N-back task in patients with dementia, depression and cardiovascular pathology

Introduction

It is well known that diabetes mellitus (DM) and cardiovascular diseases are risk factors for development and progression of Alzheimer Dementia (AD) (1, 2). Both diseases affect arteries in the brain, diminish cerebral blood flow, and lead to local cerebral hypoxia, negatively impacting energy metabolism in dementia. In clinical practice most of patients with AD have cardiovascular pathology or in combination with diabetes. (3, 4)

In our previous study we showed no difference in cognitive performance in patients with dementia, depression, and cardiovascular disease with DM vs. no DM. (5) Since then, to our knowledge, there are no studies that assess the impact of DM on cholinergic dysfunction in dementia and depression patients accompanied by cardiometabolic risk factors. This presentation is a continuation of ongoing study with two goals: First is to replicate our previous findings on cognitive performance in patients with cardiovascular pathology in dementia and depression and additionally in depression without diabetes.

Methods

Data were collected from the charts of 472 patients (155 males, 317 females), mean age 77.1 ± 5.98 years, 13.6 ± 3.07 yrs, all with cardiovascular pathology or with diabetes, who underwent cognitive testing during their initial visits to the clinic. The number of patients in this presentation is different from the presented abstract due to accumulation of data from new patients. Patients were divided into 2 groups: group 1 - patients with dementia and depression (N=346) and group 2 - patients with depression alone (N=108). Patients in each group, with and without DM, were matched regarding demographic features by age and education. In Group 1, 30% of patients had DM and in Group 2, 24% had DM.

The cognitive battery included the MMSE (6), the clock drawing task (CDT), the verbal fluency category (VFC) and letter (VFL) tasks, computerized simple (SRT), complex (CRT) back task with textures as targets. Statistical analysis was performed with SPSS v21(7). Wilcoxon signed rank test was utilized on all variables to compare two subgroups of patients (with and without diabetes).

Results

All patients had depression and memory problems. The length of depression and memory loss was 38.5 ± 23.9 and 38.5 ± 23.9 yrs, respectively. A significant number of patients had hypertension (63.9%), hypercholesterolemia (73.5%), CAD (2.5%), diabetes (20.0%), stroke (10.59%), history of head trauma (1.07%), hypertension (16.1%), anemia (5.54%), history of cancer (1.07%).

Neuromaging studies (non contrast MRI) were done for 47.6% of the cohort. Abnormal neuroimaging was found in 59.4% of the cohort. Cognitive and functional decline was assessed using a structured interview and a number of neuropsychological tests.

Significant difference in cognitive performance was seen between patients in Group 1 (Depression and Dementia) and Group 2 (Depression alone) on MMSE (mean MMSE 26.3±6.4 and 26.9±6.1, accordingly, p=0.03), N-back task (performance, reaction time and error) (6). There was no significant difference between patients with DM and no DM on MMSE and N-back task. There was a significant difference between patients with DM and no DM on SRT and CRT. However, the more challenging WMN back task with textures as the targets demonstrated a significant difference in processing speed (DSRT 128.09, no DM 103.76, p=0.007).

Discussion

Recent attention in neurodegenerative disease and aging has been focused on mental chronometry, in particular the cognitive processing speed deficits in patients with AD, depression (6), parkinsonism (7), hand movements (8) and other. (9) The effects of cardiovascular illness and diabetes on development and progression of AD are still actively investigated. (10)

We confirm our previous findings of absent difference in cognitive performance between DM and no DM in mildly demented and depressed individuals. We did not find any differences in the isolated depression group either.

On the N-back task we found differences between diabetics and non diabetics only in the depression group. Mean RT was slower in the DM only in the depression group (p<0.04). This is likely more informative to demonstrate a difference in processing speed between DM/No DM as it requires a greater cognitive load.

Interestingly, mildly demented patients with DM have a slower rate of cognitive decline relative to no DM patients (10). We posit that diabetics with dementia may develop more metabolic changes predisposing to higher ketone body utilization by the brain.

In the dementia and depression group (1), lack of difference in N-back task processing speed in DM and no DM subgroups could probably be explained by the difference in ketone body utilization, which becomes a valuable source of energy in mild AD (11, 12).

In the depression group (2), the difference in N-back task processing speed between DM and no DM subgroups could suggest that glucose is still a vital energy source for the brain. Decreased processing speed during N-back task in patients with dementia and depression, compared to patients with only depression: cardiovascular pathology without diabetes (9).

We propose that using different energy substrates in dementia with depression vs. depression alone could be helpful for developing dietary recommendations in the future.

Conclusion

For patients with depression, non-verbal N-back task was able to detect differences in processing speed between DM and no DM subgroups.

For patients with dementia and depression, no differences in performance between DM and no DM subgroups were found.

Future research can further explore practical applications of N-back task in patients with dementia and depression, including cognitive remediation.

Acknowledgments

The authors do not disclose any financial interest in this presentation. There is no grant support for this study.

References

8. Yassa MA, Duering M, Butters M, et al. Neuroimaging studies (non contrast MRI) were done for 47.6% of the cohort. Abnormal neuroimaging was found in 59.4% of the cohort. Cognitive and functional decline was assessed using a structured interview and a number of neuropsychological tests.