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Decreased myocardial perfusion SPECT lung-to-heart ratio: Lucent lungs

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We present a case of a patient with chronic obstructive pulmonary disease whose myocardial perfusion SPECT imaging demonstrated diffusely decreased Tc-99m sestamibi lung uptake ("lucent lungs"); our results indicate that there may be a lower limit of normal for lung-to-heart ratio, below which pathology can be inferred.

Case report

An 84-year-old female was referred for a single-day, gated, rest/stress, Tc-99m sestamibi myocardial perfusion imaging (MPI) study for evaluation of palpitations. Her medical history included chronic obstructive pulmonary disease (COPD) and recent small bowel resection that was complicated by a myocardial infarction and an episode of atrial flutter. A standard low-dose rest (9.3 mCi) / high-dose stress (36.4) Tc-99m sestamibi protocol was used. Due to the patient's inability to exercise, a standard regadenoson pharmacological stress test with 0.4 mg regadenoson was performed. The patient experienced chest pain; however, there were no ST-segment changes during regadenoson administration. The patient received 100 mg intravenous aminophylline for the chest pain, which subsequently resolved. All images were acquired on a GE Millenium MG with a dual 90-degree detector system using a 180-degree circular orbit and a low-energy, high-resolution collimator. Images were processed with ordered subset expectation maximization (OSEM).

Review of the "rotating" planar images demonstrated "lucent" and hyperexpanded lung fields in both the stress and the rest acquisitions (Fig. 1). The calculated lung-to-heart ratio was 0.32 at stress and 0.31 at rest. Correlation with prior noncontrast chest CT demonstrated hyperinflated lungs on the topogram (Fig. 2). The axial and coronal CT images demonstrated significant emphysema and large geographic areas of air trapping (Fig. 3).

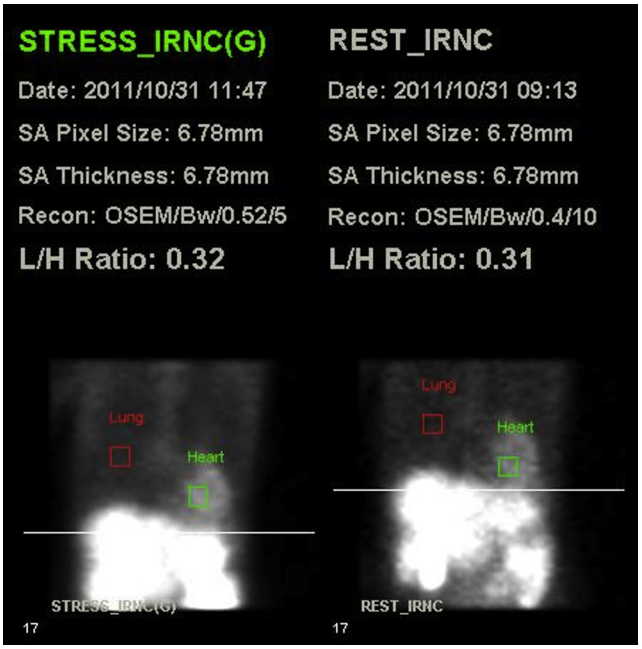

Figure 1. 84-year-old female with COPD. "Rotating" planar images demonstrate "lucent" and hyperinflated bilateral lung fields in both the stress and the rest acquisitions. The calculated lung-to-heart ratio was 0.32 at stress and 0.31 at rest.

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Figure 2. 84-year-old female with COPD and lucent lungs. Topogram from prior noncontrast chest CT demonstrates hyperinflation of the lungs.

Reconstructed stress and rest tomographic images demonstrated homogeneous and physiologic tracer distribution throughout the entire left ventricular myocardium, and no evidence of regadenoson-induced myocardial ischemia (Fig. 4). The long axis of the left ventricle was somewhat vertical. Gated tomographic images with the patient at rest demonstrated normal left-ventricular wall motion and wall thickening. The left-ventricular ejection fraction was greater than 75%, and end-systolic and end-diastolic volumes were normal (Fig. 5). Of note: right-ventricular volume and function also appeared normal.

