SmartFocus on dynamic CZT-SPECT

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Expanding cardiac diagnostic capabilities with dynamic CZT-SPECT

HOW NUCLEAR IMAGING DEPARTMENTS ARE ACHIEVING BETTER THROUGHPUT, MORE ACCURATE RESULTS, AND IMPROVED PATIENT OUTCOMES.

In the rapidly evolving field of cardiac medical imaging, there is an urgent need for modernization and improved accuracy, particularly for myocardial perfusion SPECT imaging protocols[1].

Many of the nuclear imaging systems that are currently in use are 15 to 25 years old, and in many facilities the protocols being used were developed more than 25 years ago[2]. Hence the limitations of outdated nuclear imaging systems and outdated procedure protocols have posed significant challenges for clinicians and patients[3].

To remain relevant, both the technology and the protocols for SPECT myocardial perfusion imaging (MPI) must advance and continue to evolve. In recent years, the introduction of Cadmium-Zinc-Telluride Single Photon Emission Computed Tomography (CZT-SPECT) technology has emerged as a game-changer, offering a host of benefits that have revolutionized the field of nuclear cardiac imaging.

CZT-SPECT: SIGNIFICANT IMPROVEMENTS OVER TRADITIONAL NUCLEAR IMAGING SYSTEMS

SPECT MPI has long shown value in the diagnosis and prognosis for patients with cardiovascular disease. However, accuracy and sensitivity of the technique may be reduced in patients with complicated clinical presentations such as multivessel disease, micro-vascular disease and left bundle branch block (LBBB). Advances such as AI-based attenuation correction (Spectrum Dynamics TruCorr®) and CZT-based technology enabling the measurement of myocardial flow reserve (MFR) may help provide previously unavailable diagnostic and prognostic information.

Consider this case from Sakakibara Heart Institute, Japan, where the patient presented with chest pain in the presence of increased clinical risk factors. The standard perfusion images show a mostly normal presentation, with some potential apical ischemia. The ischemic distribution is slightly greater with the addition of AI Attenuation Correction (TruCorr); however, the defect is considered small **(fig1a & fig 1b)**. Additionally, since Sakakibara has a Spectrum Dynamics D-SPECT® cardiac system with SPECT MFR capabilities, dynamic SPECT was included in the MPI protocol.

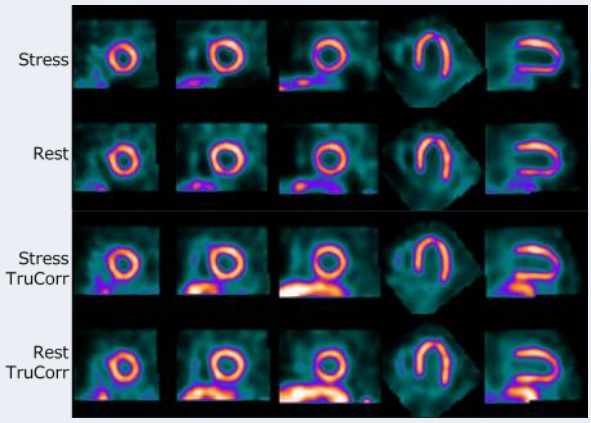

FIG 1A

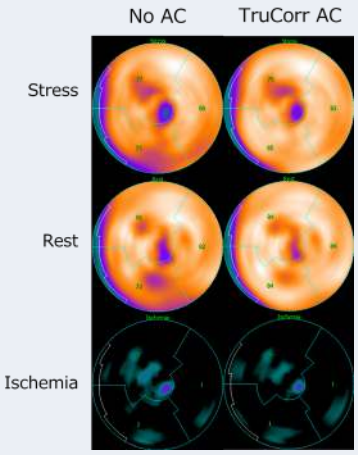

FIG 1B

> In addition to the increased diagnostic and prognostic information provided by CZT SPECT, imaging departments that have invested in CZT-SPECT for myocardial perfusion studies have reported a twofold increase in productivity.

