Evaluation of the 4D NCAT Phantom to Simulate Organ Dynamics

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Abstract: An accurate investigation of fast tracer kinetics enables a diagnostic technique which provides both spatial and temporal information of organ function. Simulations of dynamic organ acquisition require phantoms that produce time-changing activity in the regions of interest. This feature was considered in the 4D NCAT phantom.

The objective of this study is to demonstrate the capability of generating dynamic phantom images which contain the exact information of radiotracer distribustion changes in the organs of interest using the 4D NCAT digital phantom.

The accuracy of constant, ascending and descending steep Time activity Curves (TACs) of blood and myocardial tissue in 99m-Tc teboroxime injection were evaluated. Also, the effect of temporal resolution in accuracy of output data point (in 4 states 1/8,1/16,1/32,1/64 sec) were considered.

According to the assessment, the response of the dynamic 4D NCAT phantom for constant curves had just slight errors. The average relative differences between input and output data points of steeper TACs were noteworthy in both ascending and descending mode. By increasing of the temporal data point sampling, the average relative difference between input and output data points were decreased. Overall, 93.3% of the reviewed sample points depicted relative errors smaller than 0.004%.

The primary studies with 4D NCAT version 2012 revealed some initial challenges in creating TACs, which were subsequently resolved with the new version emitted by Dr. Paul Segars. Overall, the modified 4D NCAT phantom now enables convenient and accurate simulation of organ dynamics.

Key Words: Time-activity curve, 4D NCAT phantom, Dynamic Imaging.