Discussion

Although myocardial perfusion SPECT imaging is used primarily to evaluate myocardial blood flow and function, careful inspection of the "rotating" planar images and tomographic images may yield important extracardiac findings (1, 2). Dedicated cardiac cameras have a relatively narrow field of view, but general nuclear medicine cameras (with their larger field of view) allow visualization of additional structures above and below the diaphragm.

Increased 201-thallium, Tc-99m sestamibi, and Tc-99m sestamibi uptake in the lungs has been described extensively in the literature (1-5). Focally increased tracer uptake in the lungs has been associated with malignant tumors, benign lesions, infiltrate, atelectasis, and granulomatous disease (1, 6-9). Diffusely increased tracer uptake in the lungs has been correlated with extent of coronary disease, left ventricular dysfunction, and also poor prognosis (1, 5, 10-13). However, to our knowledge, decreased tracer uptake in the lungs ("lucent lungs") has not been described in the literature. In our case, diffusely decreased tracer uptake in the lungs is a meaningful finding and may provide further insight into the patient's symptoms.

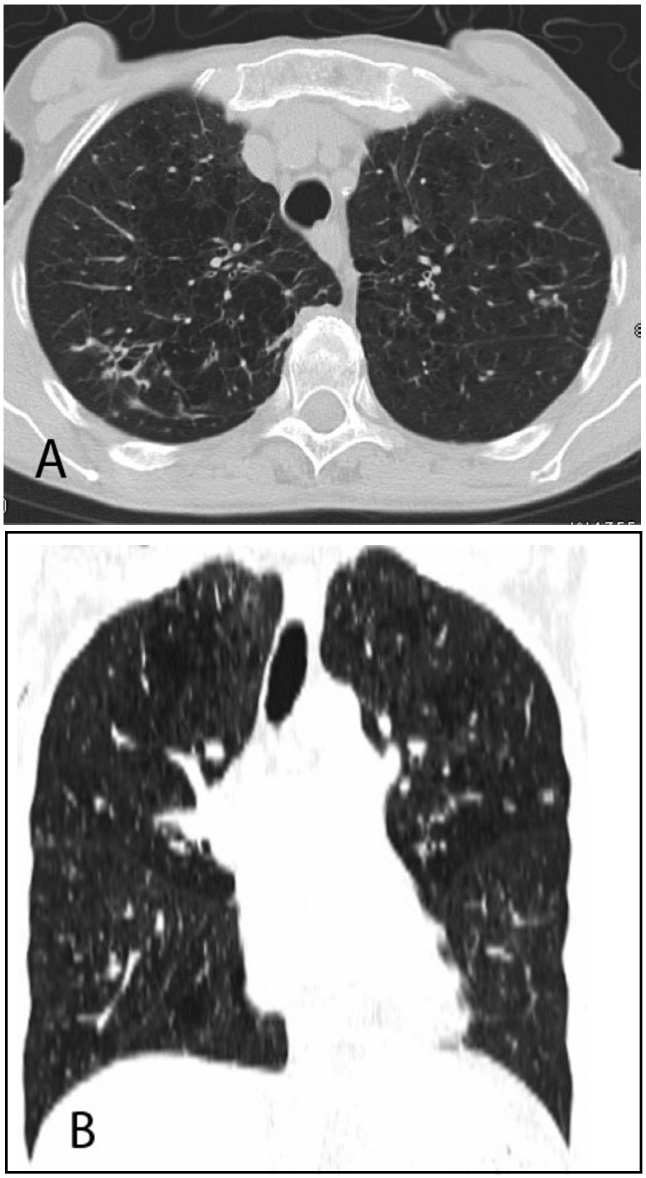

Figure 3. 84-year-old female with COPD and lucent lungs. Axial (A) and coronal (B) images from prior noncontrast chest CT demonstrate significant emphysema and large geographic areas of air trapping.

