Diagnostic Accuracy of Cardiac Positron Emission Tomography Versus Single Photon Emission Computed Tomography for Coronary Artery Disease

A Bivariate Meta-Analysis

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Background—Positron emission tomography (PET) myocardial perfusion imaging (MPI) offers technical benefits compared with single photon emission computed tomography (SPECT) MPI, but there has been no systematic comparison of their diagnostic accuracy for coronary artery disease. We performed a bivariate meta-analysis of the published literature to compare the sensitivity and specificity of PET versus SPECT stress MPI for ≥50% stenosis of any epicardial coronary artery in patients with known or suspected coronary artery disease.

Methods and Results—We searched MEDLINE and EMBASE from inception through January 2012 and the references of identified studies for prospective, English language studies that evaluated the sensitivity and specificity of PET and/or SPECT MPI with coronary angiography as the reference standard and reported sufficient data to calculate patient-level true and false positives and negatives. Two investigators independently extracted patient and study characteristics; a third investigator resolved any disagreements. We identified 117 studies, including 108 evaluating SPECT MPI, 4 evaluating PET MPI, and 5 evaluating both modalities. Bivariate meta-analysis demonstrated a significantly higher pooled mean sensitivity with PET (92.6% [95% Confidence Interval, 88.3% to 95.5%]) compared with SPECT (88.3% [95% confidence interval, 86.4% to 90.0%]) (P=0.035). No significant difference in specificity was observed between PET (81.3% [95% confidence interval, 66.6% to 90.4%]) and SPECT (75.8% [95% confidence interval, 72.1% to 79.1%]) (P=0.39). Few studies investigated coronary angiography with PET. Only 5 studies directly compared SPECT and PET.

Conclusions—In a meta-analysis of 11,862 patients, PET MPI demonstrated a higher sensitivity for coronary artery disease than SPECT MPI. No difference in specificity was detected in the pooled analysis of PET and SPECT MPI. **(*Circ Cardiovasc Imaging*. 2012;5:700-707.)**

Key Words: cardiac PET ■ coronary artery disease ■ meta-analysis ■ myocardial perfusion imaging ■ single photon emission computed tomography

Coronary angiography (CAG) is the standard technique for diagnosing coronary stenosis but carries well-documented risks for patients.[1] Stress myocardial perfusion imaging (MPI) may aid in the noninvasive assessment of coronary artery disease (CAD) such that only patients likely to benefit from revascularization can be referred for invasive CAG. An estimated 9 million MPI procedures are performed annually in the United States for this purpose.[2] Two mature nuclear imaging techniques are available for stress MPI: single photon emission computed tomography (SPECT) and positron emission tomography (PET). PET radiotracers and instrumentation offer technical advantages in image quality[3,4] that may lead to more accurate referrals and lower downstream costs,[5] but SPECT remains the dominant technique, partly because of the large installed base of cameras.[6]

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Given recent concerns about the accuracy of noninvasive testing before CAG,[7] a comprehensive understanding of the diagnostic value and limitations of these 2 techniques is critical. Multiple diagnostic accuracy studies have been published for both PET and SPECT MPI, but previous reviews of these data[8–12] have included studies that used reference standards other than CAG or retrospective designs. Additionally,

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these reports pooled sensitivity and specificity derived from weighted averages of the individual studies rather than statistical modeling to adjust for the negative correlation of sensitivity and specificity of a diagnostic test within individual studies.[13,14] Therefore, we performed a systematic review and bivariate meta-analysis to compare the diagnostic accuracy of cardiac PET and SPECT for the evaluation of patients with known or suspected CAD in prospective studies using coronary angiography as the reference standard.

Methods

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines[15] and also included items unique to diagnostic accuracy studies.

Data Sources and Searches

Two investigators independently searched MEDLINE using PubMed and EMBASE using the proprietary Web interface from the earliest possible date through January 30, 2012. We combined Medical Subject Heading terms and key words describing imaging techniques (SPECT or PET) and the disease state of interest (CAD) with previously validated search filters for diagnostic accuracy studies[16] in our search (available in the online-only Data Supplement). We also manually reviewed the references of included studies and relevant chapters of cardiology textbooks[17–19] and identified review articles and meta-analyses on the topic.