The results of SPECT MFR measurement on the D-SPECT demonstrated significantly reduced blood flow reserve (MFR) in all vascular territories **(fig 2a)** and as a result, the patient was referred for an invasive coronary angiogram. The angiogram confirmed significant stenoses in the vascular territories detected by SPECT MFR **(fig 3a)** and the patient underwent coronary artery bypass surgery (CABG) to restore circulation. Subsequently, a follow-up MPI with MFR demonstrated normal flow values **(fig 2b)**, indicating a successful CABG procedure.

Imaging departments that have invested in CZT-SPECT for myocardial perfusion studies have reported a twofold increase in productivity, even in the face of increasing constraints on time and staff resources. The ability of CZT-SPECT technology to produce clearer images and more accurate results while using ultra-low doses of radiation has been proven, even in individuals with a high body mass index.

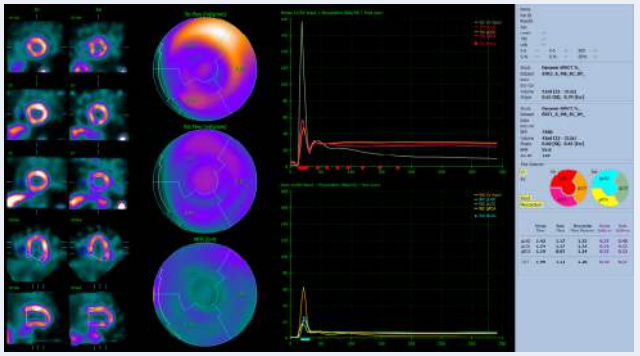

FIG 2A: Reduced blood flow and MFR in all coronary territories.

FIG 3A: Invasive coronary angiogram confirming multivessel disease. RCA# 1: 99%, LAD#5: 50%, #6: 90%, #7: 90%, LCX#11: 75%, #12: 90%, #14: 90%

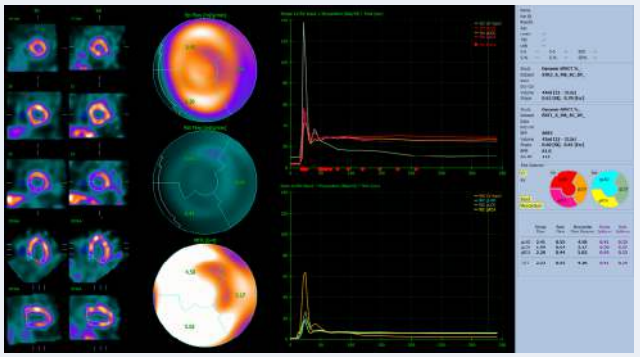

FIG 2B: Normal blood flow and MFR in all coronary territories.

The distinct advantages of CZT technology, including high sensitivity, temporal resolution and spline fitting reconstruction, have positioned it as a pivotal tool in modernizing cardiac scanning technology and placing patients at the center of care.

INCREASED THROUGHPUT AND IMPROVED OUTCOMES

It has been shown that investing in a CZT-SPECT camera can lead to dramatic increases in patient throughput and improvements in patient outcomes. The technology's capabilities have increased the sensitivity of these cameras by five to 10 times, facilitating more rapid scan acquisition, enabling substantial reductions in tracer dose, saving time and simplifying quality control procedures.

THREE DISTINCT ADVANTAGES FOR MPI

The Spectrum Dynamics CZT-SPECT camera systems offer three distinct advantages that enable procedures that are not possible with older technology:

- **High sensitivity.** D-SPECT and VERITON-CT®, Spectrum Dynamics' whole body CZT SPECT-CT systems, have the highest sensitivity of any SPECT camera on the market. Clinicians receive the statistical information they need to build a quality image and can obtain flow data, all of which is achievable whilst using standard or lower doses of radiation. In fact, thanks to CZT-SPECT, clinicians are often able to use well below the ASNC's MPI target dose of 5 millisieverts.
- **Temporal resolution.** CZT-SPECT captures blood flow as it moves rapidly through the heart, enabled by superior temporal resolution compared with traditional sodium iodide (NaI) cameras.
- **Spline fitting reconstruction.** The use of spatiotemporal spline fitting improves the agreement between PET and SPECT myocardial blood flow reserve measurements, providing reproducible results that are correlated to PET imaging.

