Physiology

Cognitive Dysfunction in Type 2 Diabetes Mellitus Patients: A Study from Rural Hospital

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Abstract: Type 2 diabetes mellitus has been associated with impairment of cognitive function. Clinical data on the cognitive status in diabetes mellitus patients from rural areas of India are lacking. We intended to determine the cognitive status in patients with type 2 diabetes mellitus from rural area. Study protocol included detailed clinical history, clinical examination and investigations. Two hundred patients with type 2 diabetes mellitus underwent cognitive assessment testing by using a modified mini mental state examination. We found that cognitive dysfunction was associated with diabetes. Cognitive dysfunction was related to the older age, high blood glucose level, duration of diabetes, hypertension, dyslipidaemia, retinopathy and nephropathy. We conclude that type 2 diabetes patients should be evaluated for their cognitive function.
Keywords: Cognitive function, Cognitive impairment, Diabetes mellitus, Mini mental state examination.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) patients are more likely to develop cognitive impairment and dementia than nondiabetic individuals [1].Some studies suggest that many factors like age, sex, chronic hyperglycemia, and duration of disease, complications, hypertension, education, depression, and physical inactivity play significant roles in pathophysiology of cognitive impairment in diabetics [2-6]. These studies were conducted in urban areas. There are no data available on the cognitive impairment in diabetic patients from rural areas. We designed this study to observe cognitive dysfunction in T2DM patients from rural areas.

MATERIALS AND METHODS

Following approval from institutional ethical committee, this descriptive observational study was done. We have selected consecutive 200 type 2 diabetic patients attending Medicine inpatient and outpatient departments of Adichunchanagiri institute of medical sciences. Patients were considered to have type 2diabetes when diabetes was diagnosed after 30 years of age, without insulin use in the first year after the diagnosis and without history of ketonuria. Following patients were excluded from study

- Patients with significant hearing or visual impairment and unable to participate in an interview in a meaningful manner
- Patients with past or current history of cerebrovascular accident or epilepsy
- Patients with family history of dementing illnesses
- Type 1 diabetic patient

- Patients with other risk factors known to cause cognitive impairment like stage 3-5 Chronic kidney diseases, Parkinson's Diseases, Alzheimer's disease, Chronic liver diseases, Human immune deficiency virus, Hypothyroidism, Vitamin B12 deficiency and other drugs, alcoholism, neurosyphilis, malignancy, structural brain disease, chronic central nervous system infection, psychiatric diseases like major depression, schizophrenia

Study protocol included detailed clinical history, clinical examination and investigations. Demographic characteristics such as sex, age, years of study, 'per capita' income and duration of diabetes, and medical history of hypertension, dyslipidemia, smoking, and treatment of diabetes were assessed.

Definition of terms

Patients on oral hypoglycemic drugs, Insulin or those having fasting blood sugar > 126 g/dl were regarded as having diabetes mellitus. Those with blood pressure > 140 / 90 mmHg taken twice or those on antihypertensive drugs were defined as hypertensive. Dyslipidemia was defined as total cholesterol ≥ 200 mg/dl and/or HDL ≤ 45 mg/dl and/or LDL ≥ 100 mg/dl and/or triglycerides ≥ 150 mg/ dl and/or use of statins or fibrates. Height, waist and hip circumference were measured in centimetres by using a non-stretchable standard tape with a metal buckle at one end over the light clothing. Waist circumference was measured in the centre of the iliac crest and the coastal margin, and hip circumference was measured at the widest point on buttocks below the iliac crest. Height was measured to the nearest 0.5 cm. Weight was measured to the nearest 0.1 kg on a calibrated balance beam scale. BMI was calculated as follow: BMI [weight (kg)/height (m2)]. Current smokers were defined as those who smoked any form of tobacco in the previous 6 months while former smoker were those who had quit more than 6 months earlier. Socio- economic statuses of the patients were divided according to kuppuswamy classification [7]. Details about presence of retinopathy (simple, preproliferative or proliferative retinopathy as defined by trained ophthalmologists), nephropathy (microalbuminuria [30 mg/g creatinine]) and neuropathy (two or more of: symptoms; absence of ankle tendon reflexes; abnormal vibration perception threshold using a tuning fork) were obtained by patient examination. Mini mental state examination (MMSE) was used for screening cognitive functions and stratification of the cut-off points was done in accordance to years of study in order to prevent the possibility of education level to mask the performance in this test[8]. The MMSE includes specific questions related to attention, orientation, memory, calculation, and language. The measure's scoring is based on 30 total points, and impairment is indicated by MMSE score of < 24, if patient had more than 8 years of study; MMSE score of < 18 if patient had between 1 and 8 years of study [9].