Study Selection

We included prospectively conducted studies that evaluated SPECT or PET stress MPI, or both, with CAG as the reference standard, used an arterial stenosis of 50% as the criterion for clinically significant CAD, and provided patient-level true and false positives and negatives. We excluded non-English studies and studies explicitly described as retrospective. In cases of studies that reported data from the same or overlapping cohorts of patients, we only included the largest report from the cohort and multiple reports from the same institutions or investigators were only included if the individual study inclusion criteria were mutually exclusive.

Upon completion of the search, 2 investigators independently scanned titles and abstracts for initial inclusions with disagreements resolved by a third investigator. Potentially eligible articles were then reviewed in depth by 2 investigators for inclusion, with disagreements resolved by a third investigator. If a published study did not report true and false positives and negatives, we attempted to contact its corresponding author to obtain these data.

Data Extraction and Quality Assessment

Two investigators independently extracted data from included studies, with discrepancies resolved by a third investigator. Relevant study, setting, and population characteristics were extracted using a standardized worksheet, along with details of the nuclear imaging and reference standard techniques (Tables I to IV in the online-only Data Supplement for SPECT and Tables V to VIII in the online-only Data Supplement for PET study data). Methodological quality was assessed using a Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool[20] provided in the online-only Data Supplement.

Data Synthesis and Analysis

For this meta-analysis, we adapted a bivariate statistical model provided in the Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy.[14] This type of model does not convert sensitivity and specificity pairs from individual studies into a single marker of diagnostic accuracy, but rather, preserves the 2-dimensional nature of the data while taking any correlation between sensitivity and specificity into account.

We used parameter estimates of logit sensitivity and specificity with SEs, random-effects variances in logit sensitivity and specificity, and the covariance between them. Summary estimates of sensitivity and specificity were computed by inverse transformation of logit estimates to the original receiver-operating characteristic (ROC) scale. A bivariate summary ROC curve for SPECT and PET with summary operating points and 95% confidence regions was built using logit sensitivity and specificity estimates and their respective variances.

We prespecified sensitivity analyses to evaluate the effects of stress (exercise or pharmacologic) and radiotracer (technetium-99m or thallium-201), as well as the combined effect of electrocardiographic gating and attenuation correction on our SPECT results and the use of line source (PET only) or PET-computed tomography attenuation correction within the PET results.

We addressed potential heterogeneity coming from studies with poorer quality by repeating the meta-analysis after separating the studies according to QUADAS score (studies scoring greater than the median of all studies were defined as good). We tested for significant differences using the 2-tailed *t* test for independent samples, with statistical significance defined at the 5% level. To assess the presence of publication bias, we tested funnel plots with SE on the vertical axis and the log of diagnostic odds ratio on the horizontal axis for asymmetry using Egger test. Heterogeneity was also assessed by calculating Cochran Q and I^2 statistics for included PET and SPECT studies.

We used PROC NLMIXED in SAS, version 9.3 (SAS Institute, Cary, NC), to perform the bivariate summary ROC curve analysis, Review Manager, version 5.1.2 (The Cochrane Collaboration, Copenhagen, Denmark) to produce the summary ROC curves, and StatsDirect, version 2.7.8 (StatsDirect Ltd, Cheshire, United Kingdom) to build funnel plots.

Results

Our initial database search yielded 6660 citations for review with an additional 212 citations identified by manual review of bibliographic material from textbooks, review articles, and included articles (Figure 1). After removing duplicates, we screened the remaining 2828 unique articles for inclusion. Among these, we excluded 2344 upon title and abstract review. We then reviewed the full text of 486 articles. Ultimately, 117 articles met all criteria for inclusion: 108 evaluated SPECT MPI, 4 evaluated PET MPI, and 5 evaluated both modalities.

