Assessing Dementia and Mild Cognitive Impairment with the Clock Drawing Test

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BACKGROUND

The Clock Drawing Test (CDT) is a popular screening test for dementia with complex underlying brain-behavior relationships. Reviewed below are several studies that associate clock drawing with executive and mental planning deficits in patients with Alzheimer's disease (AD), vascular dementia, and several subtypes of mild cognitive impairment (MCI). The clock drawing test used in this research is model after Edith Kaplan, Ph.D. where patient's are asked *"to draw the face of a clock, put in all of the numbers and set the hands for 10 after 11"*. Several analog clock scoring systems were used to assess clock drawing errors.

EXPERIMENT 1: SUBJECTS AND METHODS

Experiment 1

Objective

To assess patterns of performance between command and copy clock drawing test conditions.

Participants

AD and VaD patients were divided on the basis of MRI leukoaraiosis (LA), i.e., a low LA group vs. a moderate/ severe LA group. Dementia patients with Parkinson disease (dPD) were also studied.

Results

1.) In the command condition low LA patients made fewer errors compared to high LA ($p<.050$) and PDD patients ($p<.008$).

2.) In the copy condition low LA patients made fewer errors than high LA and PDD patients ($p<.001$).

3.) Within-group only low LA patients improved from the command to copy test conditions. In both clock drawing conditions clock errors were correlated with reduced test scores measuring executive and semantic functions.

EXPERIMENT 2: SUBJECTS AND METHODS

Experiment 2

Objective

To assess whether specific MRI defined regions of the brain are differentially associated with clock drawing errors.

Participants

Dementia patients with AD and VaD re-defined on the basis of MRI leukoaraiosis (LA) to construct a low LA group versus a moderate to severe LA group.

LA Regions

MRI LA was segmented into three regions:
periventricular LA (5mm around the ventricles)
subsurface (U-fibers; 5mm) immediately under the cortex
deep LA (remaining regions).

Results

1.) Periventricular LA was positively associated with more command errors ($p< .001$)

2.) Total LA was positively correlated with more copy errors ($p< .001$).

EXPERIMENT 3: SUBJECTS AND METHODS

Experiment 3

Objective

The aim of this study was to assess whether the clock drawing test could differentiate patients with MCI subtypes.

Participants

MCI participants were classified as presenting with either amnesic MCI (aMCI; n= 14)) vs. dysexecutive MCI (dMCI; n= 7) classified on the basis of a panel of neuropsychological tests:

Clock Errors

Dysexecutive Errors – Including perseveration; paper rotation; counter clockwise number arrangement

Mental Planning Errors – Including proper hand placement; number presence; number placement with respect to face (extra-face placement, irregular placement within face, neglect)

Results

1.) dMCI patients more total errors compared to aMCI patients ($p< .010$).

2.) dMCI patients made more mental planning errors ($p< .035$).

CONCLUSIONS

In dementia great MRI white matter burden (LA) is associated with greater evidence for dysexecutive impairment in clock drawing, i.e., lack of impairment from the command and copy test conditions. In MCI patients with dysexecutive MCI make more total errors and greater errors to suggest mental planning deficits. The new digital clock drawing test may offer additional insights into the brain behavior relationships that underlie these neurobehavioral conditions.

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