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Working and Short Term Memory Status of Male and Female Patients in Type 2 Diabetes Mellitus

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Research Article

Abstract: **Background and objectives:** Working and short term memory loss is common in diabetic patients. Though cognitive deficits affect daily activities and differences between genders are not given much importance to assess working and short term memory at bedside. Hence this study was undertaken to compare working and short term memory in type 2 diabetics with gender matched normal subjects. **Methodology:** Present study was conducted in Al-Ameen Medical College and Government district Hospital, Bijapur on 114 diabetics (male=72, female=42) and 119 normal subjects (male=79, females=40) aged (40-60 yrs.). Cognitive function assessment was done for short term and working memory by using 5 memory tests-AVLT, VFT, VRT, WDST and VST were used. The results were expressed in average total scores (%). χ^2 test was used for statistical analysis. **Results:** Memory scores of all 5 tests decreased in male diabetic patients when compared to normal male subjects and this decrease was statistically significant ($P<0.0001$). When female diabetes patients were compared with normal female subjects out of 5 memory tests memory scores in 4 tests were decreased (except VRT) and this decrease was found to be statistically significant ($P<0.05$). Male diabetic patients when compared with female diabetic patients, decrease in memory scores in male diabetic patients was found to be statistically significant in all tests (except in WDST). **Interpretation and conclusion:** The short term and working memory status in the present study decreased significantly in the male diabetic patients, which may be due to hyperglycemia, hypoglycemia, vascular dementia and insulin resistance, type of diabetes, age of onset, duration and type of therapy. Therefore these observed effects of gender are of potential clinical importance because working and short term memory loss may interfere with day today activities.

Keywords: short term and working memory, Diabetes, hyperglycemia, hypoglycemia.

Introduction

Memory is one of the most important cognitive domains with respect to every day function and is the process of storing, encoding and retrieving information. Different forms of memory are recognized including short term, long term and working memory. Short term memory refers to the function that temporarily retains stimuli that have just been perceived and lasts for ~20 secs. Working memory is a short term memory system that allows concurrent retention and manipulation. It is used for thinking about what is an already known and deriving conclusion on the basis of that knowledge[1]. Some cross sectional studies suggest that hypoglycemia, hyperglycemia, hyperinsulinemia and vasculopathy in DM lead to decline in cognitive function. Studies of cognitive function among older persons might focus on the areas of cognition most affected by common dementing illness, including memory, attention, language, visuospatial ability and abstraction[2]. Several studies have reported significant cognitive impairment among subjects with DM compared with non DM individuals. Some studies reported that impairment is more in diabetic males. Hence this study is undertaken to assess impairment in Working and Short term memory in type 2 diabetes patients in comparison with gender matched normal subjects in Indian population.

Materials and Methods

The present study was conducted in the department of physiology Al-Ameen Medical College, Bijapur. One Hundred and fourteen (114) diabetic patients (males=72, females=42) between 40-60 years of age visiting to the Al-Ameen Medical college Hospital Bijapur (Karnataka), District civil hospital Bijapur and Monthly diabetic camps were volunteers for this study. One hundred and nineteen (119) normal subjects (males=79, females=40) Gender matched near hospital premises and from Bijapur city were volunteers for this study. Different memory tests were used to assess short term and working memory. Short term memory tests used were: Auditory verbal learning test (AVLT), Visual reproduction test (VRT) and Verbal fluency test (VFT). Working memory tests used were: Working digit span test (WDST) and Validation span test[3, 1](VST) Data was analyzed using *chi-square* test.

Results and Discussion

Table 1: χ^2 and P values of chi-square test of memory tests of normal subjects and diabetic patients according to gender

Test	Normal Subjects (Males)			Diabetes Patients (Males)			χ^2	P Value
	MEAN	SD	SEM	MEAN	SD	SEM		
1.AVLT	63.3	6.1	0.69	36.5	15	1.7	117.8	<0.0001(S)
2.VFT	100	0.0	0.0	73	24	2.8	55.7	<0.0001(S)
3.VRT	100	0.0	0.0	95	8.9	1	23.8	<0.0001(S)
4.WDST	97.7	7.1	0.8	50	21	2.4	15.3	<0.0001(S)
5.VST	98.7	4.9	0.55	51	22	2.6	18.8	<0.0001(S)

Table 2: χ^2 and P values of chi-square test of memory tests of normal subjects and diabetic patients according to gender