The lung-to-heart ratio has long been used as a method to quantify tracer uptake in the lungs (3, 4, 10-12). Unfortunately, there is a great deal of variation in the previously reported cutoff values for increased lung-to-heart ratio (2, 14). The reason for this is that the lung-to-heart ratio is isotope-specific and also relies heavily on the time between

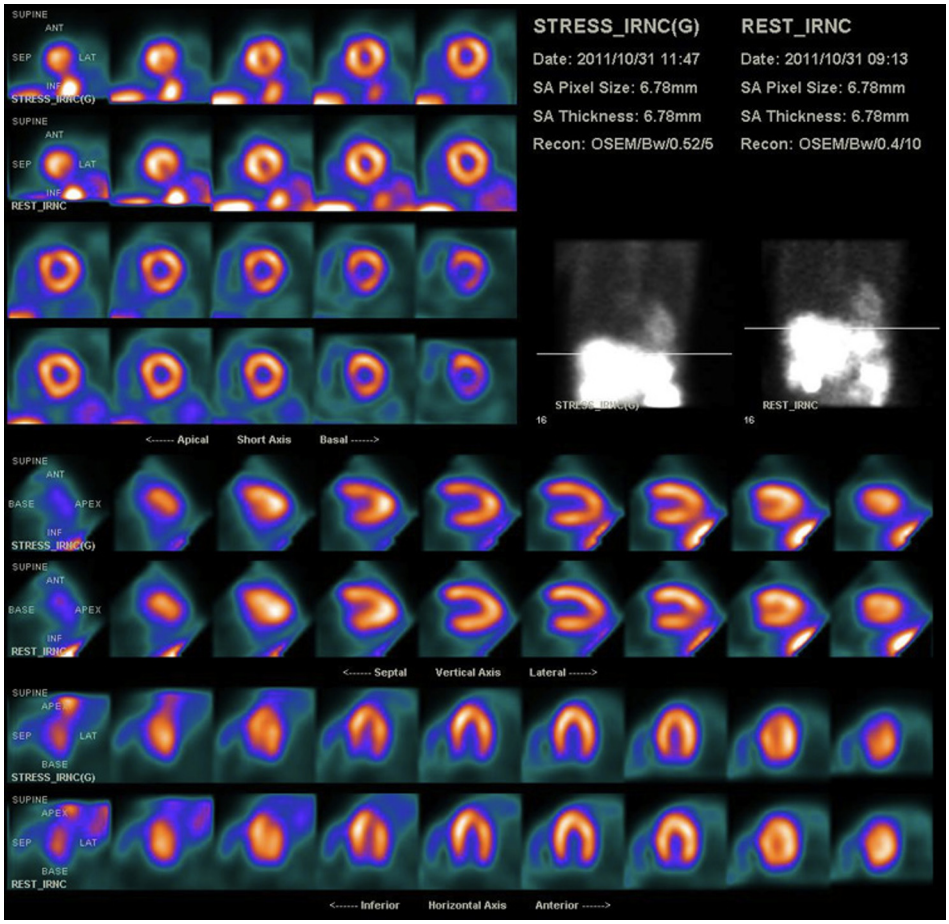

Figure 4. 84-year-old female with COPD and lucent lungs. Reconstructed stress and rest tomographic images demonstrate homogeneous and physiologic tracer distribution throughout the entire left ventricular myocardium and no evidence of regadenoson-induced myocardial ischemia.

injection of the radiotracer and acquisition of the image as well as the method of calculation (2). For 201-thallium, the reported upper limit of normal for lung-to-heart ratio ranges from 0.37 to 0.55 (2). For Tc-99m sestamibi, the upper limit of normal for lung-to-heart ratio ranges from 0.42 to 0.56 (2). However, the lower limit of normal for lung-to-heart ratio has not been described.

