ADNI Alzheimer's Disease Neuroimaging Initiative

UCSF ASL Perfusion Raw QC Guide

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QC Guide

Procedure:

Quality evaluation of ADNI ASL data in the San Francisco lab is a three level process. The first level is a consistency check of basic ASL parameters. The second level is a visual inspection of data quality using a 3 level scoring system. The third level is a quantitative quality assessment that runs automatically.

At the first level, we inspect ASL protocol name, nominal image resolution, TR/TE timing and number of measurements, as listed in the XML metafile associated with the image data.

At the second level, we inspect signal uniformity, geometrical distortions, gray matter contrast, and presence of artifacts using Good, Fair, Unusable as a scoring system. The scores are entered in a spreadsheet (excel) with rows representing the scan and scores for each QC measure in columns. In addition, a binary summary score (pass/fail) for global quality is provided.

At the third level, mathematical algorithms quantify the "divergence" of the ASL data to a representative data set. For regions outside the brain mask (background), the representative dataset is white noise. Thus, degradation in image quality due to excessive movement, aliasing, ringing, spiking, which usually cause artifacts outside the brain is captured as increase in background divergence. For regions inside the brain mask, the representative data is the mean image of the brain data. The divergence of each ASL frame relative to the mean image is computed and a summary metric - based on the variability of divergence - is reported. The summary metric includes the median divergence and the max and min values.

The inherent assumption which is made here for high quality in the context of ASL is that the divergence is low and variability high. Lastly, an approximation of SNR is estimated for ASL from the ratio between mean ASL signal and rms of background noise.

Spreadsheet Key:

A. Basic Parameter Check

Visual check of data entries in the XML metafile-

- TE
- TR
- Pixel Spacing
- Slice Thickness

Number of Measurements
Number of slices

B. Manual QC Checks-

***Signal Uniformity*:** Is the intensity/brightness of the image continuous throughout the brain?

Good- Signal may be slightly more intense in one region of the brain with respect to the whole, but is basically uniform

Fair- Signal is strongly more intense in one region of the brain or is somewhat patchy around the brain

Unusable- Signal is completely non-uniform, many patches of hypo/hyper intensity

***Geometrical Accuracy*:** Is a complete brain visible in the image? Are any geometrical distortions present that detract from the completeness of the image? There is often geometrical distortion around the eyes, face, and large arteries but image is considered useable if actual brain signal remains intact.

Good- Brain image is unimpaired for the most part

Fair- Some distortions present causing signal drop off in various areas of the brain

Unusable- Gross distortion throughout the brain causing severe image impairment

***Gray Matter Contrast*:** Is there a clear contrast between gray matter vs. CSF and gray matter vs. image background? Are the deep gray matter structures in the basal ganglia clearly visible? This is measured both visually and quantitatively by sampling a small section of intensity in the gray matter and comparing it to the same size section in the background of the image.

Good - Clear contrast between gray matter and background
- Clear visualization of basal ganglia and cortex
- Intensity of gray matter is roughly between 2200-2500 (while background is ~ 2000)

Fair - Gray matter/ background contrast is distinguishable but not clearly
- Basal ganglia and cortex is faintly visible
- Intensity of grey matter is roughly between 2100- 2200 (while background is ~ 2000)

Unusable - Gray matter is undistinguishable from background or CSF
- No visible basal ganglia or cortical structures
- Intensity of gray matter is less than 2100 (while background is ~ 2000)

***Egregious Artifacts*:** Looks for the presence of large, disruptive artifacts such as motion, ringing and ghosting which render the image unusable. A binary rating of no/yes is given depending on presence/ absence of such deleterious artifacts.

***Global Score*:** Pass or fail rating based on the previous four QC categories. A rating of "unusable" in any of the four will result in a global "fail."

