiovascular diseases from diagnosis and prognosis of coronary artery disease (CAD) to evaluation of ischemic cardiomyopathy is challenging. The decisive factor of noninvasive techniques is that new methods have provided new tools for this target. Obviously, the well-established techniques such as echocardiography and SPECT will continue to play an essential role in clinical practice for patient diagnosis and stratification. However, newer techniques such as PET, cardiovascular magnetic resonance, and multislice computed tomography are demonstrating increasing clinical potential in clinical cardiology. Hybrid imaging devices, the newest development, have matured to a point that they can also be successfully used for cardiovascular imaging. The most promising combination is a hybrid system with multislice CT (MSCT) and PET. Recently, hybrid devices with 64-slice CT aimed specifically at imaging coronary arteries have been developed. Dual-energy CT and PET allow noninvasive imaging of the coronary arteries. The combination of PET/CT is of utmost importance for patient treatment and stratification. The main advantage of MSCT/PET is that it combines the spatial resolution of MSCT with the temporal resolution of PET/CT.

Conclusion

PET/CT has a promising future in the field of cardiovascular imaging. The technique allows for the noninvasive assessment of the coronary arteries, and its potential is still being explored. However, the technique requires further development, and its clinical impact will depend on its ability to provide accurate and reproducible results.

PET/CT is a valuable tool in the diagnosis and management of cardiovascular disease. It provides detailed images of the coronary arteries, helping to identify stenosis and other abnormalities. Additionally, it allows for the assessment of myocardial perfusion and metabolism, which can be crucial in determining the severity and extent of coronary disease. The technique is particularly useful in the evaluation of patients with chest pain, heart failure, and post-MI complications.

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