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Differential diagnosis of dementia combining web-based cognitive testing and MRI

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Abstract

Background: Differential diagnostics in dementia is challenging. To date, the basic assessment still includes imaging of the brain and cognitive testing with pen and paper. Web-based cognitive tests however hold potential for standardized and low-cost screening in clinical workup. How they perform when combined with imaging of the brain is unknown. We therefore evaluated the accuracy of a new web-based cognitive battery (Muistikko [1]) detecting different types of dementia, when combined with brain MRI, and compared this to traditional cognitive testing and MRI.

Method: We included 229 subjects from two memory clinic cohorts (PredictND and VPH-DARE), consisting of 188 controls, 29 patients with Alzheimer's dementia (AD), 7 with frontotemporal dementia (FTD) and 5 with vascular dementia (VaD) (Table 1). All patients performed a traditional cognitive test battery (consisting of MMSE, RAVLT, TMT-A and B, Animal Fluency), web-based cognitive testing and had MRI of the brain. Although Muistikko is composed of seven subtasks, only global cognitive score (GCS) was used as defined in [1]. From MRI, multiple imaging biomarkers were defined [2]. Disease-state index classifier was developed from the predictors [2]. Cross-validation was used to calculate balanced accuracy (BACC; average of sensitivities for each diagnostic group). Given the class imbalance, we also calculated prevalence corrected accuracy (PACC).

Result: BACC was 66 % and PACC 64% when using the traditional cognitive test battery + MRI. Both BACC and PAC were 69 % when using the web-based cognitive testing + MRI (Table 2). Of note, since we compare four diagnostic groups, BACC by guessing would be 25%.

Conclusion: This study shows that combining web-based cognitive tests with MRI data results in high accuracy when separating different types of dementia. The results

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were comparable with the standard traditional work-up. Web-based cognitive testing is therefore a promising tool to support the clinician in the daily challenge of differential diagnostics, especially when combined with MRI data. References: [1] Paajanen, S. et al. Detecting cognitive disorders using Muistikko web-based cognitive test battery. Alzheimer's & Dementia 13(7):Supplement,P234-P235,2017 [2] Bruun, M. et al. Evaluating combinations of diagnostic tests to discriminate different dementia types. Alzheimers Dement 2018 Aug17;10:509-51.

TABLE 1

Table 1: Baseline characteristics of PredictND and VPH-DARE cohort.

PredictND	N	Females (%)	Age	MMSE
control	169	68	64±9	29.3±1.0
AD	27	56	72±10	26.6±1.8
FTD	2	50	62±0	27.5±3.5
VaD	5	40	77±7	26.0±1.7
VPH-DARE				
control	19	53	66±6	28.8±1.1
AD	2	0	70±0	26.0±2.8
FTD	5	40	59±3	22.2±3.3
VaD	0	-	-	-

AD: dementia due to Alzheimer's disease, FTD: frontotemporal dementia, VaD: vascular dementia, MMSE: mini-mental state examination

TABLE 2

Table 2: Classification results using traditional cognitive test battery (COGT)+MRI and web-based cognitive testing (COGW)+MRI.

COGT+MRI		Classification			
		Control	AD	FTD	VaD
Clinical diagnosis	Control	164	0	17	7
	AD	1	13	10	5
	FTD	1	1	5	0
	VaD	0	0	2	3

COGW+MRI		Classification			
		Control	AD	FTD	VaD
Clinical diagnosis	Control	158	13	9	8
	AD	0	17	7	5
	FTD	1	1	5	0
	VaD	0	0	2	3

AD: Alzheimer's disease, FTD: frontotemporal dementia, VaD: vascular dementia.
BACC: balanced accuracy to correct imbalance between the number of cases diagnostic groups and weigh each diagnostic group equally.
PACC: prevalence corrected accuracy, number of cases in each diagnostic group is corrected to correspond their prevalences in clinical practice. Prevalences used are CN 35%, AD 42%, FTD 6% and VaD 12%.