Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Applicability of diagnostic constructs for cognitive impairment in patients with type 2 diabetes mellitus

Onno N. Groeneveld [a,*], *Esther van den Berg* [b], *Guy E.H.M. Rutten* [c], *Paula S. Koekkoek* [c], *L. Jaap Kappelle* [a], *Geert Jan Biessels* [a], *on behalf of the COG-ID study group*

[a] *University Medical Center Utrecht, Brain Center Rudolf Magnus, Department of Neurology, PO Box 85500, 3508 GA Utrecht, The Netherlands*

[b] *Erasmus Medical Center, Department of Neurology, PO Box 2040, 3000 CA Rotterdam, The Netherlands*

[c] *University Medical Center Utrecht, Julius Center for Health Sciences and Primary Care, PO Box 85500, 3508 GA Utrecht, The Netherlands*

ARTICLE INFO

Article history:
Received 14 March 2018
Received in revised form
9 May 2018
Accepted 16 May 2018
Available online 24 May 2018

Keywords:
Cognitive impairment
Diagnostic procedure
Type 2 diabetes mellitus

ABSTRACT

Aims: Type 2 diabetes mellitus (T2DM) is associated with subtle cognitive changes, but also with more severe stages of cognitive dysfunction, including mild cognitive impairment (MCI) and dementia. For these severe stages, it is uncertain which domains are primarily affected and if all patients with impairment are captured by formal criteria for MCI or dementia.

Methods: Ninety-five patients with T2DM suspected of cognitive impairment, identified through screening in primary care, underwent neuropsychological examination assessing five different domains. MCI or dementia were diagnosed using formal criteria.

Results: Forty-seven participants (49%) had impairment on at least one domain, most often involving memory (30%), information processing speed (22%) and visuoperception and construction (22%). Of these 47 people, 29 (62%) had multi-domain impairment. Of the 47 participants with objective impairment, 36 (77%) met criteria for MCI, three (6%) for dementia and eight (17%) met neither diagnosis, mostly because these patients did not complain about acquired dysfunction.

Conclusions: This study shows that the clinical diagnostic evaluation of cognitive impairment in patients with T2DM should take into account that multiple domains can be affected and that not all patients with objective cognitive impairment fulfill criteria for MCI or dementia.

* Corresponding author at: Brain Center Rudolf Magnus, Department of Neurology, G03.232, University Medical Center Utrecht, PO Box 85500, 3508 GA Utrecht, The Netherlands.
E-mail address: o.n.groeneveld@umcutrecht.nl (O.N. Groeneveld).

https://doi.org/10.1016/j.diabres.2018.05.025
0168-8227/

1. Introduction

Type 2 diabetes mellitus (T2DM) is associated with cognitive dysfunction. This includes subtle cognitive changes, also referred to as diabetes-associated cognitive decrements, as well as an increased risk of severe cognitive dysfunction, including mild cognitive impairment (MCI) and dementia [1,2]. It is well established that diabetes-associated cognitive decrements involve the domains memory, information processing speed, and attention and executive functioning [1,3]. It cannot be taken for granted, however, that for more severe stages of cognitive dysfunction the patterns of affected domains are the same. According to current insights, subtle diabetes-associated cognitive decrements and more severe cognitive dysfunction do not necessarily represent a continuum, as different age groups are affected, with different prognoses, and different underlying processes may be involved [4,5]. Thus far, it is uncertain which domains are primarily affected in patients with T2DM and severe cognitive dysfunction. In addition, it is unknown which proportion of patients with T2DM and objective cognitive impairment meet formal criteria for MCI or dementia. Identification of affected cognitive domains and evaluation of the applicability of diagnostic constructs such as MCI or dementia are important to establish an accurate diagnosis in patients with T2DM and cognitive impairment.

