

A Study of Cognitive Impairment in Patients with Type 2 Diabetes Mellitus – A Prospective Observational Study

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Abstract

Introduction: Type 2 diabetes mellitus (DM) is the most lifestyle risk factor for cognition. Regular treatment and management of Type 2 DM could prevent the onset and progression of cognitive impairment. Cognitive decline associated with DM may influence one's ability to perform self-care and affect glycemic control.

Aim: Our prospective observational study aimed to analyze the cognitive impairment using a mini-mental status examination (MMSE) in patients with Type 2 DM.

Materials and Methods: This prospective observational study was conducted to analyze the cognitive impairment using MMSE in patients with Type 2 DM. A total of 50 patients diagnosed with Type 2 diabetes were included in the study. All the demographic and laboratory investigation data so obtained was tabulated and was analyzed statistically, and results were discussed.

Results: Of 50 patients, 26 patients were male and 24 patients were female. Based on the age group, 11 patients were in the age group below 40 years, 21 patients between 40 and 50 years, 16 patients between 51 and 60 years, and 2 patients >60 years. Based on the duration of Type 2 diabetes, 16 patients had <5 years and MMSE score of 24.28 and 34 patients had >5 years and MMSE score of 22.14. Based on cognitive impairment, 44 patients had mild cognitive impairment and 6 patients had moderate cognitive impairment.

Conclusion: From this study, we concluded that the duration of Type 2 DM and level of HbA1c affect the cognitive status of the individuals. A greater understanding of the mechanisms linking Type 2 DM and cognitive impairment may facilitate the development of new ways for the treatment of cognitive impairment.

Key words: Cognition, Mini-mental status examination score, Type 2 diabetes mellitus

INTRODUCTION

Type 2 diabetes is a chronic metabolic condition characterized by abnormally high blood glucose levels as a result of insufficient usage of insulin. Diabetes often involves disturbances of carbohydrate, fat, and protein metabolism. Type 2 diabetes mellitus (DM) increases the

risk of developing complications. Some of these diabetic complications can ultimately lead to cardiovascular disease, kidney disease, neuropathy, and diabetic retinopathy.^[1,2] DM patients have 1.2–1.5-fold greater rate of cognitive dysfunction. Even prediabetes stages and insulin resistance status are associated with increased risk of cognitive decline and brain atrophy. However, Type 2 diabetes may be present in up to 80% of individuals with cognitive impairment who are aged 65 years or older.^[3] Poor glycemic control and long-term episodes of hypoglycemia or hyperglycemia may lead to microangiopathy, neuronal loss, and cognitive impairment.^[4]

DM may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss.

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www.ijss-sn.com

Month of Submission : 05-2020
Month of Peer Review : 05-2020
Month of Acceptance : 06-2020
Month of Publishing : 06-2020

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A fasting plasma glucose (FPG) test measures blood glucose in a person who has not eaten anything for at least 8 h. Oral glucose tolerance test measures blood glucose after a person fasts at least 8 h and 2 h after the person drinks a glucose-containing beverage. Both the test is used to detect diabetes and prediabetes. The current WHO diagnostic criteria for diabetes should be maintained – FPG ≥ 7.0 mmol/l (126 mg/dl) or 2-h plasma glucose ≥ 11.1 mmol/l (200 mg/dl) HbA1c is regarded as the best tool in analyzing long-term glycemic control in DM. The major glycosylated hemoglobin is the HbA1c. The normal value is 4–6%.

Cognitive impairment is a syndrome caused by a range of neurological conditions and characterized by progressive functional impairment of mental processes (also known as cognitive domains) such as memory, attention, speed of processing information, executive function, reasoning, visuospatial abilities, and language. In Type 2 DM, cognitive changes mainly affect learning and memory, mental flexibility, and psychological speed.

Domains of cognition are the gold standard until today for assessing the neurocognitive functions.^[5] Among the neurocognitive tests, the mini-mental status examination (MMSE), which was introduced in the year 1975, is most commonly used.^[6] The MMSE is a questionnaire which tests several aspects of cognitive domains – “orientation, registration, verbal recall, calculation, visual construction, attention, and language.”^[7] Although Type 2 DM is considered as a risk factor for cognitive decline, it is not regularly assessed in routine clinical care. Diabetes associated cognitive decline is not caused by only one factor, but the multi-factor and multi-link complex pathological changes.^[8] Cognitive decline may lead to bad diabetic control and poor adherence to treatment modalities, including diet plans.^[7] Hence, this study has been done to evaluate the cognitive status of individuals with Type 2 DM.

Aim

Our prospective observational study aimed to analyze the cognitive impairment using MMSE in patients with Type 2 DM.