Test	Normal Subjects (Females)			Diabetes Patients (Females)			χ^2	P Value
	MEAN	SD	SEM	MEAN	SD	SEM		
1.AVLT	61.7	6.1	0.97	47.6	14	1.9	25.9	<0.0001(S)
2.VFT	100	0.0	0.0	84	19	2.7	25.1	<0.0001(S)
3.VRT	100	0.0	0.0	99	5.2	0.7	2.97	>0.05(NS)
4.WDST	96	8.1	1.28	64	30	4.2	10.4	<0.001(S)
5.VST	92	11.8	1.87	64	33	4.6	8.32	<0.01(S)

Table 3: χ^2 and P values of chi-square test of memory tests of Diabetic males and Diabetic females

Diabetic Patients						χ^2	P Value
Male			Female				
M	SD	SEM	M	SD	SEM		
36.5	15	1.7	47.6	14	1.9	18.6	<0.001(S)
73	24	2.8	84	19	2.7	17.6	<0.001(S)
95	8.9	1	99	5.2	0.7	6.3	<0.05(S)
50	21	2.4	64	30	4.2	1.71	>0.05(NS)
51	22	2.6	64	33	4.6	4.04	<0.05(S)

In this study Diabetes patients were compared with normal subjects. Comparison was done for males and females separately and also diabetic patients (both male and female) compared against each other.

1. Auditory verbal learning test

Refer table no.1.The memory score of normal male subjects was found to be 63.3% whereas score of male diabetes patients was found to be 36.5%.The memory scores (%) in the diabetic male patients were found to be decreased.(χ^2=117.8, P<0.0001).Refer Table No.2.The memory score of normal female subjects was found to be 61.7% whereas score of female diabetes patients was found to be 47.6%.The memory scores (%) in the diabetic female patients were found to be decreased and this decrease in the scores were statistically significant when compared to normal female subjects. (χ^2=25.92, P<0.001) Refer Table No.3.The memory score of male diabetes patients was found to be 36.5% whereas score of female diabetes patients was found to be 47.6%. (χ^2=18.6, P<0.001)

2. Verbal fluency test

Refer Table No.1.The normal male subjects scored 100% in comparison with male diabetes patients who scored 73%. A statistically significant decrease in the memory status was observed in diabetic male patients as compared to normal male subjects. (χ^2=55.72, P<0.0001)Refer Table No.2.The normal female subjects scored 100% in comparison with female diabetes patients who scored 84%. There was a decrease in score found and A statistically significant decrease in the memory status was observed in diabetic female patients as compared to normal female subjects. (χ^2=25.19, P<0.0001)Refer Table No.3.The diabetes male patients scored 73% in comparison with female diabetes patients who scored 84%. (χ^2=17.6, P<0.001)

3. Visual reproduction test

Refer Table No.1.The memory scores in male normal subjects were found to be 100% when compared to the male diabetes patients who scored 95%. Memory scores in male diabetes patients were found to be decreased and this decreased memory status in the diabetic male patients was found to be statistically significant. (χ^2=23.85, P<0.0001)Refer Table No.2.The memory scores in female normal subjects were found to be 100% when compared to the female diabetes patients who scored 99%. Memory scores in female diabetes patients were found to be decreased and found to be statistically non-significant. (χ^2 =2.97, P>0.05)Refer Table No.3.The memory scores in diabetic male patients were found to be 95% when compared to the female diabetes patients

who scored 99%. Memory scores in male diabetes patients were found to be decreased and it was found to be statistically significant. (χ^2=6.3, P<0.05)

4. Working digit span test

Refer Table No.1.The memory score of normal male subject was found to be 97.7% whereas male diabetes patients scored 50%. (χ^2=15.35, P<0.0001)Refer Table No.2.The memory score of normal female subject was found to be 96% whereas female diabetes patients scored 64%.The memory scores (%) in the female diabetic patients decreased and it was found to be statistically significant. (χ^2=10.47, P<0.001)Refer Table No.3.The memory score of diabetic male patients was found to be 50% whereas female diabetes patients scored 64%.The memory scores (%) in the male diabetic patients decreased and it was found to be statistically non-significant when compared to diabetic female patients. (χ^2=1.71, P>0.05)