Notably, CZT-SPECT's miniaturization of detectors and use of digital imaging have resulted in greater sensitivity, spatial resolution and energy resolution compared with traditional NaI cameras.

A key feature of Spectrum Dynamics' CZT-SPECT camera is its swiveling detector motion (BroadView) with real-time[4] D imaging (TruFlow), which enables absolute flow quantification with a level of precision that has not previously been possible. This unique functional combination has led to increased clinician confidence and more accurate diagnoses, with a time efficient procedure protocol that addresses the demands of increasing patient throughput and departmental workflow.

> “The distinct advantages of CZT technology, including high sensitivity, temporal resolution and spline fitting reconstruction, have positioned it as a pivotal tool in modernizing cardiac scanning technology and placing patients at the center of care.”

STUDY RESULTS DEMONSTRATE THE VALUE OF CARDIAC CZT-SPECT

Clinical studies have demonstrated the following key advantages of CZT-SPECT:

- **Excellent image quality, even among patients with obesity.** In a multicenter study involving 118 individuals with obesity, CZT-SPECT produced high image quality, normalcy rate and diagnostic accuracy for coronary artery disease[6].
- **Attenuation correction.** When CZT-SPECT is used with an FDA-approved artificial intelligence algorithm, a complete stress only imaging procedure can be performed in less than 30 minutes, with no rest imaging required in patients with a normal stress study. This can reduce individual patient radiation dose and procedure time, reduce radiotracer costs and enable increased patient throughput[9].

- **Quantification of myocardial blood flow and MFR.** A study involving 127 individuals demonstrated that MFR assessed by CZT-SPECT can predict future adverse events and stratify disease severity in individuals with heart failure with preserved ejection fraction[7].
- **Comparable to PET.** In the 2018 WATERDAY Study, CZT-SPECT performed on a D-SPECT cardiac system provided similar myocardial flow reserve when compared with PET[8,11,12]. CZT-SPECT also had high diagnostic value for detecting impaired myocardial flow reserve and abnormal fractional flow reserve in individuals with stable coronary artery disease. Further, when image reconstructions were performed with the addition of a D-SPECT specific Spline-Fitting reconstruction, even greater reproducibility was demonstrated.
- **Prognostic value.** While dynamic PET is still accepted as the most accurate molecular imaging methodology for the assessment of MBF and MFR, the use of CZT-SPECT has increasingly been applied for flow measurement, owing to the greater availability of SPECT 99mTc-labeled tracers, lower costs compared with PET and similar prognostic value[10].

THE FUTURE OF CARDIAC CZT-SPECT

These results are encouraging, and within the context of 25 years of incremental improvements in MPI, CZT-SPECT has provided the opportunity to take technological improvements to the next level while maintaining relevant imaging options for advanced cardiac imaging. Thanks to this breakthrough in technology, CZT-SPECT lays the foundation for a promising future. Consider the possibilities:

- **AI-based improvements.** AI-generated attenuation correction can provide a cost-effective solution that enables further reductions in the dose administered to patients, while still maintaining quantitative accuracy. Additionally, AI applications can provide an effective solution for the reduction of image noise that can occur with low-dose imaging. Combining CZT-SPECT with these AI applications has resulted in improved image reconstructions.
- **Automated dynamic motion correction.** Motion correction algorithms for dynamic SPECT have recently become available in current post-processing applications, similar to what is used for PET, which may result in improved workflow efficiency, image reproducibility and diagnostic accuracy.
- **Standardized rapid SPECT MFR protocols.** Standardized rapid MFR protocols will be valuable to support procedure adoption, leading to greater workflow efficiency.
- **Enhanced SPECT radiopharmaceuticals with higher perfusion rate and flow extraction.** The global progress of radiopharmaceutical development is accelerating, creating the promise of an increasing array of novel tracers that may be used with CZT-SPECT.