MATERIALS AND METHODS

This prospective observational study was conducted to analyze the cognitive impairment using MMSE in patients with Type 2 DM under different study parameters such as gender, age, duration of Type 2 DM, HbA1c values, and MMSE score. A total of 50 patients diagnosed with Type 2 diabetes were included in the study. Inclusion criteria: Age should be between 30 and 70 years and laboratory and clinically confirmed Type 2 DM patients and exclusion

criteria: Patients with a history of Type 1 DM, h/o taking CNS medications, h/o cerebrovascular disease, known case of dementia/psychiatric disease, and h/o difficulty in doing daily activities. The procedure was explained in detail to the subjects and written informed consent was obtained. A detailed history was taken from the patients and a complete clinical examination was done. Patient blood samples are collected for laboratory investigation of HbA1c.

Cognitive status of the study subjects assessed using MMSE questionnaire. The MMSE is composed of 11 major items; temporal orientation (5 points), spatial orientation (5 points), immediate memory (3 points), attention/concentration (5 points), delayed recall (3 points), naming (2 points), verbal repetition (1 point), verbal comprehension (3 points), writing (1 point), reading a sentence (1 point), and constructional praxis (1 point). The MMSE has a maximum score of 30, with five different domains of cognition analyzed: (1) Orientation, contributing a maximum of 10 points, (2) memory, contributing a maximum of 6 points, (3) attention and calculation, as a measure of working memory, contributing a maximum of 5 points, (4) language, contributing a maximum of 8 points, and (5) design copying, contributing a maximum of 1 point. Individuals scoring two points below the maximum in any independent domain (except design copying) were considered to be impaired. These cutoff scores were used to grade the level of cognition. The cutoff scores for the classification of cognitive impairment include:

- MMSE scores ≥ 27 – normal cognition
- MMSE scores 21–26 – mild cognitive impairment
- MMSE scores 11–20 – moderate cognitive impairment
- MMSE score ≤ 10 – severe cognitive impairment.

The data so obtained were tabulated and were analyzed statistically and results were discussed.

RESULTS

Of 50 patients, 11 patients were in the age group below 40 years, 21 patients between 40 and 50 years, 16 patients between 51 and 60 years, and 2 patients >60 years [Figure 1].

Of 50 patients, 26 patients were male and 24 patients were female [Figure 2].

Of 50 patients 16 patients had <5 years and 34 patients had >5 years [Figure 3].

Of 50 patients, 44 patients had mild cognitive impairment and 6 patients had moderate cognitive impairment [Figure 4].

Patients with HbA1c >7.1 had MMSE score of 21.82 and HbA1c <7 had MMSE score of 25.4 [Figure 5].

Patients with the duration of Type 2 DM >5 years had MMSE score of 22.14 and <5 years had MMSE score of 24.28 [Figure 6].

DISCUSSION

DM is a chronic condition, but people with diabetes can lead a normal life, provided they keep their diabetes under control. Lifestyle modifications (LSM) are an essential

component of any diabetes management plan. LSM can be a very effective way to keep diabetes in control. Improved blood glucose control can slow the progression of long term complications. Small changes can lead to improvements in diabetes control, including a decrease in the need for medication. Cognitive dysfunction is also considered as an important chronic complication. Even though advancement is being made, cognitive dysfunction is still a neglected field in diabetes. A conserved cognitive status is vital for the awareness of the disease and its compliance. Both DM and cognitive impairment are mutually exclusive as hyperglycemia increases cognitive impairment occurs, which leads the patients to decrease in memory attention which further increases the hyperglycemia.

In the present study, cognitive impairment is assessed for 50 patients with Type 2 DM using MMSE questionnaire. About 88% had mild cognitive impairment and 12% had moderate cognitive impairment. It states that patients diagnosed with