One hundred thirteen studies used SPECT MPI to examine a total of 11 212 patients (Tables I to III in the online-only Data Supplement). Two of the 113 studies compared 2 different radiotracers in separate study arms,[21,22] resulting in 115 SPECT cohorts for inclusion in our meta-analysis. Study sample sizes ranged from 18 to 443 patients. Most included stable patients with known or suspected CAD; a few studies examined specific cohorts, such as subjects undergoing surveillance CAG after coronary revascularization, lung transplant candidates, or cardiac transplant recipients. The mean patient ages of the included studies ranged from 45 to 72 years. The majority of SPECT studies were performed in the United States (38%) and Europe (36%), and predominantly at university hospitals (81%). SPECT MPI was more commonly performed after pharmacologic stress (52 studies) than exercise stress (42 studies). Seventeen studies reported patients undergoing either exercise or

Table. Results of SPECT and PET Subgroup Analyses

	Sensitivity (95% CI)	Specificity (95% CI)
Base case		
SPECT (n=115)	88.3 (86.5–90.0)	76.0 (72.4–79.4)
PET/PET-CT (n=9)	92.6 (88.3–95.5)*	81.3 (66.6–90.4)
Subgroup analyses SPECT		
Exercise stress (n=41)	89.4 (85.9–92.1)	74.7 (67.9–80.4)
Pharmacologic stress (n=52)	88.4 (85.4–90.8)	79.7 (74.6–84.0)
Technetium-99m (n=60)	90.1 (87.5–92.1)	75.0 (69.6–79.7)
Thalium-201 (n=42)	87.0 (83.6–89.8)	78.2 (72.0–83.3)
Good SPECT studies† (n=54)	87.7 (84.4–90.6)	79.5 (74.9–83.5)
Poor SPECT studies (n=61)	88.9 (86.5–90.9)	72.1 (66.4–77.2)‡
Subgroup analyses PET		
PET only (n=7)	92.9 (85.9–96.6)	85.6 (75.5–92.0)
Good PET/PET-CT studies† (n=7)	95.2 (91.8–97.2)§	80.8 (77.2–84.0)

SPECT indicates single photon emission computed tomography; PET, positron emission tomography; CI, confidence interval; and CT, computed tomography.

*$P<0.04$ compared with SPECT; †Good defined as QUADAS score >8; ‡P<0.04 compared with Good SPECT; §P<0.001 compared with Good SPECT.

pharmacologic stress and 4 studies did not report the type of stress. Fifty-eight studies used technetium-99m-based radiopharmaceuticals (sestamibi in 47, tetrofosmin in 11, and *bis* (N-ethoxy, N-ethyl, dithiocarbamato) nitrido technetium-99m in 1) and 41 used thallium-201 as the radiotracer. Seven studies reported a dual-isotope protocol (thallium at rest and technetium sestamibi at stress), 6 studies combined data from thallium and technetium-based agents, and 1 study did not specify the radiotracer.

We identified 9 PET MPI studies; 2 used computed tomography for attenuation correction and the remaining 7 used PET cameras with radionuclide attenuation correction (Tables V to VII in the online-only Data Supplement). Sample sizes of the PET studies ranged from 19 to 209 patients, for a total enrollment of 650 patients. Similar to SPECT studies, PET studies primarily included stable patients with suspected or known CAD. Mean patient ages in the PET studies ranged from 56 to 66 years. Seven of the 9 studies were conducted in North America (5 studies in the United States and 2 in Canada) and all were performed within university hospitals. One study used exercise stress and another used either pharmacological stress or exercise stress. The remaining 7 used pharmacological stress. Rubidium-82 was the most frequently used tracer (6 of 9 studies). Other studies used O-15–water, N-13–ammonia, or F-18–fluorodeoxyglucose.

Individual reviewers' assessments of SPECT and PET study quality using the QUADAS tool agreed on 97.7% of items (1601 of 1638) (Tables IX and X in the online-only Data Supplement for SPECT and Tables XI and XII in the online-only Data Supplement for PET). The median number of QUADAS criteria met across all SPECT and PET studies was 8 of 14. Fewer than half (54) of SPECT studies fulfilled ≥8 of 14 QUADAS criteria and no SPECT study met all criteria (Figure 2). The prevalence of CAD in the included study cohorts was <70% in 36 studies (32%); most studies combined patients with known CAD and patients without any history of CAD. Detailed reporting of uninterpretable results

