Cross-sectional automatic measurement of brain volume on MRI: reproducibility of kNN-based probabilistic segmentation

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Introduction: k-Nearest Neighbor based probabilistic segmentation (kNN) is a cross-sectional method for measuring volume of different brain compartments[1]. The purpose of this study is to assess the reproducibility of kNN for repeated imaging with subject repositioning.

Methods: Ten subjects (aged 61 to 81 years) were scanned on a 1.5T Philips MR scanner (sequences: T1, T2, IR, PD and FLAIR). After subject repositioning, scanning was repeated. kNN-based probabilistic segmentation of the IR and FLAIR images was performed using an earlier published protocol[2]. Volumes of sub-cortical structures (SCS), cortical gray-matter (CGM), total cerebro-spinal fluid (CSF), lateral ventricle, white-matter lesion and total brain (SCS+CGM) were determined.

Results:

Volume in ml	First session		Difference between sessions		
	(mean (SD))	Range (min-max)	(mean (SD))	Range (min-max)	Mean (%)
Sub-cortical structures	595.4 (96.4)	396.3-739.8	0.2 (5.4)	-6.9-12.2	0.1
Cortical gray-matter	409.9 (50.4)	312.4-490.4	0.2 (5.6)	-9.4-9.9	0.0
CSF	287.3 (43.2)	223.8-376.0	0.1 (2.5)	-4.5-3.7	0.1
Lateral ventricles	26.9 (9.2)	13.7-42.0	0.0 (0.4)	-0.4-0.9	0.0
White-matter lesions	3.4 (3.4)	0.2-11.3	0.0 (0.2)	-0.3-0.3	2.7
Total brain	1005.3 (136.5)	777.2-1230.1	0.4 (3.0)	-3.4-6.8	0.0

The measured volume differences between both scan sessions were small and not significant (paired t-test $p > 0.05$) for any of the measured structures.

Discussion: kNN-based probabilistic segmentation has a good reproducibility. Subject repositioning has only a small effect on the measured volume. For longitudinal measurements it should be taken into account that in individual subjects the volumes of sub-cortical structures and cortical gray-matter can have an inaccuracy up to 2%.

References:

1. Anbeek et al., Neuroimage 27:795-804, 2005
2. Jongen et al., Diabetologia 50:1509-1516, 2007