In this case, the lung-to-heart ratio at stress and rest was 0.32 and 0.31, respectively. This ratio was calculated using a heart region of interest over the area of myocardium with the highest counts (inferior wall) and with the lung region of interest over the mid-contralateral lung, as described by Hitzel et al (Fig. 1) (14). Irrespective of the numerical calculations for the lung-to-heart ratio, the lungs appeared "lucent" and hyperinflated in the "rotating" planar images (Fig. 1). These findings of relatively low lung uptake in both lungs corresponded to the severe emphysematous changes and hyperinflated lungs seen on prior noncontrast CT (Figs. 2, 3). In other scenarios, decreased tracer uptake in the lungs may be seen to include pneumothorax and pneumonectomy; however, in those cases, the findings would be unilateral.

Although additional studies must be performed to determine an exact threshold for decreased lung-to-heart ratio for 201-thallium, Tc-99m sestamibi, and Tc-99m tetrofosmin, we emphasize that readers should always inspect the "rotating" planar images carefully for evidence of increased or decreased tracer uptake in the lungs (as well as other extracardiac findings). In addition, we stress that interpreters should be aware of the possible implications of decreased tracer uptake in the lungs. Decreased lung uptake ("lucent lungs") in this case was associated with COPD and severe emphysema. Such findings may assist in explaining the patient's symptoms and may affect medical management.

References

1. Shih, W.J. and P. Milan, Unilateral left pulmonary Tl-201 uptake on raw data images of dual-isotope gated SPECT due to pulmonary infiltrates and atelectasis. *J Nucl Cardiol*, 2005. 12(1): p. 120-2. [PubMed]
2. Georgoulias, P., et al., Long-term prognostic value of early poststress (99m)Tc-tetrofosmin lung uptake during exercise (SPECT) myocardial perfusion imaging. *Eur J Nucl Med Mol Imaging*, 2010. 37(4): p. 789-98. [PubMed]
3. Leslie, W.D., et al., Prognostic utility of sestamibi lung uptake does not require adjustment for stress-related variables: a retrospective cohort study. *BMC Nucl Med*, 2006. 6: p. 2. [PubMed]
4. Matoh, F., et al., [Usefulness of lung and right ventricular thallium-201 uptake during single photon emission computed tomography in exercise testing of patients with coronary artery disease]. *J Cardiol*, 2005. 46(4): p. 131-40. [PubMed]
5. Tsou, S.S., et al., Exercise and rest technetium-99m-tetrofosmin lung uptake: correlation with left ventricular ejection fraction in patients with coronary artery disease. *Jpn Heart J*, 2002. 43(5): p. 515-22. [PubMed]
6. Gratz, S., et al., Unexpected 99mTc-tetrofosmin findings during myocardial perfusion scintigraphy: intraindividual comparison with PET/computed tomography. *Nucl Med Commun*, 2008. 29(11): p. 963-9. [PubMed]

7. Stefanescu, C., et al., 99mTc isonitrils biophysical aspects in pulmonary tuberculosis. Part I. In vivo evaluation of 99mTc MIBI and 99mTc Tetrofosmin biophysical localization mechanisms. *Rev Med Chir Soc Med Nat Iasi*, 2006. 110(4): p. 944-9. [PubMed]
8. Yuksel, D., et al., Non-cardiac Tl-201 uptake on myocardial perfusion SPECT study. *Anadolu Kardiyol Derg*, 2005. 5(2): p. 140-1. [PubMed]
9. Kim, S.M., et al., Focal pulmonary uptake during Tc-99m myocardial perfusion SPECT imaging. *Clin Nucl Med*, 2001. 26(11): p. 913-5. [PubMed]
10. Moralidis, E., et al., Identification of advanced coronary artery disease with exercise myocardial perfusion imaging: the clinical value of a novel approach for assessing lung thallium-201 uptake. *Eur J Nucl Med Mol Imaging*, 2007. 34(4): p. 573-83. [PubMed]
11. Georgoulias, P., et al., Early post-stress pulmonary uptake of 99mTc tetrofosmin during exercise (SPECT) myocardial perfusion imaging: correlation with haemodynamic, perfusion and function parameters. *Nucl Med Commun*, 2006. 27(2): p. 119-26. [PubMed]
12. Cavusoglu, Y., et al., Regional distribution and extent of perfusion abnormalities, and the lung to heart uptake ratios during exercise thallium-201 SPECT imaging in patients with cardiac syndrome X. *Can J Cardiol*, 2005. 21(1): p. 57-62. [PubMed]