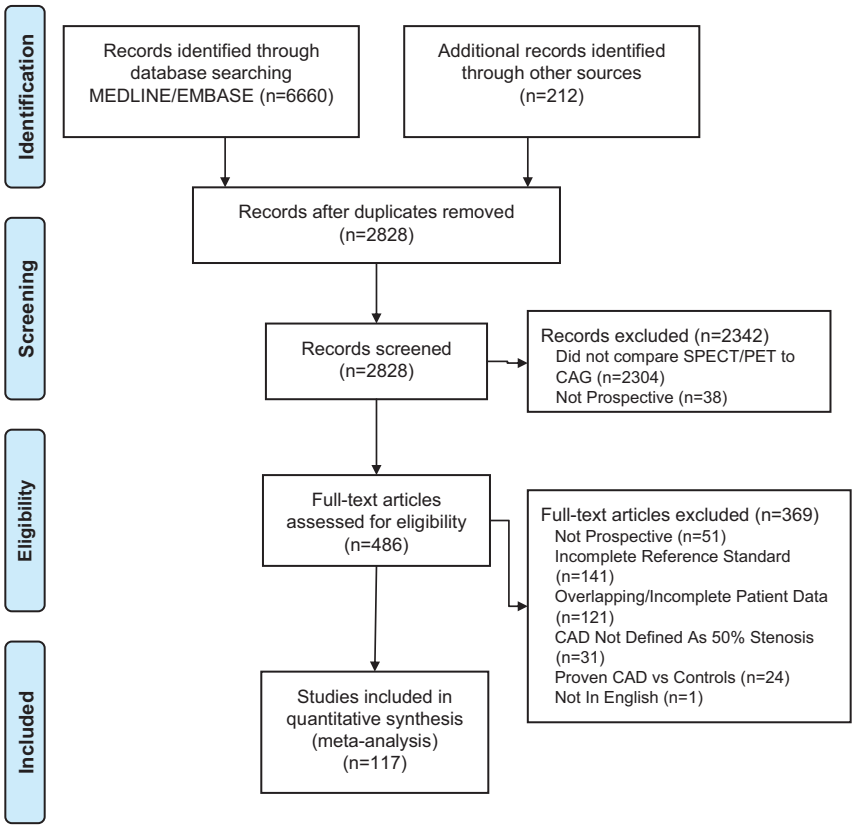

Figure 1. Results of the literature search and disposition of articles screened for inclusion. SPECT indicates single photon emission computed tomography; PET, positron emission tomography, CAG, coronary angiography; and CAD, coronary artery disease.

and disposition of all screened patients within a study were common sources of potential bias in included studies. Only 1 study stated explicitly that clinical data were available to the SPECT readers during image interpretation.

Seven of the 9 PET studies (77.8%) were of good quality. All of the PET studies met at least 4 of the QUADAS criteria, although no study met all 14 criteria (Figure 3). The prevalence of CAD was <70% in 3 PET studies. Nearly half of PET studies reported results of MPI and CAG that were performed >30 days apart. No PET study stated explicitly that physicians interpreting the PET images had access to patients' clinical data.

Initial reviewers' data extraction for diagnostic accuracy data agreed on 96.4% (109 of 113) of the SPECT studies and 100% (9 of 9) of the PET studies. Heterogeneity was measured by calculating Cochran Q and I^2 statistics and bias was assessed with Egger tests using diagnostic odds ratios of included PET and SPECT studies. Both Cochran Q and I^2 statistics for included SPECT studies suggested an important level of statistical heterogeneity (Cochran Q =290.95 with 114 degrees of freedom, $P<0.01$; and I^2 =60.7%), whereas statistical heterogeneity was low for the included PET studies (Cochran Q =9.26 with 8 degrees of freedom, $P=0.32$; and I^2 =13.7%). Estimation of bias was performed through the use of funnel plots along with Egger tests. Funnel plots of the SE of individual SPECT studies plotted against the diagnostic odds ratio of the study indicated that smaller studies with low diagnostic odds ratios may not have been identified in the literature review (Figure 4). Egger test supported this finding, suggesting a statistically significant level of bias ($P<0.001$) for included SPECT studies. Similar funnel plots of the PET studies did not suggest the presence of publication bias (Egger P value=0.44) (Figure 5).