Data Analysis

Data obtained were analyzed by using the appropriate statistical tool.

RESULTS

Out of 200 type 2 diabetic patients 80 (40%) people suffered from cognitive impairment.

Age distribution

In our study maximum number of patients (50%) with cognitive function impairment (CFI) belonged to sixth decade (Table 1).

Sex distribution

In our study 120 patients were males and 80 were females. Among patients with CFI 44 were females and 36 were males (Table 2).

Socioeconomic status

The maximum number of CFI cases was seen in upper- lower socioeconomic status (SES) (40%) followed by lower (32.5%) (Table3).

Duration of diabetes

In our study CFI was more in patients with 16-20years duration of diabetes (32.5%), followed by patients with diabetes more than 20years (30%).CFI was less (2.5%) in patients with diabetes less than one year (Table 4).

Age at onset of diabetes

Among patients with CFI, 50(62.5%) patients were diagnosed as diabetes before the age of 40 years (Table 5).

Table-1: Age distribution

Age groups in years	Cognitive Function	
	Normal n (%)	Impaired n (%)
30-40	10(8.33)	2(2.5)
41-50	30(25)	8(10)
51-60	40(33.33)	20(25)
61-70	34(28.33)	40(50)
>70	6(5)	10(12.5)
Total	120	80

Table-2: sex distribution

Sex	Cognitive Function		Total
	Normal n (%)	Impaired n (%)	
Male	84(70)	36(30)	120
Female	36(45)	44(55)	80

Table-3: Socioeconomic status

Socioeconomic status	Cognitive Function	
	Normal n (%)	Impaired n (%)
Upper	10(8.33)	4(5)
Upper middle	50(41.66)	8(10)
Lower middle	30(25)	10(12.5)
Upper lower	20(16.66)	32(40)
Lower	10(8.33)	26(32.5)
Total	120	80

Table-4: Duration of diabetes

Duration of diabetes in years	Cognitive Function	
	Normal n (%)	Impaired n (%)
<1	30(25)	2(2.5)
1-5	40(33.33)	2(2.5)
6-10	20(16.66)	6(7.5)
11-15	10(8.33)	20(25)
16-20	12(10)	26(32.5)
>20	8(6.66)	24(30)
Total	120	80

Table-5: Age at onset of diabetes

Age at onset of diabetes	Cognitive Function	
	Normal n (%)	Impaired n (%)
<40 years	30(25)	50(62.5)
≥ 40 years	90(75)	30(37.5)
Total	120	80

Blood glucose level

Among patients with CFI, 50(62.5%) patients fasting blood sugar (FBS) values were more than or equal to 110mg/dl. 60(75%) CFI patients post prandial blood sugar (PPBS) values were more than or equal to 200 mg/dl. Among patients with normal cognitive function, 100(83.33%) patients fasting blood sugar (FBS) values were less than 110mg/dl. 90(75%) normal cognitive function patients post prandial blood sugar (PPBS) values were less than 200 mg/dl.(Table 6)

Table-6: Blood glucose level

Blood glucose level mg/dl		Cognitive Function	
		Normal n (%)	Impaired n (%)
FBS	<110	100(83.33)	30(37.5)
	≥ 110	20(16.66)	50(62.5)
	Total	120	80
PPBS	<200	90(75)	20(25)
	≥200	30(25)	60(75)
	Total	120	80

Hypertension

Among patients with CFI, 50(62.5%) patients had high blood pressure. Among patients with normal cognitive function, 100(83.33%) patients had normal blood pressure (Table 7).

