

Study of Dementia in Diabetic patients with particular reference to Cerad and Trail Making Test

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Abstract— The objective of this study is to determine whether people with diabetes have an increased risk of cognitive impairment and cognitive decline. The subjects under study were classified into three groups: test, control and general. In the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) ten-word list, a person's ability to recall is measured. The trail making test is a short and convenient estimate of cognitive functions, principally attention and working memory. The cognitive scores obtained were compared using statistical analysis (One-way ANOVA). The performance in trail making test varies significantly in relation to gender, age, family history and duration. Family history and duration have no significant role in CERAD test, but sex and age have significant role in this test. Males performed better in CERAD and trail making test. Diabetic patients with peripheral neuropathy (PN) are prone for Cognitive dysfunction compared to diabetics without PN and non-Diabetics. The results show that tests like Trail Making Test and CERAD are useful tools in detecting cognitive dysfunction associated with diabetic PN.

Index Terms— Diabetes Mellitus, Dementia, Cerad test, Trial Making Test.

1 INTRODUCTION

The brain is the centre for intellect, emotions, behavior and memory. Progressive deterioration of intellect, memory and thought process due to change in the brain caused by disease or trauma is called dementia. Dementia and non-insulin dependent DM is highly prevalent disorders in the elderly [1],[2]. Reviews on the epidemiological studies on cognitive impairment in patients with diabetes mellitus found evidence of cross-sectional and prospective associations between type 2 diabetes mellitus and moderate cognitive impairment, on memory and executive functions [3]. Neuropathic disorders that are associated with diabetes mellitus are known as diabetic neuropathy. Neuropathies lead to numbness and sometimes pain and weakness in the arms, hands, feet, and legs. Troubles may also occur in every organ system, including the heart, digestive tract and sex organs. People with diabetes can develop neuropathy at any time, but the longer a person has diabetes, the greater the risk. Diabetic neuropathy is a debilitating disorder that occurs in nearly 50 percent of patients with diabetes. It is a late finding in type 1 diabetes but can be an early finding in type 2 diabetes. The primary types of diabetic neuropathy are sensorimotor and autonomic neuropathy. Patients may present with only one type of diabetic neuropathy or may develop combinations of neuropathies [4]. Diagnosis of dementia in diabetic patients includes physical examination, neurological and psychiatric examination. Mini Mental State Examination (MMSE), 7-

minute screen, Trail Making Test (TMT), CERAD, and Geriatric Depression Scale (GDS) are some assessment instruments for detecting cognitive impairment. In this study we used CERAD and TMT. The chief aim of cognitive screening test is to detect dementia in early stages.

The CERAD 10-word list has been shown to be one of the most sensitive tests for detecting Mild Cognitive Impairment (MCI)[5]. The CERAD 10-word list consists of three immediate recall trails, followed by an interference task lasting several minutes and then a delayed recall with or without a cued recall trail. TMT consists of two parts, A and B and it is a test of speed and efficiency. The color and spatial demand of the TMT interact with the side of damage in patients with unilateral impairment. Patients with a right sided lesion would do part A poorly and patients with left sided lesion would do part B poorly [6].

2 MATERIALS AND METHODS

A total of 102 volunteers between the age 35-80 attending a diabetic clinic in Malappuram and Calicut districts of Kerala state were tested.

2.1 Vibrosense

Vibrosense is a digital hand-held vibrator type vibratory perception threshold (VPT) analyzer with stabilized vibration generator. Vibrosense is an accurate tool to diagnose peripheral neuropathy.

The cognitive tests CERAD and TMT were done to evaluate the impairment in cognitive decline.

Test materials: includes Work sheets, Pencil, stopwatch and CERAD 10-word cards

2.2. Method

The subjects were made aware of the test. Before starting the experiment, the subject was seated in a well-illuminated

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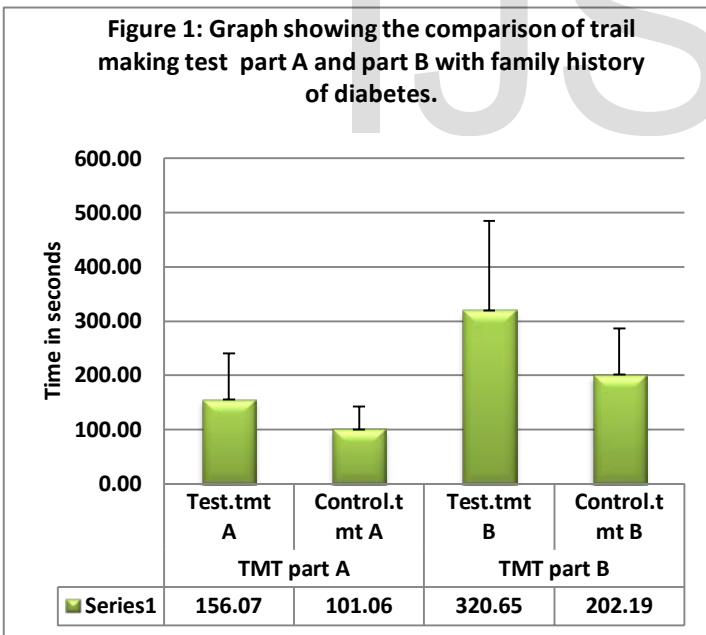
and quiet room. The subjects' name, sex and other personal details were collected. In part A of the TMT, the volunteer has to draw lines connecting the consecutively numbered circles on the work sheet. In part B the volunteer has to start from pink coloured 1 to yellow coloured 2 and in this manner the lines are drawn connecting the consecutively numbered and alternatively coloured circles.