Bivariate meta-analysis demonstrated a higher pooled mean sensitivity with PET (92.6%; 95% confidence interval, 88.3% to 95.5%; and variance 0.07) compared with SPECT (88.3%; 95% confidence interval, 86.5% to 90.0%; and variance 0.60) ($P=0.035$). No statistically significant difference in specificity was observed between PET (81.3%; 95% confidence interval, 66.6% to 90.4%; and variance 0.41) and SPECT (76.0%; 95% confidence interval, 72.4% to 79.4%; and variance 0.69) ($P=0.38$). Covariance of sensitivity and specificity was 0.04 for PET and −0.18 for SPECT. Figure 6 illustrates the calculated summary ROC curves, including the summary operating points for sensitivity and specificity and 95% confidence ellipsoids.

The Table summarizes the results of subgroup and sensitivity analyses. Regardless of type of stressor (pharmacologic versus exercise) and tracer (thallium versus technetium) used, comparison of the studies yielded results consistent with the overall result for SPECT, without meaningful changes in observed sensitivity and specificity. The subgroup of SPECT (n=54) and PET (n=7) studies with good quality based on the QUADAS results SPECT demonstrated higher sensitivity for PET compared with SPECT (95.2 versus 87.7%, $P<0.001$), but

Figure 2. Reviewer judgments of methodological quality of included single photon emission computed tomography myocardial perfusion imaging (SPECT MPI) studies, according to the Quality Assessment of Diagnostic Accuracy Studies tool. "Yes" answers indicate that measures to reduce the indicated bias were reported in the study.

Figure 3. Reviewer judgments of methodological quality of included positron emission tomography myocardial perfusion imaging (PET MPI) studies, according to the Quality Assessment of Diagnostic Accuracy Studies tool. "Yes" answers indicate that measures to reduce the indicated bias were reported in the study.

no statistically significant difference in specificity (80.8 versus 79.5%, P=0.64), similar to the overall meta-analysis findings.

Discussion

Our meta-analysis of 117 studies comparing either PET or SPECT stress MPI, or both, with coronary angiography, demonstrates that PET MPI has higher sensitivity than SPECT MPI with similar specificity and is, therefore, superior for detecting clinically significant CAD. Exercise and pharmacologic stress both result in similar sensitivity and specificity when used for SPECT MPI. Few diagnostic accuracy studies of PET MPI have been performed to date.

We are aware of 2 recent systematic reviews of PET MPI. Al Moudi et al[12] identified 25 studies of the diagnostic accuracy of SPECT and PET MPI published between 1984 and 2009. Nandalur et al[11] performed a meta-analysis of 19 studies that evaluated the diagnostic accuracy of PET MPI. Both demonstrated sensitivity for PET MPI similar to our findings, but higher specificity than we observed. We are also aware of 2 older reviews of SPECT MPI[8,9]; both identified sensitivities for SPECT MPI similar to our meta-analysis but qualitatively

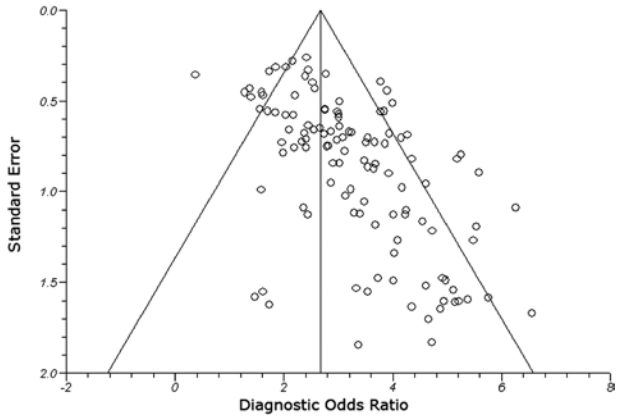

Figure 4. Funnel plot for included single photon emission computed tomography myocardial perfusion imaging (SPECT MPI) studies.

