

Correlation between Metabolic Syndrome and Mild Cognitive Impairment

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Abstract

MCI (Mild cognitive impairment) is an intermediate stage in the trajectory from normal cognition to dementia. Subjects with MCI have a high rate of progression to dementia over a relatively short period. Subjects with MCI also experience a greater mortality than cognitively normal subjects.

Method: One hundred and fifty eight patients aged 65 years or more (106 males and 52 females) were included in our study. In addition to a detailed medical and neurological history and examination, MMSE (Mini-Mental State Examination), CDR (Clinical Dementia Rating Scale), Geriatric Depression Scale, Global Deterioration Scale and lipid profile were performed for all patients.

Results: Significant correlation between metabolic syndrome and its components and MCI.

Conclusion: Patients with metabolic syndrome have higher risk for development of MCI.

Keywords: MCI; Metabolic syndrome; Dementia; Risk factors

Introduction

Mild cognitive impairment (MCI) is an etiologically heterogeneous syndrome characterized by memory performance below the normal range, otherwise unimpaired intellectual functioning and well preserved activities of daily living [1]. MCI is a clinical transitional state between the cognitive changes of aging and the earliest clinical features of dementia, a prodromal phase during which slight forgetfulness might be present but other cognitive abilities are preserved [2]. MCI can affect many areas of thought and action such as language, attention, reasoning, judgment, reading and writing. However, the most common variety of MCI causes memory problems [3]. The prevalence of MCI among the population >65 years in developed countries is as high as 10-25% and the annual conversion rate of MCI to AD (Alzheimer's Disease) has been estimated in general to be about 10-15% [4]. The metabolic syndrome is a clustering of conditions that includes obesity, hypertension, dyslipidemia and impaired glucose metabolism and associated with increase the risk of cardiovascular disease [5]. There is evidence linking the metabolic syndrome with cognitive decline and dementia, but not all studies have found an association [6-8]. Several studies were reported that the risk of developing cognitive impairment increase from 2 to 7 times among those with the metabolic syndrome [9,10]. While hypertension [11], diabetes [12], obesity [13], hypertriglyceridemia [14] and impaired glucose tolerance [15] have each been associated with cognitive impairment, ranging from mild cognitive changes to dementia, the relationship between each metabolic risk factor and cognition is complex [16]. The role of the metabolic syndrome on the rate of cognitive decline remains controversial [17]. Early identification of the people with metabolic syndrome and subsequent treatment of their symptoms could modify or prevent the development of cognitive impairment [18,19]. The study aimed to assess the association between metabolic syndrome and MCI in patients aged \geq 65 years.

Patients and Methods

The study was carried out on 186 patients aged \geq 65 years old of both sex attended the outpatient clinic of Medical or Neurology Department of Al-Azhar University Hospitals during the period from May to the end of December 2017. One hundred and fifty eight completed the study and twenty eight patients were dropped because

they refuse to complete investigations. This study had been approved by ethical committee of Al-Azhar University Hospitals. Patients who had dementia (MMSE score less than 24 or CDR more than 0.5), cerebrovascular stroke, aphasia or dysphasia, brain tumor, severe head trauma, parkinsonism, premorbid psychiatric illness (schizophrenia, mood disorders and mental retardation), severe sensory impairment (blindness, deafness), drug and alcohol abuse, chronic medical disease (chronic liver disease, renal disease or COPD), or patients who refused to participate in the study were excluded from the study. The patients were divided into two groups, group (A) met criteria for diagnosis of metabolic syndrome and group (B) don't have metabolic syndrome. All patients included in the study were subjected to complete medical and neurological history regarding to detailed history about age, gender, residence, education level, weight, height, BMI (body mass index), WC (waist circumference), diabetes mellitus, hypertension, smoking, drug or alcohol abuse and family history of dementia. Detailed history of cognitive impairment (onset, duration, course and aggravating factors). Neurological examination including mental state, cranial nerves, motor, sensory systems and cerebellum. Psychometric tests including MMSE, CDR, ADL (Activities of Daily Living Scale), Geriatric Depression Scale and Global Deterioration Scale were applied for all patients and also some laboratories were done including random blood sugar, HbA1c, serum cholesterol, triglyceride, LDLP (low density), HDLP (high density) lipoproteins, thyroid function and serum uric acid. CT or MRI brain was done for all patients. The statistical analysis was done using the Chi-squared test with the p-Value less than 0.05 considered significant. This analysis was performed using the SPSS-16 Software and the results were tabulated accordingly.

