Title:
Apparent Diffusion Coefficient Z-score Maps Compared to Normative Atlas in Hypoxic Ischemic Encephalopathy

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Purpose: In neonates with Hypoxic Ischemic Encephalopathy (HIE) construct Z-score overlays for ADC maps to quantify regional differences in ADC, compared to a normal ADC atlas.

Materials and Methods:
IRB approval was obtained. We retrospectively identified 26 neonates (16 male, 10 female) with moderate and severe HIE (Sarnat 2 and 3). Subjects were imaged in their first week of life (mean: 2 days). For each, we generated a standard (Z-score) map by coregistering and comparing the individual’s ADC map to a normal control ADC atlas constructed by averaging geometry and intensity of 18 normative ADC maps (age: 0-7 days). MRI reports of HIE-subjects were reviewed and ROIs placed on ADC maps at sites where decreased diffusion was described. Voxelwise SD values (relative to the atlas) were calculated and overlaid on the HIE ADC/DWI images, with threshold adjusted to demonstrate pixels with SD values below -1. A radiologist reviewed the DWI/ADC images with overlay of the Z-score maps (Fig 1).

Results:
Decreased diffusion was described in MRI reports of 9 subjects (35%). Areas involved included lobar gray-white (GW) matter (n=6), deep-gray nuclei (DGN)(n=7), cerebellum (n=2), brainstem (n=1), and deep white matter (WM) (n=1). The mean SD difference from the atlas in these areas was – 0.91 SD, with measurements as low as -5.1 SD. Image review using DWI/ADC with overlay of Z-score maps demonstrated decreased diffusion in 9 subjects. Areas involved include lobar GW matter (n=6), DGN (n=5),
cerebellum (n=4), brain stem (n=2), deep WM (n=1). 7 of these 9 subjects also had abnormalities on MRI report. In two cases, ADC/Z-score demonstrated regions of decreased diffusion in subjects without reported abnormalities in clinical reports. Two subjects with abnormalities in clinical reports did not have ADC/Z-score differences. In these two subjects, the ROI based SD (at sites described in the report) were -0.35 and -0.38, respectively.

Conclusion:

Qualitative assessment of DWI/ADC images identifies regions with inconsistent ADC differences compared to normal, in routine clinical practice. Quantitative tools, such as Z-score maps derived from a normal ADC atlas could facilitate consistent identification of diffusion abnormalities.
Figure # 1.