An Investigation of Cerebral Perfusion in Aphasia Using Arterial Spin Labeling

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Introduction

• Magnetic Resonance Perfusion Imaging is a neuroradiological technique that can directly measure regional cerebral blood flow (rCBF)
• Previous research has indicated reduced rCBF, or hypoperfusion, among stroke survivors (e.g. Hillis et al., 2001; Fridriksson et al., 2002)
• Hypoperfusion in chronic stroke survivors may correlate more strongly with cognitive and behavioral deficits than standard anatomical neuroimaging (Love et al., 2002)

Questions

• What is the nature of hypoperfusion among stroke survivors, as compared to age-matched and young unimpaired controls?
• What is the time course of rCBF among stroke survivors?

Methods

• Images were acquired on a GE Signa EXCITE 3 Tesla scanner using an ASL FAIR sequence (scan parameters: TR=2500ms, 16 slices (5mm skip 1 mm), FOV=22) and an 8 gradient head coil
• A Pulsed Arterial Spin Labeling (PASL) Procedure was used; PASL uses radiofrequency pulses to magnetically tag arterial blood water
• Images were acquired following a post-labeling delay (transit delay) during which the tagged blood water is delivered to cerebral areas
• During the patient’s first scan, perfusion data were acquired across 8 transit delays (ranging from 300 msec to 3 sec) to measure both the time course and localization of rCBF
• Perfusion data were analyzed to find an optimal transit delay TI2 for the stroke patient and a second ASL scan was performed, using the optimal TI time

Participants

• Participants were screened for a negative history of drug or alcohol abuse; all participants were right-handed
• Stroke survivor (45 years old, 5 years post-stroke): damage to left anterior cortical hemisphere; subsequent aphasia; single unilateral stroke, no history of other neurological impairment
• Age-matched unimpaired control, 39 years old
• Younger unimpaired control, 23 years old

Results

1st Scan: Transit Delay ASL Sequence: Perfusion data acquired across 8 T2 transit times, from 300 msec to 3 sec, to determine optimal T2 transit delay for stroke survivor

Stroke Survivor, 45 years, 5 years post-stroke
Age-Matched Control, 39 years
Young Control, 23 years

• Transit Delays: Stroke survivor exhibits longer transit delay than age-matched and younger controls: This indicates a slower time course of cerebral perfusion in the stroke survivor

2nd Scan: Optimal Transit Delay ASL Scan for Stroke Survivor: T11 = 600 msec, T12 = 2300 msec

Discussion and Conclusions

• The first ASL scan was performed to determine an optimal arterial transit delay for the stroke survivor; this patient exhibited longer arterial blood flow transit times between the tagging region and the imaging regions, as compared to the age-matched and younger controls
• The second ASL scan used a personalized optimal T2 arterial transit time for the stroke patient, and hypoperfusion was still evident, especially in perilesional areas. We posit two possible explanations for this finding:
  • A longer T2 transit time may be needed to capture the full extent of cerebral perfusion in people with chronic cerebrovascular abnormalities who have slowed and reduced regional CBF
  • Certain cerebral regions may be chronically hypoperfused and functionally underactive among chronic stroke survivors
• Compromised cerebral perfusion was particularly evident in several cortical regions that have been implicated in language processing: the left superior temporal gyrus, the left supramarginal gyrus, the left inferior frontal gyrus, and the left angular gyrus.
• The finding of increased T2 transit time for the stroke survivor (45 years old, 5 years post-stroke) indicates a slower time course of cerebral perfusion in the stroke survivor
• Transit Delays: Stroke survivor exhibits longer transit delay than age-matched and younger controls: This indicates a slower time course of cerebral perfusion in the stroke survivor

Cerebral perfusion within language-related cortical areas

References


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