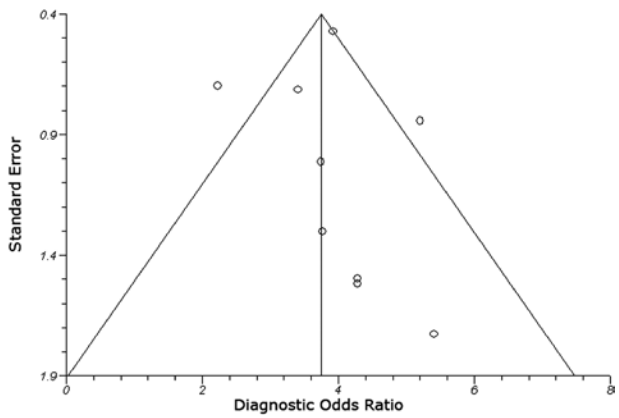

Figure 5. Funnel plot for included positron emission tomography myocardial perfusion imaging (PET MPI) studies.

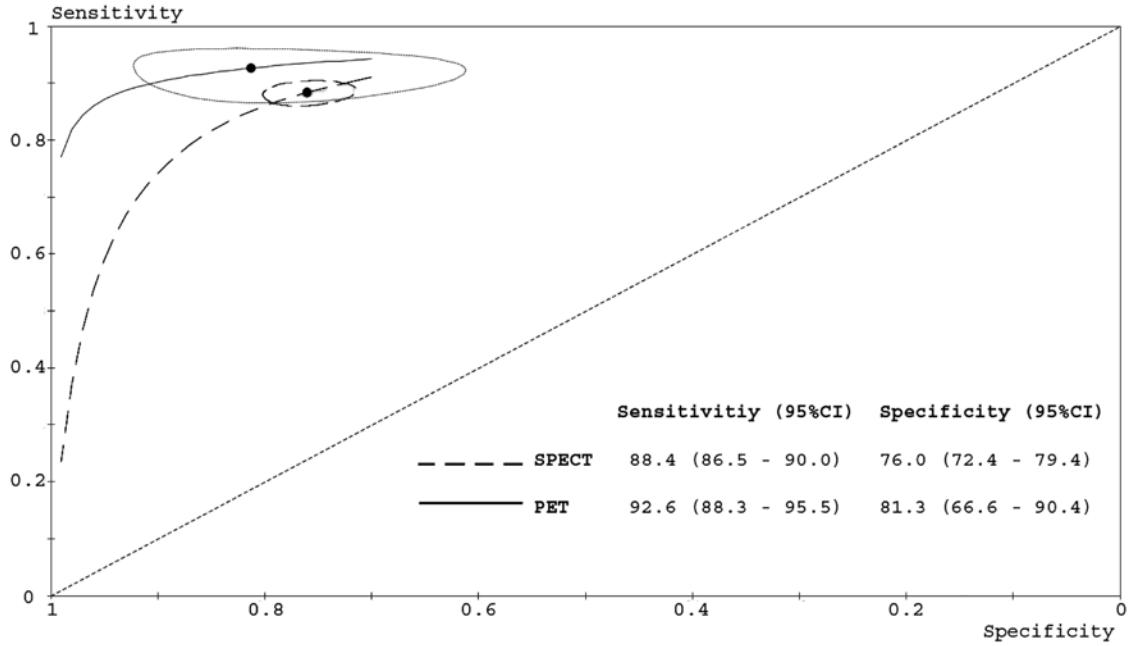

Figure 6. Summary ROC curves for SPECT and PET MPI. Curves include a summary operating point for sensitivity and specificity on the curve and a 95% confidence ellipsoid. ROC indicates receiver-operating characteristic; SPECT, single photon emission computed tomography; PET, positron emission tomography; MPI, myocardial perfusion imaging; and CI, confidence interval.

lower specificity. These reviews combined data from both prospective and retrospective study designs without a systematic evaluation of study quality and pooled data from diagnostic accuracy studies that used reference standards, such as coronary flow reserve,[23] with studies that used coronary angiography as the reference standard for diagnosis.

Most of these reviews pooled the sensitivity and specificity of included studies separately. This approach is common in the literature, including the 2003 American College of Cardiology Foundation/American Heart Association/American Society of Nuclear Cardiology Guidelines,[10] but fails to account for the 2-dimensional relationship of sensitivity and specificity and may underestimate the accuracy of a diagnostic test.[14] Simple pooled estimates fail to account for variability across different studies, which may be because of unbalanced ratios of diseased and non-diseased patients or other, unmeasured differences in studies.[24] Pooled estimates also cannot be directly compared between modalities.

