Cerebral Blood Flow Measurement in Alzheimer Disease and Mild Cognitive Impairment using QUASAR and 3T MRI

T. Yoshiura[1], T. Noguchi[1], A. Hiwatashi[1], O. Togao[1], K. Yamashita[1], E. Nagao[1], H. Arimura[2], T. Okuaki[3], I. Zimine[3], M. van Cauteren[3], and H. Honda[1]

[1]Department of Clinical Radiology, Kyushu University, Fukuoka, Japan, [2]Department of Health Sciences, Kyushu University, Fukuoka, Japan, [3]Philips Medical Systems, Japan, Tokyo, Japan

Introduction

Individuals with mild cognitive impairment (MCI) are known to convert into Alzheimer's disease (AD) at a rate of 10-15 % per year. Thus it is of great value to diagnose MCI for early treatment of AD. A few previous studies have suggested that cerebral blood flow (CBF) measurement using non-invasive arterial spin labeling (ASL) on 1.5 T MRI may be useful in detecting MCI and AD [1]. We studied individuals with those conditions using a quantitative ASL pulse sequence (QUASAR) and 3T MRI.

Materials and Methods

Nine consecutive patients who were diagnosed as having MCI (3 males and 6 females, age 68-86 years old, mean 76.4 years old, mean MMSE = 23-30), seven patients with AD (2 males and 5 females, age 60-81 years old, mean 73.0 years old, MMSE = 15-23) and seven cognitively normal old subjects (4 males and 3 females, 62-81 years old, mean 70.3 years old, MMSE = 27-30) were studied using a 3T MRI scanner (Gyroscan Achieva, Quasar Dual, Philips Medical Systems). Quantitative CBF measurement was performed using a multi-inversion time pulsed ASL sequence (QUASAR): TR/TE=4000/22ms, sampling interval=300 ms, 13 time points, 7 slices, slice/gap=7/1mm, venc=4cm/s, NSA=84, imaging time=5min52s. Imaging volume covered approximately upper half of the cerebrum. CBF maps were obtained using improved model-free quantification as described in [2]. Absolute CBFs of whole gray matter (CBF-GM), right and left inferior parietal cortices (CBF-RIP and CBF-LIP), right and left thalami (CBF-RTH and CBF-LTH) were measured using a ROI method. In addition, relative CBF values in the right and left inferior parietal lobules normalized by averaged bilateral thalamic CBF (CBF-RIP/TH and CBF-LIP/TH) and whole gray matter CBF (CBF-RIP/GM and CBF-LIP/GM) were obtained. These CBF parameters were compared among the three subject groups using analysis of variance.

Results

Results are summarized in Table. No significant difference was observed among the 3 groups in CBF-GM, CBF-RTH and CBF-LTH. On the other hand, CBF-RIP, CBF-RIP/GM and CBF-RIP/TH were significantly decreased in AD group in comparison with normal group ($p < 0.05$, respectively). In addition, CBF-RIP/GM was significantly decreased in MCI group in comparison with normal group ($p < 0.05$). No significant difference was found among the 3 groups in CBF-LIP, CBF-LIP/TH, nor CBF-LIP/GM. Typical CBF maps are shown in Figure.

Table. CBF parameters obtained from normal, MCI and AD subjects.

	Normal	MCI	AD
CBF-GM (ml/min/100g)	28.7±7.6	29.1±4.1	24.1±4.1
CBF-RTH (ml/min/100g)	32.8±5.9	31.1±8.1	31.2±8.0
CBF-LTH (ml/min/100g)	32.6±6.9	31.5±6.9	31.5±8.7
CBF-RIP (ml/min/100g)	24.0±5.1	19.8±4.1	17.2±13.1*
CBF-LIP (ml/min/100g)	25.2±6.2	22.4±5.0	20.9±3.5
CBF-RIP/GM	0.85±0.01	0.68±0.12*	0.71±0.1*
CBF-LIP/GM	0.89±0.11	0.77±0.14	0.88±0.16
CBF-RIP/TH	0.74±0.07	0.64±0.12	0.56±0.12*
CBF-LIP/TH	0.77±0.10	0.73±0.19	0.68±0.12

*Significant decrease in comparison with normal group ($p<0.05$).

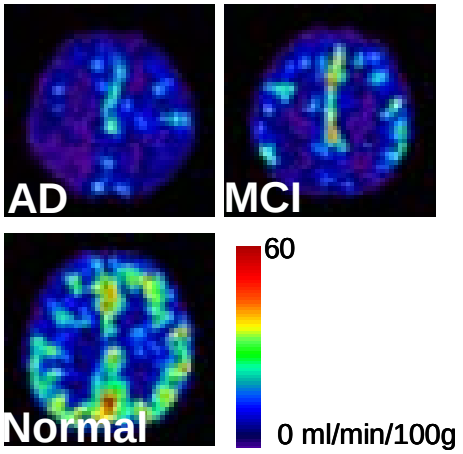

Figure. CBF maps of an AD, an MCI and a normal subjects.

Discussion

Results suggested that non-invasive CBF measurement using QUASAR and 3T MRI may be useful in diagnosing MCI and AD. We need to further evaluate the diagnostic values of quantitative CBF measurement.

Reference

1. Johnson NA, Jahng G-H, Welner MW, et al. Pattern of cerebral hypoperfusion in Alzheimer disease and mild cognitive impairment measured with arterial spin-labeling MR imaging: initial experience. Radiology 2005;234:851-859.

2. Petersen ET et al., 15th ISMRM, Berlin , 2007, p. 376.