

LOCAL CEREBRAL HEMODYNAMICS BY TRACING STABLE XENON WITH TRANSMISSION COMPUTED TOMOGRAPHY

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Aspects of imaging local cerebral hemodynamics by tracing stable xenon with transmission computed tomography (TCT) were investigated. Compartmental and black box theories were applied to derive local blood flow values from measured arterial and cerebral xenon concentrations. The large quantity of spatial information, sparse temporal sampling, and the substantial uncertainty in measured pixel values led us to select simple exponential fitting models with a black box interpretation as the method of solution. Seven models of one to three fitted coefficients were evaluated through computer simulations for various scan schedules. Results indicated that scans acquired between 1.5 and 4 minutes of the washin phase are the most useful in determining precise blood flow values.

Problems associated with the method, in particular patient motion, physiological effects of xenon, radiation exposure, and time dependence artifacts in slow scanners, were analyzed by both experiment and computer simulation.

Tomographic measurements of cerebral xenon distributions in both animal and human subjects were carried out. Derived results were presented in functional image format. The anatomical detail seen in the cerebral blood flow and xenon solubility images of our best animal study was superior to that of any current technique.

An expired air xenon gas analyzer was designed and constructed, based upon the gamma ray attenuation properties of xenon. Its dynamic sensitivity and precision was demonstrated in performance tests.

The results of our investigation strongly support the method as a useful new application of the large number of TCT scanners presently in operation around the world.