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Results

The study was carried out on 156 patients aged ≥ 65 years old of both sex divided into two groups, group (A) met criteria for diagnosis of metabolic syndrome and group (B) don't have metabolic syndrome. Group A were 73 patients (44 male and 29 female) with mean age 70.68 ± 5.03 years while group B were 85 patients (62 male and 23 female) with mean age 70.9 ± 6.26 years. Regard education level, about 25% of patients were educated while the remaining either not educated or just read and write and also 22% of patients were smoker (Table 1). The frequency of metabolic syndrome component were 55% hypertensive, 47.5% diabetic, 41.1% had central obesity, 45.6% had high serum triglyceride and 56.3% had low serum HDL (Tables 2 and 3).

After results of psychometric tests, 100 patients (63.3%) have MCI, 55 patients of them had metabolic syndrome and remaining 58 patients (36.7%) had normal cognition (Table 4). The correlation of result of MMSE score with age of patients, sex, education level and smoking were insignificant (Tables 5 and 6). Also there is a significant correlation between MMSE score and all components of metabolic syndrome and

with number of components of Metabolic syndrome, the increase in number of Metabolic syndrome components associated with low score of MMSE (Tables 7 and 8).

Discussion

MCI is an important public health concern due to the increased risk of progression to dementia and increased mortality [20]. The concept of MCI permits timely identification of patients at high risk of developing dementia, thus opening a potentially larger therapeutic window and increasing the significance of modifiable risk factors [21,22]. Early diagnosis and intervention of MCI could postpone or prevent the onset of subsequent dementia. It is critical to identify potentially protective factors for the development of MCI and progression to dementia. One hundred and fifty eight patients aged 65 years old or more of both sex were included in the study, 73 patients (46.2%) have metabolic syndrome (group A) and 85 patients (53.8%) didn't have metabolic syndrome (group B) with no significant difference between both groups regarding age, sex, education level. In our study we found that, metabolic syndrome prevalence was 46% among general populations (56%in females and

Variables	Group A (n=73)		Group B (n=85)		Total (n=158)		P value
	No.	Percent	No.	Percent	No.	Percent	
Sex							0.064
Male	44	60.27%	62	73%	106	67.1%	
Female	29	39.73%	23	27%	52	32.9%	
Education level							0.358
Illiterate	30	41.1%	34	40%	64	40.5%	
Read and write	29	39.7%	27	31.8%	56	35.4%	
Educated	14	19.2%	24	28.2%	38	24.1%	
Smoking	6	8.33%	29	33.7%	35	22.2%	0.001
Age (M \pm SD)	70.68 \pm 5.03		70.9 \pm 6.26		70.8 \pm 5.64		0.55
BMI (M \pm SD)	28.08 \pm 4.28		26.56 \pm 4.07		27.27 \pm 4.22		0.025
WC (M \pm SD)	94.95 \pm 12.42		90.45 \pm 12.42		92.53 \pm 12.58		0.025
MMSE (M \pm SD)	25.74 \pm 1.95		27.08 \pm 1.73		26.46 \pm 1.95		0.001

Table 1: Demographic data of the studied patients.

