Evaluation and Minimization of the Difference in MR Perfusion Maps among Softwares

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Purpose:

MR perfusion imaging is a useful tool to assess regional blood flow in patients with acute stroke. However, different analysis software produces significantly different perfusion maps, due to different preprocessing and different analysis algorithm; it can be hazardous in multi-center study. The purposes of this study are, (1) to evaluate the difference of perfusion maps analyzed by different analysis softwares, and (2) to assess the methods to minimize those variations in perfusion maps.

Materials and Methods:

Source data of MR perfusion, obtained from several institutions, were postprocessed by 15 different ways by using 8 commercially available softwares. Visual assessment of perfusion maps was performed with and without automated color-scale adjustments (ACSA) with common lookup table (LUT). The quantitative values were measured by automated ROI tool. Absolute values and relative ratios (compared to the contralateral normal side) of ROIs were calculated. The areas of DWI-PWI mismatch were also evaluated.

Results:

Without ACSA, the color-coded perfusion maps of different manufactures revealed significantly different appearance between softwares. The differences between softwares became smaller when ACSA was used. However, the discrepancies of geographical distribution of perfusion abnormality, including DWI-PWI mismatch, were still noted even with ACSA. The cause of the remaining discrepancies was considered to be the difference of analysis algorithm, because the difference utilizing similar algorithm was smaller. The absolute values of ROI showed substantially different results. The differences between softwares were smaller for relative ratios, compared to absolute values.

Conclusions:

The quantitative values of MR perfusion significantly differed between the types of analysis softwares. The use of relative ratios and ACSA with common LUT can minimize those variations. Standardization of analysis and evaluation methods should be established for further minimization of the variations, in order to facilitate the utility of perfusion imaging, especially in multi-center study.

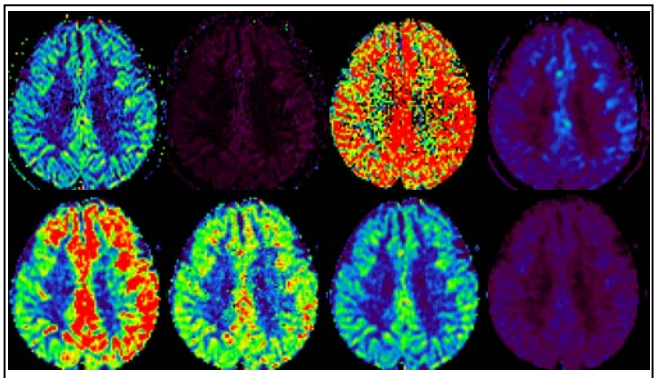

Fig. 1, CBF maps without ACSA.
CBF maps analyzed by 8 different types of softwares are shown. The color-coded maps reveal significantly different appearance, even with the same LUT.

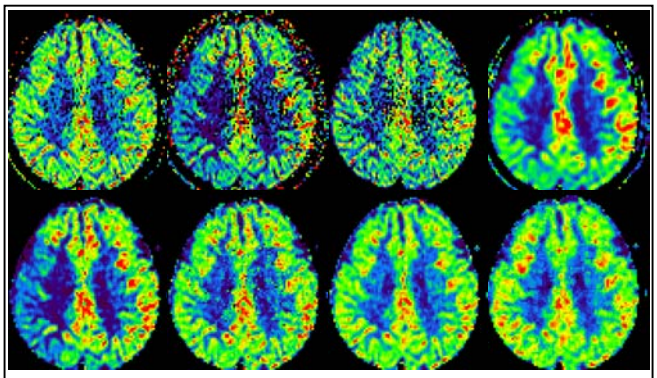

Fig. 2, CBF maps with ACSA.
The same CBF maps were displayed by using ACSA. The difference between softwares becomes smaller. The area of perfusion deficit in right MCA territory is noted in some softwares, but not in others.

References:

1. Kudo K, et al. Various Factors That Affect Image Quality and Quantitative Value of CT Perfusion. 90th annual meetings of RSNA. 2004.
2. Yamada K, et al. Magnetic resonance perfusion-weighted imaging of acute cerebral infarction: effect of the calculation methods and underlying vasculopathy. Stroke. 2002. 33(1): p. 87-94.
3. Wu O, et al. Tracer arrival timing-insensitive technique for estimating flow in MR perfusion-weighted imaging using singular value decomposition with a block-circulant deconvolution matrix. Magn Reson Med. 2003. 50(1): p. 164-174.
4. Ostergaard L. Cerebral perfusion imaging by bolus tracking. Top Magn Reson Imaging. 2004. 15(1): p. 3-9.