C. Automated QC Checks-

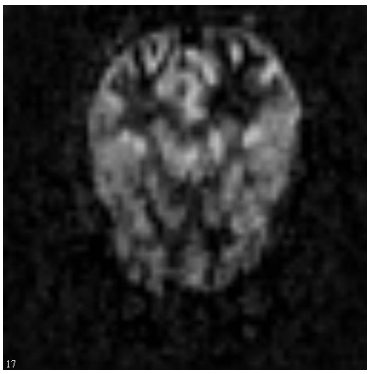
SNR: Signal to noise ratio defined as overall ASL signal divided by rms of background noise

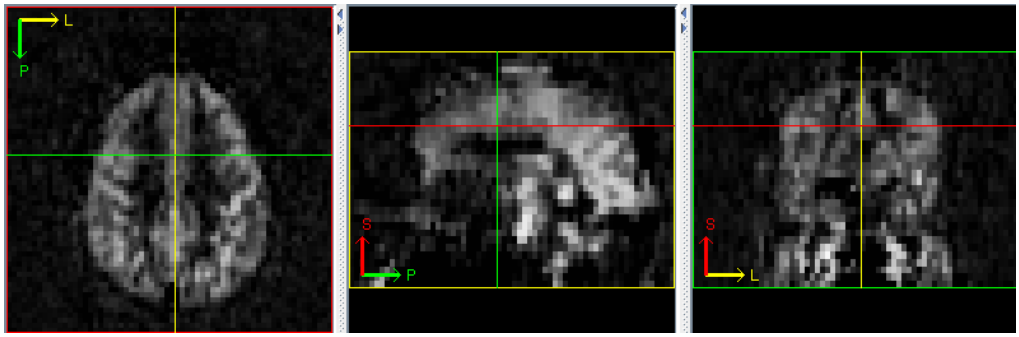
Background Divergence: Numerical value representing the divergence of background noise relative to hypothetical white noise; minimum, median, and maximum values are provided.

In-brain Divergence: Numerical value representing the divergence of the ASL intensity distribution in each image frame to the mean ASL distribution.

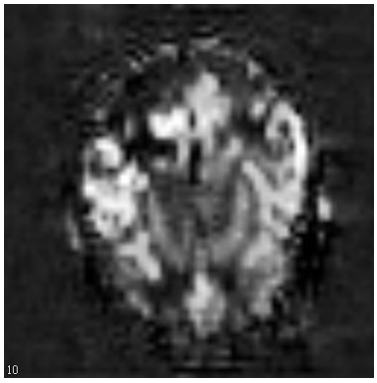
The following examples are global QC ratings.

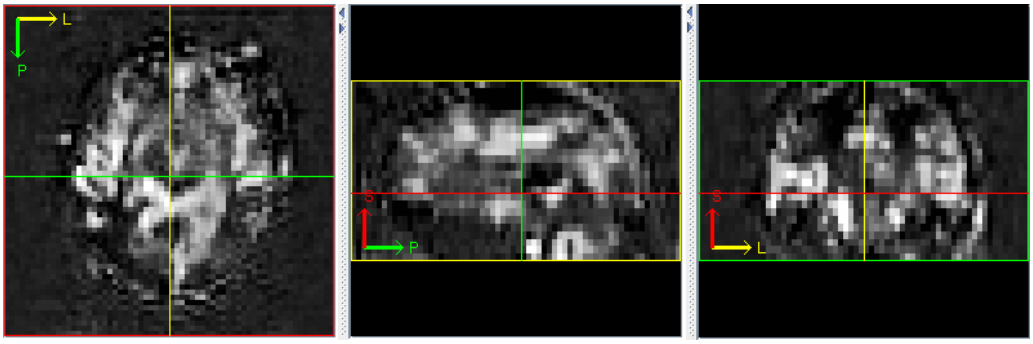
009_S_2208
Global QC = Pass





011_S_0021
Global QC = Fail





Dataset Information

Dataset Name	Date Submitted
UCSFASLFS—ASL Perfusion	October 2012

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