



Myocardial Perfusion SPECT

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Standard Myocardial Perfusion SPECT Protocols and Associated Patient Radiation Doses

Myocardial perfusion single-photon emission computed tomography (SPECT) is a well-established, highly standardized test to detect significant coronary artery disease and to risk-stratify patients with regard to cardiac event-free survival. Recently there have been significant advancements in scintillation camera hardware and software that allow for decreased image acquisition times and considerably lower injected radiopharmaceutical activity, resulting in lower patient radiation doses. Moreover, there has been a recent emphasis on patient-centered imaging, whereby SPECT imaging protocols are tailored to specific patient needs and diagnostic expectations. These patient-centered protocols have been designed to preserve or improve image quality and, when possible, also decrease patient radiation dose.

Study	Injected activity	Effective Dose Estimate
1-day rest/stress ^{99m} Tc based	10 mCi rest 30 mCi stress	9.3 mSv ^{99m} Tc tetrofosmin 11.4 mSv ^{99m} Tc sestamibi
1-day stress/rest ^{99m} Tc based	10 mCi stress 30 mCi rest	9.3 mSv ^{99m} Tc tetrofosmin 11.4 mSv ^{99m} Tc sestamibi
2-day stress/rest or rest/stress ^{99m} Tc based	25 mCi stress 25 mCi rest	11.6 mSv ^{99m} Tc tetrofosmin 14.8 mSv ^{99m} Tc sestamibi
Stress-only ^{99m} Tc based	25 mCi stress	5.8 mSv ^{99m} Tc tetrofosmin 6.8 mSv ^{99m} Tc sestamibi
1-day ²⁰¹ Tl rest/ ^{99m} Tc based stress	3.5 mCi ²⁰¹ Tl 25 mCi ^{99m} Tc m	21.2 mSv ²⁰¹ Tl / ^{99m} Tc tetrofosmin 22.1 mSv ²⁰¹ Tl / ^{99m} Tc sestamibi
1-day stress/redistribution ²⁰¹ Tl	3.5 mCi ²⁰¹ Tl stress	15.3 mSv
1-day stress/reinjection/redistribution ²⁰¹ Tl	3.0 mCi ²⁰¹ Tl stress 1.0 mCi ²⁰¹ Tl reinjection	19.7 mSv
Attenuation correction ¹⁵³ Gd X-ray CT		< 0.3 mSv < 1 mSv



Recommendations to Decrease/Limit Patient Radiation Exposure

- Follow the recommendation of the American Society of Nuclear Cardiology to decrease patient radiation exposure to <9 mSv in 50% of patients by 2014.¹
- Follow appropriate use guidelines in selecting patients for myocardial perfusion SPECT^{2,3}
 - Do not perform cardiac imaging in patients without cardiac symptoms unless high-risk markers for coronary events are present
 - Do not perform cardiac imaging for patients who are at low risk of coronary events
 - Do not perform radionuclide cardiac imaging as part of routine follow-up of asymptomatic patients
 - Do not perform cardiac imaging as a pre-operative assessment in patients scheduled to undergo low or intermediate risk non-cardiac surgery
- Avoid stress/delayed and stress/reinjection/delayed Tl-201 protocols and rest Tl-201/stress Tc-99m based protocols, all of which increase patient radiation exposure considerably.⁴
- Implement stress-only SPECT protocols in patients with no prior myocardial infarction and a low/moderate likelihood of coronary artery disease. Radiation dose can be significantly decreased in those patients in whom stress SPECT is entirely normal and a subsequent resting scan is deemed unnecessary.⁴
- Implement new software methods, incorporating iterative reconstruction, resolution recovery, and noise modulation, that cope with lower cardiac SPECT counting statistics and thereby provide excellent image quality despite reduced time SPECT acquisitions and/or reduced injected radiopharmaceutical activities.^{4,5}
- Implement new hardware methods, including cardio-focused collimation and solid state detectors that provide excellent image quality despite reduced time SPECT acquisitions and/or reduced injected radiopharmaceutical activities.^{4,5}
- Instead of “weight-base” dosing, in which injected radiopharmaceutical activity is increased in larger patients, prolong SPECT acquisition times (as tolerated by the patient) to achieve equivalent myocardial count density scans.^{4,5}

References

1. Cerquiera MD et al, Recommendations for reducing radiation exposure in myocardial perfusion imaging. J Nucl Cardiol, May 2010. (<http://www.asnc.org/imageuploads/RadiationReduction060110.pdf>)
2. Hendel RC et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 appropriate use criteria for cardiac radionuclide imaging. J Am Coll Cardiol, 2009;53:2201-29. (<http://content.onlinejacc.org/article.aspx?articleid=1139755>)



3. Hendel RC et al. Choosing Wisely, ABIM. (http://choosingwisely.org/wp-content/uploads/2012/04/5things_12_factsheet_Amer_Soc_Nuc_Cardio.pdf)
4. DePuey EG et al. Patient-Centered Imaging: ASNC Preferred Practice Statement. *J Nucl Cardiol*, March 2012, in press. (<http://www.asnc.org/media/PDFs/PatientCenteredImagingFINAL.pdf>)
5. DePuey EG. Advances in SPECT camera software and hardware: currently available and on the horizon. *J Nucl Cardiol*, 2012, in press. (*abstract not yet available – PMID in process*)