

The relationship between carotid intima-media thickness and cognitive function and depression in postmenopausal women

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Abstract

Introduction: Atherosclerosis, cognitive impairment, and depression are common entities in postmenopausal patients. Our aim was to ascertain the relationship between the carotid intima-media thickness (IMT) and cognitive function and depression in postmenopausal women.

Material and methods: This was an observational, cross-sectional, comparative study among postmenopausal women. A carotid artery ultrasound was performed, and the IMT was measured. Mental function was assessed with the mini-mental state examination (MMSE), and the presence of depression with the Hamilton Depression Rating Scale (HDRS). For statistical analysis the Mann-Whitney *U* test and Spearman correlation were used. Sensitivity, specificity, positive predictive value, negative predictive value, and odds ratio (OR) were calculated.

Results: Seventy-five patients were studied. The median of age was 52 years (31–76), and the IMT was 1.1 mm (0.6–0.20). The HDRS score was 8.9 (1–21), and that of the MMSE was 29 (18–30). After dividing the group according to the presence or absence of depression, it was found that age and IMT were greater in the group with depression, and the MMSE score was greater in the group without depression. After dividing according to the MMSE score, age and HDRS score were significantly greater in the group with cognitive impairment. The intima-media thickness had an OR of 12.2 (2.6–58.0) for cognitive impairment and an OR of 5.2 (1.9–14.1) for depression.

Conclusions: The intima-media thickness is associated with greater risk of cognitive impairment and depression.

Key words: depression, cognitive status, intima-media thickness.

Introduction

During the transition to menopause, hormonal changes predispose to depression in women without a history of depression [1].

Regarding cognitive impairment in women, multiple causes have been implied, such as oestrogen deficiency, although it seems to be related to aging *per se* [2]. Women in the first postmenopausal year have worse performance in verbal learning, verbal memory, motor function, and attention tasks at work than those in late reproductive years or during the menopausal transition [3].

It has been observed that the decrease in cerebral blood flow that accompanies carotid stenosis is associated with cognitive impairment in verbal memory, visuospatial ability, and verbal fluency areas, while a greater degree of stenosis was associated with a lower score in learning and memory [4].

In a study that evaluated cognitive function, depression, and anxiety in patients with carotid stenosis

> 70%, it was found that visual and verbal memory and motor speed were affected, and anxiety was increased. Bilateral and symptomatic stenosis was associated with slow processing speed, and the degree of stenosis was not associated with cognitive performance or anxiety level [5]. Severe carotid stenosis was associated with decreased cognitive performance but not with depressive symptoms [6]. The carotid intima-media thickness (IMT) is associated with an increased risk of myocardial infarction and cerebrovascular events in patients with no history of cardiovascular events [7]. Carotid IMT is greater in postmenopausal women and is unrelated to the time since menopause, but it is associated with body mass index (BMI) [8]. Likewise, an increased IMT was associated with poor memory and decreased cognitive speed [9].

Therefore, the objective of the present study was to analyse the relationship of carotid IMT with cognitive function and depression in postmenopausal women.

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Material and methods

We report herein an observational, cross-sectional, comparative study carried out among postmenopausal women (> 12 months of amenorrhoea) who attended an endocrine gynaecology consultation. In all of them, the following were analysed: age (years), weight (kg), height (m), waist circumference (cm), and hip circumference. The BMI (BMI, weight in kg/height in m²) and the waist-hip ratio (WHR, waist circumference/hip circumference) were calculated.

Carotid artery ultrasound was performed in all subjects, and the IMT was evaluated as follows: in the soft tissue category, locating the carotid artery 1 cm from its bifurcation, the image was maximized by visualizing on the screen the diameter of the lumen of the vessel and then measuring the distance between the first and second echogenic lines. The highest value obtained was used for the analysis. The intima-media thickness was considered normal when it was < 1 mm and abnormal when ≥ 1 mm [10, 11]. Pulsatility index (PI), resistance index (RI), and maximum systolic speed (MSS) were also calculated.

Cognitive function was assessed with the mini-mental state examination (MMSE). The result was considered as dementia when the score was less than 12 points, cognitive impairment when it was between 12 and 24 points, borderline cognitive impairment when it was 25 or 26 points, and normal when it was > 27 points [12].

The 17-item Hamilton Depression Rating Scale (HDRS) was applied to all of the women, who were categorised as follows: 0–7 no depression; 8–13 mild or minor depression; 14–18 moderate depression; 19–22 severe depression; and > 23 very severe depression [13]. These tests were applied by the same physician to all the participants.

Sample size was calculated considering a population of 2400 with an expected frequency of 7.4% and a confidence level of 90%, with confidence limits of 5%, leaving 72 patients.

Statistical analysis

Data are reported as median, minimum, and maximum. Comparisons between groups were made with the Mann-Whitney *U* test. Spearman's correlation analysis was performed between the IMT, the MMSE score, and the HDRS score. Sensitivity, specificity, positive

predictive value (PPV), negative predictive value (NPV), and odds ratio (OR) were calculated. The protocol was authorized by the Ethics in Research Committee and the Local Research in Health Committee under number R-2020-3606-039, and the patients gave their consent to participate.