The transformative potential of CZT-SPECT technology for revolutionizing myocardial perfusion imaging cannot be overstated. Its ability to address the limitations of outdated nuclear imaging systems, to improve diagnostic accuracy and to enhance patient outcomes aligns well with the calls for modernization from leading organizations such as the American Society of Nuclear Cardiology. As the field of cardiac imaging continues to evolve, CZT-SPECT stands as a beacon of progress, offering a promising future for the accurate and efficient assessment of myocardial perfusion and blood flow, and the diagnostic evaluation of coronary disease.

“The transformative potential of CZT-SPECT technology for revolutionizing myocardial perfusion imaging cannot be overstated.”

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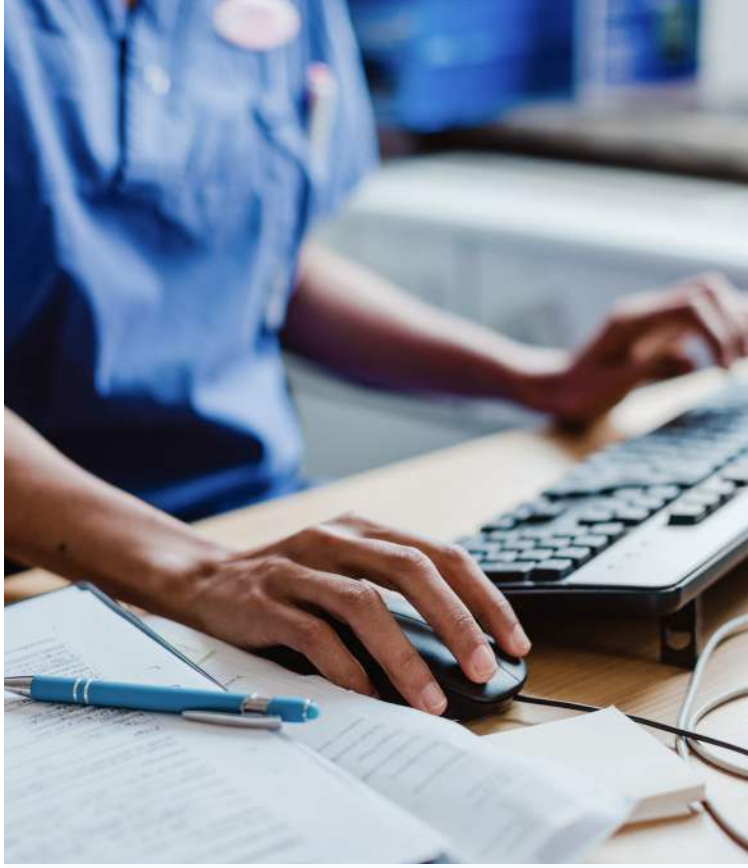

About Spectrum Dynamics

Spectrum Dynamics is spearheading the transformation of SPECT imaging systems from analog to digital detection technology, enabling hospitals and clinicians to provide healthcare services with improved image quality, efficiency and access to advanced clinical applications. Spectrum Dynamics launched the world's first digital cardiac SPECT system, the D-SPECT CARDIO, in 2007. Since then, the D-SPECT has become the system of choice for functional cardiac imaging with hundreds of systems sold worldwide. In 2018, Spectrum Dynamics launched its multipurpose SPECT and SPECT/CT systems – the VERITON® and the VERITON-CT® SPECT/CT, the first ring-shaped gantry 360° CZT digital SPECT/CT scanner

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