Variables	Group A (n=73)		Group B (n=85)		Total (n=158)		P value
	No.	Percent	No.	Percent	No.	Percent	
HIN	61	83.6%	26	30.6%	87	55.1%	0.001*
DM	59	80.8%	16	18.8%	75	47.5%	0.001*
WC							0.053
Total	41	56.2%	24	28.2%	65	35.1%	
Male	18	24.7%	12	14.1%	30	18.9%	
Female	23	31.5%	12	14.1%	35	22.2%	
Triglyceride	51	69.9%	21	24.7%	72	45.6%	0.001*
HDL	61	83.6%	28	32.9%	89	56.3%	0.001*

Table 2: Frequency of metabolic syndrome components in both groups.

Variables	Group A (M \pm SD)	Group B (M \pm SD)	Total (M \pm SD)	P value
Cholesterol	193.36 \pm 48.93	182.67 \pm 42.13	187.6 \pm 45.57	0.142
Triglyceride	179.15 \pm 83.26	121.75 \pm 43.19	148.27 \pm 70.72	0.001*
LDL	96.86 \pm 49.7	92.73 \pm 42.14	94.64 \pm 43.7	0.555
HDL	34.12 \pm 11.28	49.73 \pm 16.35	42.52 \pm 16.2	0.001*
Uric acid	5.7 \pm 1.56	6.57 \pm 2.35	6.17 \pm 2	0.008*

Table 3: Laboratory results in both groups.

Variables	Group A (n=73)		Group B (n=85)		Total (n=158)	
	No.	Percent	No.	Percent	No.	Percent
Normal cognitive	18	24.66%	40	47%	58	36.7%
MCI	55	75.34%	45	53%	100	63.3%

Table 4: Frequency of MCI among the studied patients.

Variables	MMS (M ± SD)	P value
Sex		
Male	26.55 ± 1.97	0.434
Female	26.29 ± 1.9	
Education level		
Illiterate	26.39 ± 2.17	0.896
Read and write	26.46 ± 1.77	
Educated	26.58 ± 1.95	
Smoking		
Positive	27.21 ± 1.63	0.113
Negative	26.58 ± 1.92	

Table 5: Correlation between result of MMSE score and demographic data.

Variables	(M ± SD)	MMS (M ± SD)	P value
Age	70.8 ± 5.64	26.46 ± 1.95	0.295
BMI	27.27 ± 4.22	26.46 ± 1.95	0.032*
WC	91.69 ± 14.4	26.46 ± 1.95	0.04*

Table 6: Correlation between result of MMSE score and age, BMI and WC.

Variable	MMS (M ± SD)	P value
WC		
Normal	25.77 ± 1.64	0.001*
High	26.95 ± 2.00	
Hypertension		
Positive	26.03 ± 2.04	0.002*
Negative	26.99 ± 1.69	
Diabetes mellitus		
Positive	25.61 ± 1.94	0.001*
Negative	27.23 ± 1.62	
Triglyceride		
Normal	26.04 ± 1.92	0.013*
High	26.81 ± 1.91	
HDL		
Normal	25.98 ± 1.83	0.001*
Low	27.09 ± 1.95	

Table 7: Correlation between result of MMSE score and result of laboratories.

Number	MMSE score (M ± SD)	P value
0 component	28.63 ± 1.21	0.0001*
One component	27.68 ± 1.47	
Two components	26.33 ± 1.67	
Three components	26.41 ± 2.18	
Four components	25.54 ± 1.72	
Five components	24.53 ± 0.92	

Table 8: Correlation between result of MMSE score and number metabolic syndrome components.

42% in males), National Health and Nutrition Survey [23] found the prevalence of metabolic syndrome among general populations to be 62.0%, 63.4% in female and 34.1% in male. Also, Oh et al. [24] reported the prevalence of metabolic syndrome was 63.8% in women and 31.4% in men. In the current study, the prevalence of MCI among studied patients was 63.3% which was higher than the prevalence of MCI reported in general population aged ≥ 65 years by several studies 12-18% [25,26], 14-40% [27,28] 10-25% [1] and 16-20% [21]. This difference can be explained as our study was hospital based study. The prevalence of MCI was higher among patients with metabolic syndrome (75.34%) than patients without metabolic syndrome (53%) with statistical significance. The score of MMSE was 25.74 ± 1.95 in patients with metabolic syndrome in comparison to 27.08 ± 1.73 in patients without metabolic syndrome. These results were agreed with Deme et al. [29] who reported that; metabolic syndrome correlates to lower MMSE scores and thus mild cognitive decline. The MMSE mean score of metabolic syndrome group is lower with -2.345 points compared to non-metabolic syndrome