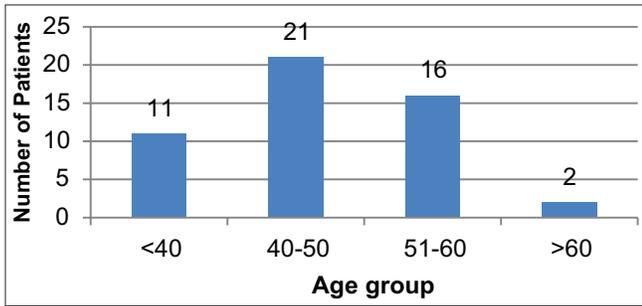


Figure 1: Age distribution

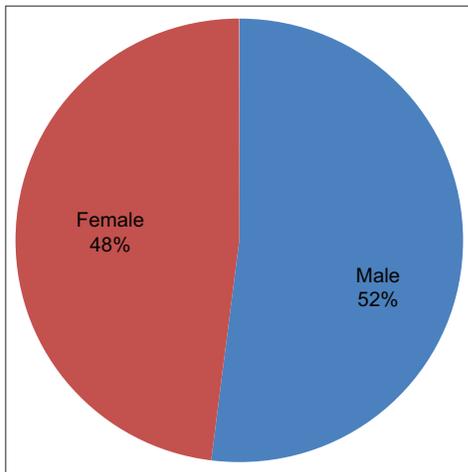


Figure 2: Gender distribution

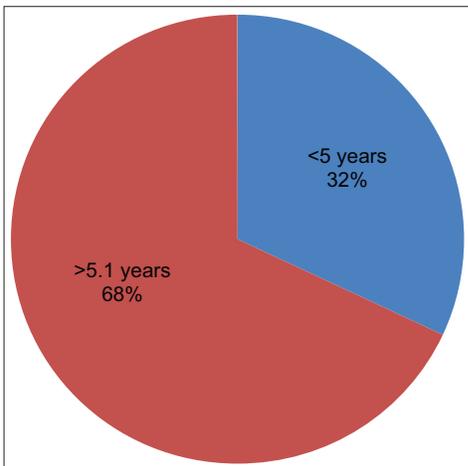


Figure 3: Duration of diabetes mellitus Type 2

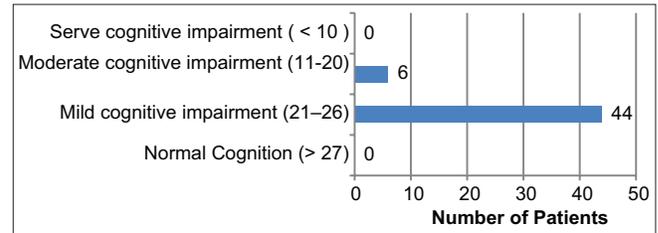


Figure 4: Cross-tabulation between no. of patients and cognitive impairment

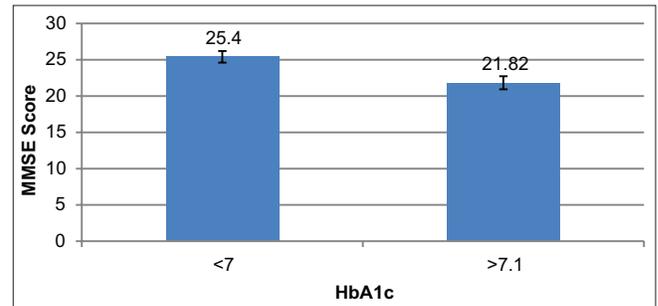


Figure 5: Cross-tabulation between HbA1c and mini-mental status examination score

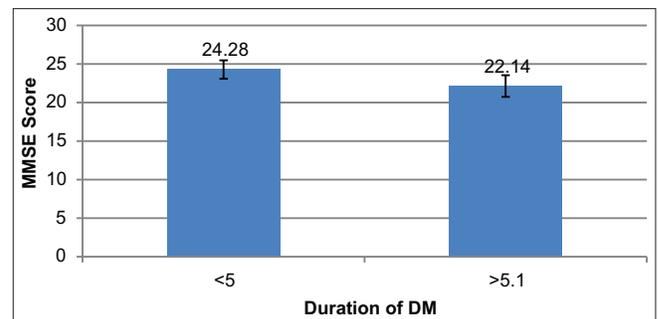


Figure 6: Cross-tabulation between duration of Type 2 diabetes mellitus and mini-mental status examination score

Type 2 DM will have mild cognitive impairment. Hence, early diagnosis prevents the progression of diseases and complications. This is similar to a study conducted by Kataria *et al.* identified a high frequency of cognitive decline in several domains of cognitive function in Type 2 DM subjects.^[9] Another study conducted by Priyam *et al.* also described that impairment in cognition is related to Type 2 DM.^[10]

In our study, it states that patients with HbA1c >7.1 have MMSE score of 21.82 and patients with HbA1c <7 have MMSE score of 25.4. It suggests that if the glycated hemoglobin level increases, the MMSE score will decrease. It is similar to the study conducted by Roy *et al.*, cognitive impairment was observed in 11.6% of the patients who had optimal glycemic control (HbA1c under 7%) and 30.2% with HbA1c 7% or above.^[11] Another study conducted by Luchsinger *et al.* showed that improving HbA1c levels in an elderly population over a period of 5 years was associated with the slowing down of global cognitive.^[12]

In the present study, it was also seen that MMSE score in Type 2 DM subjects having a duration above 5 years is 22.14 when compared to those with a duration <5 years is 24.28. It suggests that as the duration of Type 2 DM increased, then MMSE score will decrease. It is similar to the study conducted by Grodstein *et al.*, who identified that increase in the duration of Type 2 DM might be correlated with low scores on neurocognitive tests.^[13] Another study conducted by Kataria *et al.* studies states that longer the duration of Type 2 DM which indirectly proportional to the MMSE score.^[9]

CONCLUSION

From this study, we concluded that the duration of Type 2 DM and the level of HbA1c affect the cognitive status of

the individuals. A greater understanding of the mechanisms linking Type 2 DM and cognitive impairment may facilitate the development of new ways for the treatment of cognitive impairment.

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How to cite this article: Sarath VB, Balaji PV. A Study of Cognitive Impairment in Patients with Type 2 Diabetes Mellitus – A Prospective Observational Study. *Int J Sci Stud* 2020;8(3):120-123.

Source of Support: Nil, **Conflicts of Interest:** None declared.