Table 1: Comparison of TMT test and control group with family history of diabetes.

	Data	Mean ± SD	T test p Value
TMT part A	Test.tmt A	156.07 ± 84.59	0.0221*
	Control.tmt A	101.06 ± 41.66	
TMT part B	Test.tmt B	320.65 ± 164.48	0.0125*
	Control.tmt B	202.19 ± 83.83	

*At the 0.05 level, the means are significantly different.

In CERAD, the 10-word cards were shown to the volunteers and were asked to read each word loudly and to remember it. When the last word has been read, the subject was asked to recall as many words as possible. Three free recall trials were done. After a ten-minute break, the delayed recall trial was done.



2.3 RESPONSE OF VOLUNTEERS TOWARDS CERAD AND TRAIL MAKING TEST

A total of 102 volunteers between the age 35-80 from various places in Malappuram and Calicut districts of Kerala were tested. The subjects under study were classified into three groups, test, control and general population. Among the 102 volunteers, 36 of them were included in the test group and 31 were control and the general group consisted

of 35 volunteers.

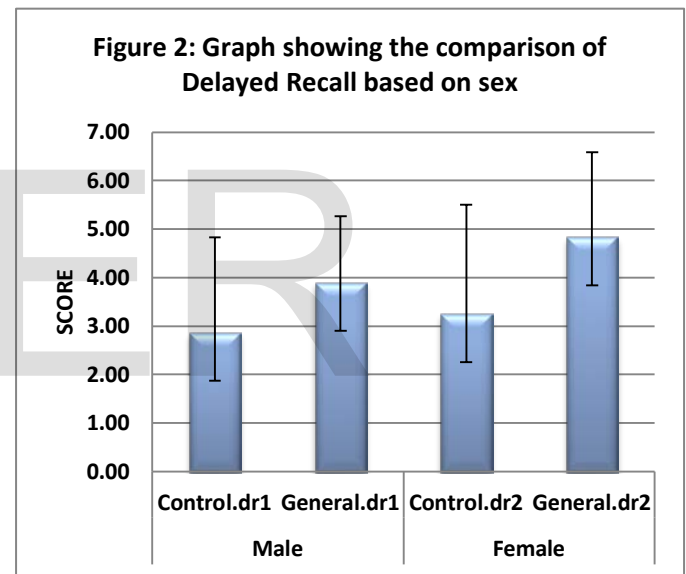
Table 2: Comparison of delayed recall of control and general based on gender.

Sex	Data	Mean ± SD	t Test P Value
Male	Control.dr1	2.87 ± 1.96	0.1428
	General.dr1	3.9 ± 1.37	
Female	Control.dr2	3.25 ± 2.25	0.0451*
	General.dr2	4.84 ± 1.75	

*At the 0.05 level, the means are significantly different.

3. RESULTS AND DISCUSSION

TMT is a brief paper and pencil neuropsychological test often used for cognitive impairment. TMT was a standard component of the Halstead-Reitan Battery, which measures cognitive dysfunction. TMT part B is useful in discriminating dementia from normal ageing [7].

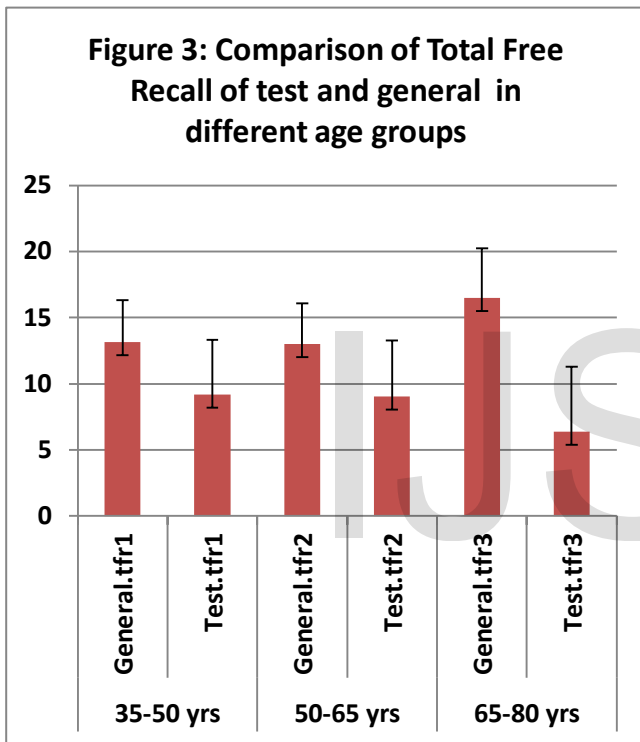


Compared to people without diabetes, people with diabetes have a greater rate of decline in cognitive function and a greater risk of cognitive decline⁸. Control group (diabetic patients without neuropathy) performed better than the test group (diabetic patients with neuropathy).