5 Validation span test

Refer Table No.1.The normal male subjects scored 98.7% where as in male diabetes patients score was found to be 51%.The deceased memory scores (%) in the diabetic patients was found to be statistically significant when compared to normal male subjects. (χ^2=18.68, P<0.0001)Refer Table No.2.The normal female subjects scored 92% where as in female diabetes patients score was found to be 64%.The deceased memory scores (%) in the diabetic female patients was found to be statistically significant when compared to normal female subjects. (χ^2=8.32, P<0.01)Refer Table No.3.The diabetic male patients scored 51% where as in female diabetes patients score was found to be 64%.The deceased memory scores (%) in the diabetic male patients was found to be statistically significant. (χ^2=4.04, P<0.05) Memory scores of all 5 tests decreased in male diabetic patients when compared to normal male subjects and this decrease was statistically significant (P<0.0001). When female diabetes patients were compared with normal female subjects out of 5 memory tests memory scores in 4 tests were decreased (except VRT) and this decrease was found to be statistically significant (P<0.05). Male diabetic patients when compared with female diabetic patients, decrease in memory scores in male diabetic patients was found to be statistically significant in all tests (except in WDST).

Alka M.Kanaya, Elizabeth barrett connor, Ginny Glidengorin and Kristine Yaffe in 2004 studied 999 white men and women aged 42 to 89 yrs. They found that women with diabetes mellitus had a 4 fold increased risk of a major cognitive decline on the VFT after 4yrs compared with non diabetic women. Their study concluded that elderly white women with diabetes had a more rapid decline in performance on the VFT compared with women with impaired glucose tolerance or normal glucose tolerance.[9] Coker LH, Shumaker SA in their study entitled "Type 2 Diabetes mellitus and cognition; an understudied issue in women's health" reviewed 32 studies in which cognitive functioning was measured with neuropsychological tests in participants with Type 2 Diabetes and a control/comparison group without diabetes. They found that of 32 studies that reported the effects of Type 2 Diabetes on cognition in non-demented middle aged and older adults, 30 included women in their sample, and two focused exclusively on women. 20 (67%) reported that participants with Type 2 Diabetes performed more poorly than those without diabetes.[10] In this study it was observed that female diabetic patients suffered decrease in memory status compared to normal female subjects which is same in the study done by few workers, Edward Gregg and Coker LH.[10] In this study it was found that memory scores of all 5 tests decreased in male diabetic patients. This decrease was statistically significant. These results are agreeable to the works of R.K Solanki[5], Worali G[6]andOtt A[7]. In 2000, Edward W. Gregg, Kristine Yaffe, Jane A. Cauley, Deborah B. Rolka, Terri L. Blackwell and K.M. Venkatnarayana studied community dwelling white women 65yrs and older (n=9679) to determine whether older women with diabetes have an increased risk of cognitive impairment and cognitive decline. Three tests of cognitive function were used, the digit symbol test, the trials B test, and a modified version of MMSE. Results found that women with diabetes (n=687) had lower baseline scores than those without diabetes on all 3 tests of cognitive function and experienced an accelerated cognitive decline as measured by the digit symbol test. Women who had diabetes for more than 15yrs had a 57% to 114% greater risk of major cognitive decline than women without diabetes.[81] In this study it was observed that female diabetic patients suffered decrease in memory status compared to normal female subjects which is same in the study done by few workers, Edward Gregg[81]and Coker LH.[10] In the present study it was observed that decrease in memory scores in male diabetic patients was statistically significant for 4 tests out of 5 tests (except VRT, P=0.019) compared to female diabetic patients. This statistical difference was may be due to less female participants in the study (n=42, 36.8%) compared to male participants (n=72, 63.2%), relatively better controlled hyperglycemia (Female, FBS 142$\pm$33 mg%, PPBS 188$\pm$46 mg%; Males, FBS 149$\pm$27 mg%, PPBS 198$\pm$33.8 mg%), younger age of female diabetic patients (47$\pm$8.54 yrs) compared to male diabetic patients (51$\pm$5.34yrs) and lesser duration of the disease seen in diabetic female patients (4.5$\pm$2.9yrs) compared to male diabetic patients (7.7$\pm$3.9yrs).

Conclusion

The short term and working memory scores were decreased in diabetic patients and this decrease in memory status was statistically significant when compared to normal subjects. Both male and female diabetic patients suffered decrease in memory scores but the decrease was more in males compared to females. The decreased memory status in diabetic patients may be due to many factors like hyperglycemia, hypoglycemia, Vascular disease, insulin resistance, amyloid deposition and also some of the factors combine to produce additive effects like, type of diabetes, co-morbidities, age of onset, duration of the disease and type of therapy.

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