Dyslipidemia

Among patients with CFI, 60(75%) patients had dyslipidemia. Among patients with normal cognitive function, 30(25%) patients had dyslipidemia (Table 8).

Complications

Among patients with normal cognitive function, 30(25%) patients had complications. Among patients with CFI, 62(77.5%) patients had complications (Table 9).

Table-7: Hypertension

Blood pressure	Cognitive Function	
	Normal n (%)	Impaired n (%)
Normal	100(83.33)	30(37.5)
High	20(16.66)	50(62.5)
Total	120	80

Table-8: Dyslipidemia

Dyslipidemia	Cognitive Function	
	Normal n(%)	Impaired n(%)
Present	30(25%)	60(75%)
Absent	90(75%)	20(25%)
Total	120	80

Table-9: Complications: Nephropathy, Retinopathy, And Neuropathy

Complications	Cognitive Function	
	Normal n (%)	Impaired n (%)
Absent	90(75)	18(22.5)
Present	30(25)	62(77.5)
Total	120	80

DISCUSSION

Diabetes is a global epidemic .T2DM leads to coronary artery disease, hypertension, renal disease, and obesity.[10]In order to prevent these complications blood glucose and blood pressure control is necessary. Management of T2DM includes several drugs and regimens. A preserved cognitive status is necessary for compliance and understanding of treatment. Early cognitive dysfunction may be detected by mini mental status examination. In this study 40% (n=80) had cognitive dysfunction. Similar observations were found in Mukharjee *et al*. Munshi *et al*. studies [11, 12]. In our study majority of T2DM patients with cognitive impairment (50%, n=40) were in the age group of 61-70 years which is similar to that of Munshi *et al*. study.

Diabetes and older age both are independent risk factors for cognitive dysfunction. The risk is more for older people with diabetes [12]. While in our study males represented more than half (70%) of the patients in the normal cognitive function group, females were more than half (55%) of the patients in the cognitive impairment group. Lower education level in rural female might be the reason for this result. Alencar et al study showed similar result [13]. There was no significant correlation between sex of patients and cognitive dysfunction in other studies [10, 11].In this study maximum number of CFI cases (58) were seen in lower socio economic status. Many of our patients live in poor socioeconomic conditions and are illiterate. Alencar et al study showed similar finding[13].In our study patients with longer duration of diabetes scored less in agreement with other studies[10,12,13]. Mukharjee *et al*. study did not show any significant positive correlation between duration of diabetes and cognitive dysfunction. In this study among patients with CFI, 50(62.5%) patients were diagnosed as diabetes before the age of 40 years. Ruis *et al.* study showed

similar observation [14]. Mukharjee *et al*. study did not show any significant positive correlation between age of onset of diabetes and cognitive dysfunction [11]. In our study among patients with CFI, 50(62.5%) patients FBS values were more than or equal to 110mg/dl. 60(75%) CFI patients PPBS values were more than or equal to 200 mg/dl. Similar association of poor diabetes control with cognitive impairment was observed in other studies [10-12]. In this study hypertensive T2DM patients had cognitive impairment which is consistent to prior studies [10, 13]. Hassing *et al*. demonstrated that hypertension combined with diabetes increases the risk of cognitive impairment.[15] In this study T2DM patients with dyslipidemia had lower test score. Alencar *et al*. study showed similar finding. [13] Mukharjee et al study did not show any significant positive correlation between dyslipidemia and cognitive dysfunction. [11] Our study showed presence of complications in T2DM patients increases the risk for cognitive dysfunction. Previous studies showed similar observations [10,11]. De Luis *et al*. study showed that microalbuminuria is associated with poor cognitive function [16]. Wong *et al*. study showed that retinopathy is independently associated with poor cognitive function [17].In Mukharjee *et al*. study there was no significant correlation between diabetic neuropathy and CFI [11].

CONCLUSION

This study showed that patients with T2DM are at increased risk for cognitive dysfunction. This risk is more in patients with high blood glucose level, long disease period, hypertension, younger age at onset of diabetes, dyslipidaemia, retinopathy and nephropathy. We recommend that cognitive function evaluation should be a routine procedure in the management of T2DM patient. Our study was hospital based with small

sample size. More community based studies with a larger number of patients are needed.

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