Technical advances have improved both techniques since their introduction. Electrocardiographic gating provides myocardial function data to be integrated with perfusion data, increasing the specificity of noninvasive assessment, and can be performed with both PET[25] and SPECT[26] MPI. Attenuation correction also improves specificity and although it has been used successfully with SPECT, attenuation correction is universally applied during PET image processing.[4] Recent advances in data acquisition and processing may also lead to improved image quality and possibly diagnostic accuracy with both techniques.

We attempted to investigate the possible interactions of these adjunctive technologies in a sensitivity analysis using the subgroup of SPECT studies that used both attenuation correction and electrocardiographic gating. However, the small number of SPECT diagnostic accuracy studies using both of these adjuncts led to a large variance in the observed sensitivity and specificity that precluded meaningful inferences.

PET MPI has several theoretical advantages compared with SPECT MPI that may explain the higher sensitivity observed in our overall meta-analysis. PET cameras do not require physical collimation, resulting in better detector efficiency (count sensitivity) and improved spatial resolution. The higher energy of PET radiotracers compared with SPECT radiotracers also contributes to higher spatial resolution. The short half-life of PET radiotracers results in higher signal-to-noise ratios and consequently better image quality compared with SPECT.[4]

PET MPI may also have an advantage with respect to radiation exposure that we only indirectly investigated. Radiation exposure from radionuclide imaging procedures is not routinely reported in clinical studies and our literature review, therefore, extracted radiotracer dose rather than exposure. Even with the higher doses of radioactivity used for PET MPI, however, the very short half-life of PET radiotracers may result in lower patient radiation exposure.[4] Previous reviews have estimated exposures of up to 22 millisieverts (mSv) for standard doses (2.5 millicuries [mCi]) of Tl-201 and 6.6 to 7.1 mSv for single doses (25 mCi) of Tc-99m,[27] the 2 most commonly used SPECT radiotracers in our literature review. In comparison, recent in vivo experiments using Rb-82, the most commonly encountered positron emitter in our analysis, estimated total exposure of only 3.7 mSv for a rest-stress protocol consisting of two 40 mCi doses of Rb-82 for cardiac PET.[28]

Our meta-analysis used a bivariate random-effects model to account for the correlation between sensitivity and specificity observed across studies that is because of the functional relationship between the 2 at a given threshold within each study. The model assumes 2 levels of statistical distribution of variance. First, a binomial distribution and logistic transformation

of proportions preserves the shared characteristics within each study that link sensitivity and specificity, capturing the correlation between the 2, as well as the absolute values observed in each study. The second level reflects the heterogeneity (variance) between studies beyond that accounted for by sampling variability at the first level; the model assumes this heterogeneity is because of random study effects.[13]

Our meta-analysis has several important limitations. There were more studies using SPECT MPI than PET MPI in the literature. This likely reflects the large installed base of SPECT camera systems and more common use of this technology.[6] The small number of PET studies raises the possibility that the difference in sensitivity observed in the meta-analysis was because of chance alone. However, technical advantages with PET MPI, discussed above, suggest a mechanistic explanation for the higher diagnostic sensitivity. The small number of PET studies also precluded subgroup analyses of specific patient groups, such as women or sensitivity analysis of recent studies, to investigate changes in diagnostic accuracy over time.

Only 5 studies included in the meta-analysis directly compared SPECT and PET. Bateman et al[29] published a large study comparing the sensitivity and specificity of PET with SPECT that was not included in this meta-analysis because of its retrospective, case-control design. Their series demonstrated similar sensitivity and higher specificity with PET MPI compared with SPECT MPI, but the absolute sensitivity and specificity were similar to the point estimates in our meta-analysis. Husmann et al[30] also performed an analysis of PET and SPECT in parallel patient cohorts in 2008 that did not meet our inclusion criteria because patient-level true and false positives and negatives were not provided. They reported higher sensitivity with PET MPI (96%) versus SPECT (85%), similar to our overall finding, but could not calculate specificity because all patients had angiographic coronary disease.