In the present study, part A and part B of TMT showed a significant difference with the group who have family history of diabetes, but showed no significance with the group who do not have family history of diabetes. Part A showed no significance with duration of diabetes, but part B showed significance with the duration of diabetes. During acute hyperglycemia, performance was significantly impaired in TMT part B9. In test and control of Part A, males showed a significant difference but not in the females. In part A and part B, the females took more time to complete the tests.

In this study, we grouped the subjects into three age groups, 35-50 years, 50-65 years and 65-80 years. If we con-

sider the age group 50-65 years for part A, the comparison between test and control and between control and general population, the performance was significantly different. The performance of the age groups 35-50 years and 65-80 years were not significant. In part B, the score of age group 50-65 years is significantly different in test and control population. It shows that the rate of cognitive decline can be lowered by controlling the hypertension and diabetes before 60 years of age. Among test and general, age group 65-80 years showed significant difference. Age was significantly associated with completion times for TMT part A and TMT part B. It was similar to that was shown in a Japanese study that older Japanese-American individuals (>65 years) showed significant age effects on TMT scores (using only part A). [7]



tfr: Total Free Recall.

The CERAD assesses verbal memory in the form of a ten-word list-learning task, which evaluates the individual's ability to remember words presented visually across three trials. The delayed recall and immediate recall showed no significance with family history of diabetes mellitus. So, from this result we assume that family history has no significant role in causing memory decline (at least by CERAD test) in diabetes mellitus patients.

In the comparison based on the duration of diabetes, the test and control showed no significant difference with duration. The results showed that gender has a significant role in CERAD. In combinations test-general and control-general of both immediate and delayed recall, the performance of the females showed significance at 5% level. Diabetes is associated with lower levels of cognitive function and greater cognitive decline among older women [10].

In the present study all age groups of test and general

showed a significant difference at 5% level. Test and control group showed no significance. In control and general group combination, the age group 50-65 years showed a significant difference, but not the other age groups. The less number of volunteers might have been the reason for such a result.

Table 3: Comparison of Total Free Recall of test and general in different age groups

Age	Data	Mean ± SD	t test p Value
35-50 yrs	General.tfr1	13.15 ± 3.18	0.0169*
	Test.tfr1	9.2 ± 4.13	
50-65 yrs	General.tfr2	13 ± 3.08	0.0035*
	Test.tfr2	9.05 ± 4.21	
65-80 yrs	General.tfr3	16.5 ± 3.73	0.0036*
	Test.tfr3	6.4 ± 4.88	

*At the 0.05 level, the means are significantly different.

In the case of delayed recall, the age groups in test and control showed no significant difference. In test and general group combination, the age groups 50-65 years showed a significant difference. In general-control combination, the age group 50-65 years showed significance, but not in the age group 65-80 years, which may be due to the less number of subjects studied.

Evidence increasingly suggests that diabetes contributes to cognitive decline, in-turn, cognitive decline may influence self-care and thereby complicate diabetes management[11]. Elderly subjects have impaired cognitive function (The global prevalence of MCI in the elderly is estimated to be 15-20%). 12 and diabetes mellitus also is more prevalent among aging population. The presence of uncontrolled diabetes increases the problem by accelerating the cognitive decline in the elderly. Diabetic peripheral neuropathy with impaired sensory motor functions compounds the suffering in patients having cognitive impairment.

4. CONCLUSION

The result of the present study reveals a decline in the cognitive performance in Diabetics as shown by the CERAD 10-word list and Trail Making Test. TMT B is useful in discriminating dementia from normal ageing.

1. The incidence of cognitive impairment rises with increasing age.
2. Trail Making Test and CERAD are useful tools in detecting cognitive dysfunction associated with diabetic PN.
3. In both TMT and CERAD, males performed better than the females. The present results show that gender has a significant role in deterioration of cognitive function.
4. TMT showed significance with the group that has family history of diabetes; but in CERAD the family history of diabetes made no significant difference in the results.

5. Diabetic patients without neuropathy (control group) performed better than the diabetic patients with neuropathy (test group). This indicates that peripheral neuropathy, which is a complication of chronic uncontrolled glycemia in diabetes, precipitates cognitive decline and hence proper control of blood sugar is important in preventing such debilitating complications in diabetes mellitus.
6. Diabetes may be associated with lower levels of cognitive function and greater cognitive decline among older women.

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