DSC: Post-Processing, Including Demo

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HIGHLIGHTS

- Multiple parametric perfusion maps may lead to perfusion confusion
- Not all deconvolution techniques are created equal

TARGET AUDIENCE: Individuals interested in practical issues of PWI map calculation.

OBJECTIVES: Learn how to make perfusion maps and understand potential confounds.

PURPOSE: Perfusion-weighted dynamic susceptibility contrast-weighted MRI (PWI) has been shown to be highly sensitive in detecting disturbed hemodynamics. However, there exist many techniques for calculating perfusion status and multiple parameters that can be measured. We will discuss some technical considerations and potential pitfalls in calculating and interpreting PWI-derived maps.

METHODS: Several parametric maps can be derived from the sampled concentration of contrast-agent over time curves, C(t), measured using bolus-tracking PWI. We will discuss the pros and cons of different techniques for quantifying intra- and inter-subject PWI differences, ranging from approaches that characterize the shape of the bolus curve to methods utilizing tracer kinetic analyses.

RESULTS: Parameters characterizing the shape of C(t), e.g. bolus arrival time or time-to-peak, are indirect measurement of perfusion status that have been used as surrogates for mean-transit time (MTT) and cerebral blood flow (CBF). Although easy to calculate, these metrics are often considered not as accurate as techniques that use tracer kinetic theory. Methods relying on deconvolution with an arterial input function (AIF) are therefore usually preferred. Choice of deconvolution techniques greatly affects the estimates of CBF and MTT. A clinically prevalent method using truncated singular value decomposition (SVD) for deconvolution, makes no assumptions regarding the form of the residue function *R(t)*, and performs well in the presence of noise. A major limitation of the SVD-technique is its sensitivity to delay and dispersion of the bolus from the site where the AIF is measured to the origin of the capillary bed of the tissue under investigation that will introduce errors in the quantification process and is a contributing factor to the sensitivity of CBF and MTT calculation to AIF selection. The impact of delay and dispersion can be compensated with advanced deconvolution techniques.

DISCUSSION: Even with optimal methods for calculating PWI parametric maps, the interpretation of perfusion maps may be confounded by several factors. One source of error is insufficient contrast-agent concentration to induce enough signal change to reliably estimate CBF. Another potential confound is patient motion leading to signal dephasing in voxels that may be erroneously construed as resulting from high concentrations of contrast agent. Another possible source of error is truncation of *C(t)* curves by not acquiring sufficient data points that can lead to inaccurate determination of perfusion parameters. By examining the acquired unprocessed PWI data, one can detect these sources of errors and mitigate misinterpretation.

CONCLUSION: PWI is an important clinical tool due to its many desirable characteristics, including speed of acquisition, and high sensitivity for identifying hemodynamically disturbed tissue. It is important to keep into consideration potential limitations and confounds of PWI while interpreting perfusion maps for the diagnosis and prognosis of patients. When in doubt, examination of the raw data may provide clarification. On-going research improving the accuracy and reproducibility of perfusion estimates have the potential of further expanding the role of PWI in patient management.

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