We planned to include only prospectively performed studies but many study designs were ambiguous. To include as many prospective studies as possible without introducing additional bias, we only excluded studies that explicitly described themselves as retrospective. Some retrospective studies may have been included, leading to referral bias. Referral, or partial verification, bias occurs when patients with positive noninvasive findings are preferentially referred for confirmatory testing. Although clinically appropriate, this leads to a lower observed specificity than truly exists, because false positives will be recognized more often than false negatives. Adjustments for referral bias in meta-analyses of diagnostic tests have been proposed,[31] but require patient-level index test results on a continuous scale as well as clear delineation of biased and unbiased studies. Therefore, our summary point estimates of sensitivity and specificity are unadjusted for referral bias.

The QUADAS tool was designed to address potential sources of bias including referral bias.[20] The designation of good quality studies with scoring tools is problematic because of difficulties in weighting measures that may be taken to reduce potential sources of bias and their relative importance. In the interpretation of individual study results, clear statements regarding potential sources of bias may be more helpful to the reader than ambiguity, so that even studies scoring no to specific QUADAS items may be valuable but excluded from a score-based subgroup analysis.

Our inclusion criteria stipulated comparison of PET or SPECT MPI with coronary angiography in all patients, regardless of PET or SPECT findings, which represents a key component of a rigorous diagnostic accuracy study. Most studies either used blinded readers to interpret MPI results or did not specify whether readers were blinded to clinical data. Many researchers consider this part of rigorous study design, but it does not reflect clinical practice, demonstrating another limitation of scoring tools, such as QUADAS. A revision to the QUADAS document was recently published[32] but was not available at the time of our data collection and analysis.

We included only studies that compared PET or SPECT MPI with invasive CAG. CAG has been the accepted clinical standard for the diagnosis of CAD, and remains the basis for clinical decisions regarding revascularization in many patients. However, MPI is fundamentally a functional test and an anatomical standard such as CAG may not be the appropriate reference; functional tests such as fractional flow reserve have been proposed as alternate reference standards.[33] Few studies comparing MPI with coronary hemodynamics are available and these have used a variety of techniques alone or in combination with CAG; this heterogeneity precludes meta-analysis of the findings at this time.

Our literature review was limited to the English language. With the large number of studies included; however, we do not expect that meaningful differences would be seen if studies published in other languages were included. We could not rule out the possibility of publication bias, particularly among reports of SPECT MPI.

Perhaps the greatest disadvantage is the lack of randomized data comparing these and other methods of noninvasive assessment. Diagnostic accuracy for detecting coronary stenosis is only 1 aspect of patient care. A complete patient-oriented assessment of a diagnostic test would include patient outcomes after diagnosis, that is, whether the results of the test lead to clinical decisions that positively impact patient survival and quality of life.

Our meta-analysis demonstrates that PET MPI has a higher sensitivity for the diagnosis of CAD than does SPECT MPI, although there was no detectable difference in specificity when comparing the 2 modalities. Further investigations are necessary to identify which subgroups of patients are more likely to benefit from PET MPI as opposed to SPECT MPI.

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Dr Heller serves on the Scientific Advisory Board of Lantheus Medical Imaging. The remaining authors have no disclosures relevant to this project.

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CLINICAL PERSPECTIVE

Positron emission tomography (PET) and single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) are both established techniques for noninvasively diagnosing coronary artery disease. PET MPI has technical benefits in detecting sensitivity and spatial resolution compared with SPECT MPI and may also allow diagnostic imaging with lower radiation exposure. Clinical differences in diagnostic accuracy remain under investigation. A literature search of English-language studies yielded 117 diagnostic accuracy studies of MPI for detecting 50% angiographic coronary stenosis but only 5 direct comparisons of PET and SPECT. These were systematically reviewed and scored for methodological quality before meta-analysis using techniques designed for analyzing the relationship between sensitivity and specificity. Both PET and SPECT MPI were more commonly performed after pharmacological, as opposed to exercise, stress. Pooled sensitivity was higher for PET MPI at 92.6% compared with 88.3% for SPECT MPI. Pooled specificity was lower, without a clear difference between PET and SPECT MPI. Type of stress (exercise or pharmacological) and differences in radiotracer used did not seem to affect diagnostic accuracy. More research, especially in head-to-head comparisons, will be needed to identify patient groups most likely to benefit from PET MPI.