Accurate recognition and diagnosis of cognitive impairment is particularly important in patients with diabetes, because (unrecognized) cognitive impairment is associated with worse health and treatment outcomes [6,7]. Hence, recent guidelines recommend caregivers to be vigilant in detecting cognitive impairment in patient with diabetes [6,7].

In the present study, we investigated a population-based cohort of elderly people with T2DM suspected for cognitive impairment, identified through cognitive screening in a primary care setting. The aim was to assess which cognitive domains were primarily affected in patients with formal cognitive impairment. We also determined if all individuals with T2DM and cognitive impairment are captured by formal criteria for MCI and dementia.

2. Subjects, materials and methods

2.1. Study population

Patients were derived from the Cognitive Impairment in Diabetes (Cog-ID) study. The design and main results of the Cog-ID study have been described previously [8,9]. Briefly, the Cog-ID aimed to evaluate the ability of the Test Your Memory (TYM) and Self-Administered Gerocognitive Examination (SAGE) to detect undiagnosed cognitive impairment in people with T2DM in primary care, using a full evaluation at a memory clinic as reference standard. 228 people aged ≥70 years with T2DM were recruited from primary care. Exclusion criteria were: diagnosis of dementia, previous investigation at a memory clinic, and inability to write or read. At first patients filled out two self-administered cognitive tests, the Test Your Memory (TYM) and the Self-Administered Gerocognitive Examination (SAGE). The TYM is a self-administered test consisting of 10 sub-tasks, including orientation, ability to copy a sentence, semantic knowledge, calculation, verbal fluency, similarities, naming, visuospatial abilities, and recall of a copied sentence. The ability to complete the test without help represents an 11th task. The maximum score is 50 points. A score of ≤39 is suggestive of dementia [10]. The SAGE questionnaire is a self-administered test, which examines orientation, language, memory, executive function, calculation, abstraction and visuospatial abilities. The maximum score is 22 points. A score of ≤14 is suggestive of dementia [11]. The Cog-ID main study revealed that the TYM and SAGE are appropriate screening tools to detect undiagnosed cognitive impairment in patients with T2DM in primary care [9]. It has been previously established that the TYM and the SAGE measure a broader range of cognitive domains than the Mini-Mental Stage Examination (MMSE), and may be more sensitive in detecting cognitive impairment [10–12].

Secondly, a general practitioner, blinded to the test scores, performed a structured evaluation including the MMSE. The MMSE consists of 11 tasks including the domains orientation in time and space, registration of three words, concentration and calculation, word recall, language and visuospatial abilities. The maximum score is 30 points. A score of ≤24 points is suggestive of dementia [13]. Subsequently, patients suspected of cognitive impairment (i.e. screen positives; based on an abnormal score on either of the three cognitive tests or based on the general practitioner's clinical evaluation) were invited for evaluation at a memory clinic, as well as a random sample of patients not suspected of cognitive impairment (i.e. the screen negatives).

Of the 107 screen-positive participants, 95 underwent a standardized memory clinic work-up and were included in the present study. Of the twelve screen-positive participants that did not attend the memory clinic, four declined the memory clinic visit, three had comorbidities, two had personal circumstances, two found a memory clinic visit too burdensome, and one did not want to know the diagnosis at the memory clinic.

A random sample of screen-negative participants comprised 32 patients, who underwent the same work-up. Of these, 25 had no objective cognitive impairment at the memory clinic and served as a reference group for the present study. The seven other screen-negative participants proved to have cognitive impairment at the memory clinic, despite the negative screening, and were therefore not included in the reference group.

2.2. Memory clinic evaluation

The memory clinic evaluation included an interview of cognitive complaints, an MMSE, a detailed neuropsychological assessment and recording of education level. Education level was divided into seven categories (scored according to Verhage, 1964) according to the Dutch educational system (1: did not finish primary school, 2: finished primary school, 3: did not finish secondary school, 4: finished secondary school, low level, 5: finished secondary school, medium level, 6: finished secondary school, highest level, and/or college degree, 7: university degree) [14].