The Newer, the Better; and May Be Not Good Enough?

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If you want to succeed you should strike out on new paths, rather than travel the worn paths of accepted success.

John D. Rockefeller

In a meta-analysis comprising 40 studies, Cantoni et al. compared the diagnostic accuracy of C-SPECT (conventional SPECT) and of CZT SPECT. Regarding diagnostic accuracy, the area under the curve (AUC) was higher for CZT-SPECT than for C-SPECT; 0.89 and 0.83, respectively. Importantly, CZT-SPECT provided both, higher sensitivity and specificity than C-SPECT; 89% vs 85% and 69% vs 66%, respectively.

The conclusion of the authors was, that both, C-SPECT and CZT-SPECT have good diagnostic performance in detecting angiographic proven coronary artery disease (CAD), with a slightly higher diagnostic accuracy of CZT-SPECT.

Even though the absolute difference in diagnostic accuracy is quite small, these are important findings, since CZT-SPECT has shorter acquisition time and lower radiation exposure than C-SPECT, if used accordingly.

However, there are some important limitations to the current study which were most mentioned by the authors themselves: there are only 2 out of 40 studies that directly compared the diagnostic performance of C-SPECT and CZT-SPECT in the same patient population.[1] The other studies included into the meta-analysis assessed either the diagnostic accuracy of C-SPECT or CZT-SPECT, separately. Therefore, the patient populations of the studies may be quite different.

Chronologically, the C-SPECT studies are less recent than the CZT-SPECT studies, less clinical data are available. And importantly, newer techniques like innovations in camera technology, attenuation correction, and newer reconstruction algorithms were not in regular use in the C-SPECT studies.

However, as pointed out by the authors, the prevalence of obstructive CAD, the distribution of stenosis thresholds (50% or 70%) and imaging tracers used were similar in the C-SPECT and CZT-SPECT studies.

The results of the current study are in line with a meta-analysis that summarized the diagnostic accuracy of CZT-SPECT in the same patient population.[2] The sensitivity of CZT-SPECT was 0.84 (95% confidence interval [CI] 0.78 to 0.89), and the specificity was 0.69 (95% CI 0.62 to 0.76). The positive likelihood ratio was 2.73 (95% CI 2.21 to 3.39), the negative likelihood ratio was 0.24 (95% CI 0.17 to 0.31), and the diagnostic odds ratio was 11.93 (95% CI 7.84 to 17.42). At subgroup and meta-regression analyses, the diagnostic accuracy between two CZT-SPECT cameras (D-SPECT and Discovery) was similar.[2]

Shorter acquisition time and reduction of radiation for the patient are important achievements of the CZT-SPECT technology.

However, CZT-SPECT use is not the only strategy available to reduce radiation exposure. Radiation dose reduction strategies in general can be summarized under the following categories: protocol selection, software upgrades of existing systems, new SPECT—camera technologies (e.g. CZT technology) and a switch to another technology (e.g. PET-imaging).

Despite these well-established methods, most clinical laboratories in the United States are failing to reduce radiation exposure during SPECT and have not significantly changed their daily practice.[3] In 2010, the American Society of Nuclear Cardiology recommended reducing the average patient study radiation exposure to

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< 9 mSv in 50% of SPECT studies by 2014.[4] A study based on data of the Intersocietal Accreditation Commission database of accredited laboratories has been published recently.[3] The goal of this study was to evaluate if this target was reached. The results document that radiation exposure of cardiac PET studies was ≈ 3.6 mSv per study, whereas the average SPECT exposure was ≈ 14.6 mSv. Overall, 100% of PET laboratories were able to achieve the American Society of Nuclear Cardiology goal of < 9 mSv of radiation exposure per study. In contrast, only 2.6% of SPECT laboratories reached this goal.[3]

Besides the slightly higher diagnostic accuracy and radiation dose reduction other important practical points of CZT-SPECT have to be taken into account, which may play an important role why CZT-SPECT technology is not in broader use yet: there are higher purchase costs than with C-SPECT, and technically, a smaller field of view, resulting in the fact that CZT-SPECT is a specific ''cardiac camera'' and can't be used as an all-round SPECT camera.

Another, but particular important point of the current study is the quite low specificity to diagnose coronary artery disease with both, C- and CZT-SPECT, 66% and 69%, respectively. This fact may be in part due to relatively low-image resolution, attenuation defects, and poor count statistics with SPECT-imaging. These points can impact the diagnostic accuracy of SPECT—imaging and result in low specificity. Obesity, in addition to breast and inferior gut attenuation are well known to negatively impact image specificity.[5]

Obesity is not only an increasing health problem but often also a problem with cardiac imaging. In 2015, the highest level of age-standardized adult obesity was observed in Egypt (prevalence 35.3%), and the highest level of age-standardized childhood obesity was observed in the United States (prevalence 12.7%). In summary, between 1980 and 2015, the age-standardized prevalence of obesity increased by a factor of two,[6] which is consistent with a worldwide prevalence increase of overweight and obesity, combined, by 27.5% for adults and 47.1% for children, between 1980 and 2013. The absolute number of overweight and obese individuals increased from 857 million in 1980, to 2.1 billion in 2013.[7]

The above-mentioned increase in obesity prevalence might explain in part the problem of relatively low diagnostic specificity of SPECT—imaging, even with newer techniques that were developed during the same time period during which an increasing prevalence of overweight and obesity was observed.

In extreme obesity, defined as body mass index > 40 kg/m^2, PET has been shown to provide higher diagnostic accuracies at lower radiation exposure than SPECT, 86% and 63%, respectively ($p = .01$).[8,9]

According to Rockefeller's quote our effort should aim to adapt our diagnostic techniques to the highest standards, the most recent developments, and to make the most accurate techniques available for our patients. Thus, we can tackle modern challenges and the patients can benefit from a patient-tailored approach.

Disclosure

Michael J. Zellweger declares that he has no conflict of interest.

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