Results

Seventy-five patients were studied, and their mean age was 52 years (range 31–76), BMI 29.9 (range 18.1–43.81), and WHR 0.91 (range 0.80–1.22).

The intima-media thickness was 1.1 mm (0.6–2.0), the PI 1.39 (1.01–1.88), RI 0.63 (0.36–0.98), and VSM 200.5 (120–280).

The mini-mental state examination score was 29 (18–30), the HDRS score was 8.9 (1–21). The HDRS score correlated with the IMT 0.412, $p < 0.001$, and the MMSE score correlated with the IMT – 0.511, $p < 0.001$.

When dividing the group based on the presence or absence of depression, it was found that age was significantly higher in the group with depression: 49.5 (32–64) years vs. 57 (31–76) years, $p < 0.001$. There was no difference between the groups in the BMI 29.6 (20.9–43.8) vs. 30.05 (18.1–43.8) or in the WHR 0.91 (0.80–1.18) vs. 0.90 (0.80–1.22) $p < 0.673$.

It was found that IMT and PI were significantly higher in the depressed group and MSS was lower (Table 1).

The mini-mental state examination score was significantly higher in the group without depression 29 (27–30) vs. 27 (18–30), $p < 0.001$.

When dividing the group based on the presence or absence of cognitive impairment, it was found that age was significantly higher in the group with cognitive impairment, at 50 (31–65) years vs. 63 (52–76) years, respectively, $p < 0.001$. There was no difference between the groups in terms of BMI 27.8 (20.9–43.4) vs. 30.05 (18.1–43.8) or WHR 0.93 (0.82–1.09) vs. 0.90 (0.80–1.22). It was found that the IMT and the PI were significantly higher in the group with cognitive impairment, and the MSS was significantly lower in this same group (Table 2). The HDRS had a higher score in those with cognitive impairment 6.0 (1–17) vs. 12 (7–21), $p < 0.001$.

The intima-media thickness for cognitive impairment had a sensitivity of 43%, specificity 94%, PPV 89%, NPV 59%, and OR 12.2 (CI 95: 2.6–58), and the IMT

Table 1. Comparison of ultrasonographic parameters of the carotid artery in patients with and without depression

Parameters	Without depression (n = 30)	With depression (n = 45)	p-value
IMT [mm]	0.9 (0.6–1.9)	1.2 (0.7–2.0)	0.001
Pulsatility index	1.23 (1.05–1.67)	1.49 (1.01–1.88)	0.001
Resistance index	0.62 (0.47–0.97)	0.63 (0.36–0.98)	NS
MSS [cm/s]	232.9 (151–288)	188.2 (120–289)	0.001

IMT – intima-media thickness, MSS – maximum systolic speed, NS – non significant

Table 2. Comparison of ultrasonographic parameters of the carotid artery in patients with and without cognitive impairment

Parameters	Without cognitive impairment (n = 56)	Cognitive impairment (n = 19)	p-value
IMT [mm]	1.0 (0.6–1.9)	1.5 (0.7–2.0)	0.001
Pulsatility index	1.31 (1.01–1.77)	1.59 (1.33–1.88)	0.001
Resistance index	0.63 (0.47–0.97)	0.67 (0.36–0.98)	NS
MSS [cm/s]	221.5 (151–289)	144.7 (120–249)	0.001

IMT – intima-media thickness, MSS – maximum systolic speed, NS – non significant

for depression had a sensitivity of 78%, specificity 60%, PPV 69%, NPV 70%, and OR 5.2 (CI 95: 1.9–14.1).

There was a correlation between the IMT and the HDRS score 0.412, $p < 0.001$, and with the MMSE -0.511 . The MMSE correlated with the HDRS score -0.575 , $p < 0.001$.

Discussion

In this study, 75 postmenopausal women were evaluated. There was greater depression when the carotid IMT was greater, similar to that reported in another study [5], and there was less cognition with greater IMT, which has already been reported in patients with carotid stenosis [9].

When dividing the sample according to the MMSE score, it was found that there was greater cognitive deterioration in the older women, as has already been described [2].

When dividing the group based on the presence or absence of depression, it was found that age was higher in the group with depression, as has already been reported [14].

The intima-media thickness was significantly higher in the group with depression, which is consistent with a study in which anxiety was increased in those with carotid stenosis [5] but not with another in which it was not associated with depression [6]. In the group divided based on the MMSE, it was found that the carotid IMT was higher in those with cognitive impairment, as has already been reported in the literature [9], probably in relation to lower oxygenation, which would compromise brain function.

A positive correlation was found between the IMT and the HDRS score and a negative one with the MMSE, supporting the aforementioned evidence that the greater the carotid stenosis, the greater the depression and cognitive deterioration [4]. Likewise, the HDRS score was higher with lower MMSE score, which means that the higher the depression, the lower the cognitive function, agreeing with a study in which depression was present in those with mild cognitive dysfunction up to 31.8% [15].

Conclusions

It was observed that a high IMT increases the risk of cognitive impairment and depression, probably in

relation to the lower cerebral blood flow, as shown by the lower MSS in the groups with depression and with cognitive impairment, but this requires further studies.

Therefore, it can be concluded that increased IMT is associated with a higher risk of depression and cognitive impairment.

Disclosure

The authors report no conflict of interest.

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