# Taking PET to heart

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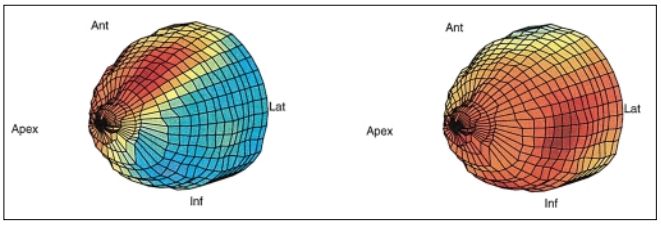
***Technology:*** Positron emission tomography (PET)
***Use:*** PET is an advanced imaging technique that allows noninvasive measurement of absolute concentrations of positron-emitting radiotracers, with high spatial and temporal resolution. Various short-lived isotopes are used to label naturally occurring compounds in the body and other analogues. PET is a tremendous research tool for the evaluation of myocardial perfusion, metabolism, receptors and autonomic innervation.

With perfusion tracers such as rubidium-82 or nitrogen-13 ammonia, PET has the highest diagnostic accuracy among the noninvasive tests for the detection of coronary artery disease (CAD)[1] and can be used to evaluate serial changes in perfusion reserve. PET imaging using fluorine-18–labelled fluorodeoxyglucose ([$^{18}$F]FDG) can identify viable ischemic myocardium in patients with CAD and impaired left ventricular function (Figure). The presence of significant [$^{18}$F]FDG in areas of reduced perfusion indicates viable, "hibernating" myocardium and identifies patients who will benefit from revascularization.[2]

***History:*** The original positron scanner, used for imaging brain tumours, was first described in 1953 by Brownell and Sweet.[3] With the introduction of medical cyclotrons in the 1970s, PET developed as a powerful but expensive research tool. Over the past decade technology has improved markedly and become much less expensive with the introduction of fully 3-dimensional partial-ring cameras, high-speed computers and automated approaches to kinetic data analysis. The cardiac PET centre at the University of Ottawa Heart Institute, established in 1995, was the first PET centre in Canada dedicated to cardiac imaging. The initial PET [$^{18}$F]FDG studies demonstrated that viability studies could be carried out without an onsite cyclotron.[4] PET perfusion imaging using generator-produced $^{82}$Rb and a fully 3-dimensional partial-ring camera was first demonstrated at our institution[5] and has been used routinely there since 1997.

***Promise:*** In clinical practice cardiac PET is used to diagnose and evaluate CAD, particularly in patients with equivocal or, possibly, false-positive results from conventional stress echocardiography or from stress thallium-201, sestamibi or tetrofosmin myocardial perfusion imaging. The greater specificity of PET perfusion imaging can reduce costs by decreasing the need for more expensive and higher-risk evaluation with coronary angiography. Similarly, PET viability imaging can facilitate the decision for revascularization, medical therapy or transplantation in patients with left ventricular dysfunction, and it may result in better patient management and optimal resource utilization.

***Problems:*** High capital and operating costs of a PET centre have delayed widespread clinical implementation and have limited access for routine clinical care. Recent advances in technology have reduced costs, however. As well, cost-benefit analyses have shown significant savings with PET imaging as a decision-making tool in the management of patients with chest pain and possible CAD and in patients with severe left ventricular dysfunction. Results from current studies will define the appropriate patient groups for PET evaluation and the most cost-effective management options.




**PET image of left ventricular myocardium (left lateral view), showing myocardial perfusion using $^{82}$Rb (left) and glucose metabolism using [$^{18}$F]FDG (right). Lateral and inferior walls have reduced perfusion (blue) and normal metabolism (red), indicating viable ischemic myocardium that would benefit from revascularization.**

***Prospects:*** Clinical use of cardiac PET will continue to increase. PET perfusion imaging has the highest diagnostic accuracy for CAD, and viability studies in the growing population of patients with congestive heart failure can assist in choosing from among the increasing number of treatment options. Newer applications for imaging cardiac innervation may be helpful in treating arrhythmia. Future research and development of radiopharmaceuticals, receptor ligands and other compounds for PET imaging may also help advance our understanding of cardiovascular disease and its treatment.

Competing interests: None declared.

## References

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