subjects. Graham et al. [25] and Yaffe et al. [30] reported that cognitive function decreased in the metabolic syndrome group compared to the normal control group. Also several cross-sectional studies reported that, metabolic syndrome was associated with significantly poorer cognitive performance [31-35]. In our study, the metabolic risk factors, diabetes mellitus, hypertension, WC, high triglyceride and low HDL levels affected the MMSE total score and significantly associated with MCI that were agreed with several studies reported that hypertension [36-38], diabetes mellitus [39], obesity [14,40], high triglyceride [41,42] and low HDL [43-47] have each been associated with cognitive impairment, ranging from MCI to dementia. The score of MMS was inversely related with number of Metabolic syndrome components, increase in number of metabolic syndrome components associated with increasing degree of cognitive impairment, that agree with [48] who report the same results. In the Longitudinal Aging Study Amsterdam [35], hyperglycemia was a key predictor, while HDL-C was found to be the most important predictor in the current study as noted above, and this was agree with [49], while [50] concluded that, high triglycerides was the most important predictor of vascular dementia. Regarding DM and cognitive impairment, we found a significant positive correlation; these results were agreed with Brownlee [51], Farris et al. [52], Den Heijer et al. [53], Biessels et al. [54], Sonnen et al. [55] and Balakrishnan et al. [56], they found same results. Also in our study we found a positive correlation between HTN and impaired cognition, this result was agree with Gorelick et al. [57], Okusaga et al. [58], Uiterwijk et al. [59], Spinelli et al. [60], Yamaguchi et al. [61] and Kilander et al. [62], they reported same correlation, our result was disagreed with Gifford et al. [63] who found an inverse relationship between blood pressure and cognitive dysfunction. Hypertension is said to decrease the number of nicotinic receptors sensitive to acetylcholine and to cause cerebrovascular diseases, cerebral infarction and cerebral gray substances, arteriosclerosis and lower cognitive function [64]. The combination of type II diabetes and hypertension is associated with greater cognitive impairment compared to normotensive diabetic patients [65]. Large population-based studies then revealed that hyperlipidemia and particularly hypercholesterolemia in middle age are associated with the risk of subsequent occurrence of MCI [66-68]. Hypertriglyceridemia changes cerebral blood by increasing the viscosity of blood and lowers cognitive function by causing arteriosclerosis [69] Lower HDL-C level is associated with more severe lesions of white matter changes, leading to MCI, even AD [70]. HDL-C has been described as a negative risk factor for the development of cognitive impairment [71]. HDL-C can prevent aggregation and polymerization of β-amyloid, thus slowing or even preventing the development of AD [72,73]. HDL-C is also has anti-inflammatory properties [74]. Abdominal obesity was associated with cognitive dysfunction as defined by scores obtained on a MMSE developed for the assessment of cognitive functioning in individuals over 65 years, even after adjustment for age [75]. Adiposity has a direct effect on neuronal degradation [76]. Obesity is also associated with subclinical inflammatory status, a condition linked to dementia [77] and cognitive decline [78]. Although the association between obesity and poor cognitive function is prominent in the elderly, middle-aged, obese adults may have a greater degree of brain atrophy compared with age-matched, non-obese people [9]. Non-elderly obese people may experience subtle cognitive dysfunction and may be at greater risk of progression to significant cognitive impairment [79].

Conclusion

Patients with metabolic syndrome have a higher risk for developing cognitive impairment and this risk increase with increased number of metabolic syndrome components.

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