ESTIMATION OF CEREBRAL BLOOD FLOW FROM DYNAMIC SUSCEPTIBILITY CONTRAST MRI USING A TISSUE MODEL

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Abstract

The measurement of regional cerebral blood flow (CBF) using the technique of dynamic susceptibility contrast (DSC) MRI is gaining acceptance as a valuable clinical tool. However, the technique as currently performed is qualitative and less accurate than the gold standard of PET imaging. As part of the St. Louis carotid occlusion study, 15 patients with cerebral hemodynamic impairment were scanned on the same day with both PET and MRI, providing us with an ideal standard against which to compare different MRI CBF estimates. We used Bayesian probability theory to perform parameter estimation using a modification of the standard model used in DSC-MRI. This model is based on conservation of mass in the tissue, also called Ficks' law. In this model the tissue concentration (that we measure by noting signal changes on the MRI scan) is equal to the CBF multiplied by a convolution of the arterial input function (the amount of contrast material delivered to the tissue by the arterial system) with the tissue residue curve (which indicates the amount of residual contrast material in the tissue over time). We applied Bayesian parameter estimation to this model with analytical expressions for the arterial input function and residue curve from the literature to estimate the CBF. Our preliminary results indicate that this approach is superior to more commonly used methods in estimating the true flow as measured by PET scanning.