TITLE: Advances in Single Photon Emission Computed Tomography Imaging Technology for Patients Requiring SPECT Diagnostic Imaging: Clinical Evidence and Cost-Effectiveness

DATE: 09 March 2012

RESEARCH QUESTIONS

1. What is the impact of advances in single photon emission computed tomography (SPECT) imaging on the efficient use technetium-99m (99mTc) in patients requiring SPECT diagnostic imaging?

2. What is the cost-effectiveness of new SPECT camera technology versus older cameras for patients requiring SPECT diagnostic imaging?

KEY MESSAGE

Four non-randomized studies regarding the impact of advances in SPECT imaging on the efficient use of 99mTc in patients requiring SPECT diagnostic imaging were identified. No cost-effectiveness information was identified.

METHODS

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2012, Issue 2), Canadian and abbreviated list of major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, and economic studies.

Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2007 and February 29, 2012. Internet links were provided, where available.

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The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and economic evaluations.

Four relevant non-randomized studies regarding the impact of advances in SPECT imaging on the efficient use of $^{99m}$Tc in patients requiring SPECT diagnostic imaging were identified. No relevant health technology assessment reports, systematic reviews, meta-analyses, randomized controlled trials, or economic studies were identified. Additional references of potential interest, including information regarding reduced scan duration and software advances, are provided in the appendix.

OVERALL SUMMARY OF FINDINGS

All of the identified studies were non-randomized, examined the use of cadmium zinc telluride (CZT) SPECT in patients undergoing myocardial perfusion imaging in patients with cardiac or suspected cardiac disease, and examined $^{99m}$Tc dosing and scan time techniques or protocols in adults.\(^1\)\(^,\)\(^2\)\(^,\)\(^4\) Overall, the evidence from the included studies indicates that high efficiency CZT SPECT may be effective in reducing $^{99m}$Tc-sestamibi doses and scan time in non-obese patients undergoing cardiac imaging.\(^1\)\(^,\)\(^2\)\(^,\)\(^4\) $^{99m}$Tc-tetrofosmin doses for patients with suspected myocardial ischemia, and may result in a 57% reduction in isotope use\(^4\) compared with conventional SPECT cameras or standard scan time protocols without sacrificing image quality. Further detail regarding the included studies is provided in Table 1.

Studies that examined outcomes with respect to scan time reduction, attenuation correction, or that examined software advances without providing information regarding $^{99m}$Tc dose-reduction are included in the appendix.

### Table 1: Summary of Included Studies

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Patients</th>
<th>Study Objectives</th>
<th>Imaging Techniques</th>
<th>$^{99m}$Tc Dose; Imaging Time</th>
<th>Results and Conclusions</th>
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</thead>
<tbody>
<tr>
<td>Duvall et al.(^1), 2012</td>
<td>71 patients with suspected obstructive CAD, weight &lt; 200 lbs.</td>
<td>To validate rapid, low tracer dose CZT SPECT MPI for CAD imaging.</td>
<td>High-efficiency CZT SPECT MPI with Tc-99m sestamibi (patients also had coronary angiography within 2 months of the CZT protocol)</td>
<td>For CZT: ≤ 15 mCi; average dose 13.3 mCi; 3 to 5 mins</td>
<td>Sensitivity: 89%; Specificity: 66%; Accuracy: 78%; High-efficiency CZT SPECT MPI with low dose $^{99m}$Tc was found to be effective in imaging obstructive epicardial CAD.</td>
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<td>Duvall et al.(^2) 2011</td>
<td>131 patients ≤ 250 lbs or</td>
<td>To examine a low-dose CZT SPECT MPI with $^{99m}$Tc-Tc-</td>
<td>Rest dose: 5 mCi</td>
<td>No significant differences in image</td>
<td></td>
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<tr>
<td>Author, Year</td>
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<td>BMI ≤ 35 undergoing cardiac imaging.</td>
<td>rest-stress CZT SPECT MPI technique.</td>
<td>sestamibi using a rest-stress protocol. Conventional SPECT (27 patients were imaged using both conventional and CZT SPECT).</td>
<td>Stress dose: 15 mCi. Rest: 5 mins; 8 mins Stress: 3 mins; 5 mins</td>
<td>quality between the shorter and longer scan time images, effective radiation dose was reduced compared with traditional SPECT. New SPECT technology was found to be effective in reducing isotope use and ionizing radiation without sacrificing imaging quality.</td>
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<td>Nkoulou et al., 3, 2011</td>
<td>50 patients with suspected myocardial ischemia.</td>
<td>To determine if CZT scanning with count subtraction can eliminate the need for higher-dose stress-rest MPI.</td>
<td>CZT rest SPECT MPI with low dose 99mTc-tetrofosmin. CZT rest SPECT MPI with higher dose 99mTc-tetrofosmin.</td>
<td>Low dose: 320 MBq. High dose: 960 MBq. Scan time not reported.</td>
<td>Clinical agreement was high between low-dose and higher dose resting CZT stress MPI, there was good correlation between low and standard dose scans with respect to segmental uptake. Authors concluded that accurate assessment of myocardial ischemia is feasible with low-dose-low-dose 1 day SPECT MPI.</td>
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<td>Duvall et al., 4, 2010</td>
<td>717 patients undergoing stress MPI</td>
<td>To evaluate low dose, low acquisition time SPECT MPI imaging.</td>
<td>CZT SPECT MPI used in 3 ways: low dose stress only imaging, high dose stress only imaging, standard dose rest-stress imaging. Specific dose or tracer not reported in abstract. 5 mins for low-dose stress only. 3 mins for high dose stress only. 3 mins for rest-stress</td>
<td>Similar image qualities seen for each imaging protocol, 57% isotope reduction in low-dose stress only compared with high dose stress only. Authors concluded that new CZT SPECT cameras significantly reduced radiation exposure and acquisition time without sacrificing image quality.</td>
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CAD = coronary artery disease; CZT = cadmium zinc telluride; lbs = pounds; MBq = megabequerel; mCi = millicurie; mins = minutes; MPI = myocardial perfusion imaging; mSv = millisevert; SPECT = single photon emission computed tomography; vs = versus; 99mTc = technetium-99m.
REFERENCES SUMMARIZED

Health Technology Assessments
No literature identified.

Systematic Reviews and Meta-analyses
No literature identified.

Randomized Controlled Trials
No literature identified.

Non-Randomized Studies


Economic Evaluations
No literature identified.

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APPENDIX – FURTHER INFORMATION:

Non-Randomized Studies – reduced scan time


Advances in SPECT Imaging Technology for Patients Requiring SPECT Diagnostic Imaging


Non-Randomized Studies – software, attenuation correction


PubMed: PM20847159

PubMed: PM20881894

PubMed: PM20858847

PubMed: PM19533264

Additional References