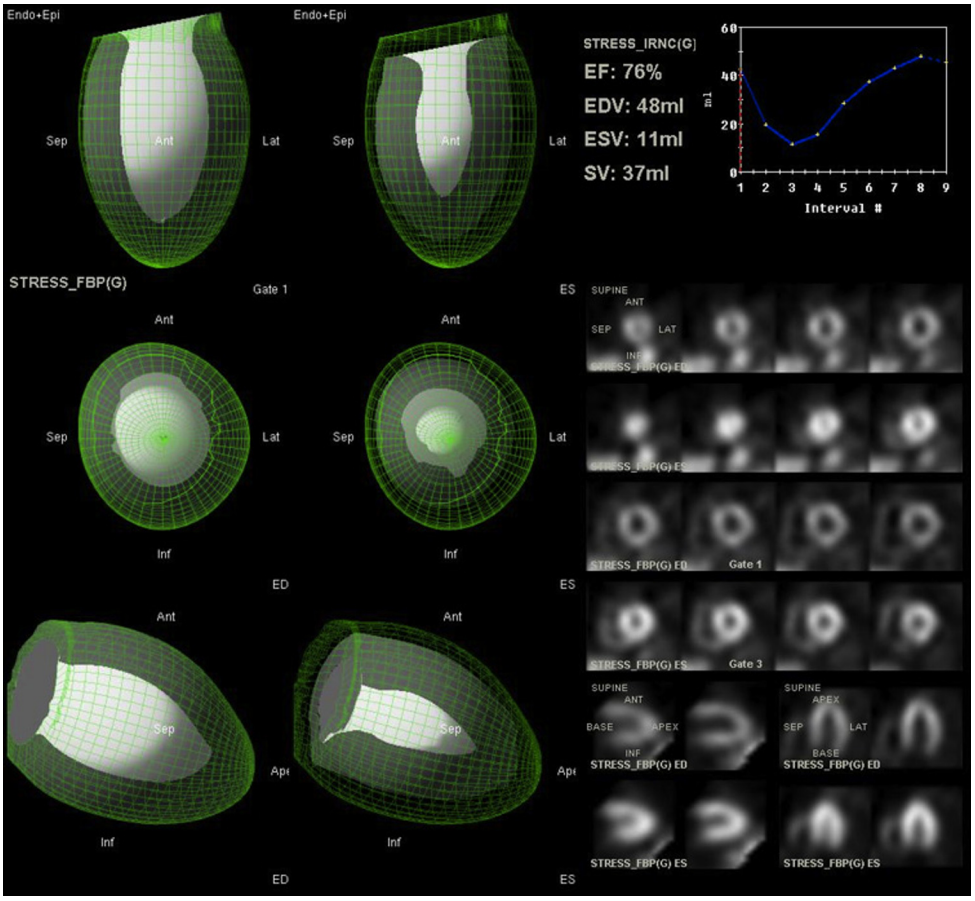

Figure 5. 84-year-old female with COPD and lucent lungs. Gated tomographic images with the patient at rest demonstrate normal left ventricular wall motion and wall thickening. Left ventricular ejection fraction is greater than 75%. End-systolic and end-diastolic volumes are normal. Right ventricular volume and function appear normal.

13. Goland, S., et al., Dipyridamole-induced abnormal Tl-201 lung uptake in patients with normal myocardial perfusion: a marker of increased left ventricular filling pressures. *J Nucl Cardiol*, 2004. 11(3): p. 305-11. [PubMed]
14. Hitzel, A., et al., Diagnostic value of Tl-201 lung uptake is dependent on measurement method. *J Nucl Cardiol*, 2001. 8(3): p. 332-8. [PubMed]