White matter hyperintensities and balance control in elderly people with diabetes and hypertension

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Introduction: White matter hyperintensities (WMHs), appearing as punctuate and/or confluent periventricular lesions on MRI, have been associated with age, cardiovascular risk factors such as diabetes and hypertension, and other co-morbidities. Clinical studies have suggested a link between WMHs and balance disorders and falls in elderly people. This study assessed the relationship between WMHs on MRI and balance in older people with type 2 diabetes mellitus (DM), hypertension (HTN).

Materials and methods

We studied 55 healthy subjects (age 65±7.0 yrs), 21 normotensive DM subjects (DM-NTN) (61.4±6.1 yrs, DM duration 13.97±12.8 yrs), 14 hypertensive DM subjects (DM-HTN) (duration-DM: 11.54±8.6 yrs and HTN: 8.9±8.0 yrs, age: 63.1±8.4 yrs) and 14 hypertensive subjects (duration-HTN: 15.3±14.24 yrs, age 69.8± 6.2 yrs). Anatomical images and MR angiography were acquired in a GE 3 Tesla VHI scanner with quadrature head coil. All patients had routine fluid-attenuated inversion recovery (FLAIR) ($T_I/T_E/T_R$ = 2250/161/11000 ms, 24 cm × 24 cm FOV, 256 × 160 matrix size, 5 mm slice thickness), dual T_2-weighted fast spin echo (FSE) ($T_{E1}/T_{E2}/T_R$ = 25/117/4000 ms, 24 cm × 18 cm FOV, 256 × 256 matrix size, 3 mm slice thickness) and 3D time of flight angiography (TOF). FLAIR images were scored using a scale from 0 to 3 (0: no lesions; 1: focal; 2: beginning confluence; 3: diffuse involvement of the entire region). Periventricular WMHs and punctuate lesions were analyzed separately and were graded on all slices in the frontal, temporal parieto-occipital and cortical regions for both hemispheres and quantified as a sum, mean and maximum grade.[1] This clinical rating scale has shown good correlations with the WMHs volume (r^2 =0.83, p<0.0001).[2] Balance was assessed using traditional measures and stabilogram-diffusion center of pressure (COP) analysis.[3] COP displacement was measured using the force platform (Type 5233A2, Kistler Instrument Corp., Armherst, NY) during 3-min quiet standing with eyes open or with eyes closed. COP fluctuations were analyzed using traditional posturographic parameters (mean and maximum radius, standard deviations in the anteroposterior and mediolateral directions and the swept area) and also using dynamic measures based on stabilogram-diffusion analysis including short term positive correlations (hxs, hys, hrs), long term negative correlations (hxl,hyl, hrl), and time scale of transition from positive to negative correlations (nx, ny). WMHs and balance data were adjusted for age.

Results White matter hyperintensities: Control subjects had less total brain continuous WMHs and total brain punctuate WMHs (sum, p=0.006 and p=0.04, respectively). DM-HTN group had higher total sum of continuous WMHs (sum, p=0.01) and HTN group had more total brain punctuate WMHs (sum, p=0.016). DM-HTN and HTN groups had higher grade of total brain continuous WMHs (sum, p=0.004 and p=0.002, respectively) and more total brain punctuate WMHs (sum, p=0.05 and p=0.005, respectively) compared to controls. DM-NTN group was not different from controls (Figure 1A, B). **Balance control:** No significant differences were found in traditional posturographic and dynamic balance measures among the groups.

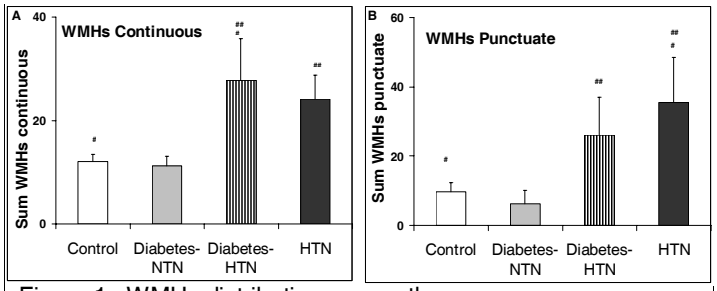

Figure 1: WMHs distribution among the groups.

Regression analysis WMHs and Balance Control: Total brain continuous-sum and punctuate-sum WMHs were associated with some indices of dynamic balance parameters, during standing with eyes open (hxl_1, nx_1) and eyes closed (nx_2): continuous and punctuate WMHs were positively associated with hxl_1 (p=0.0001 and p=0.002) and negatively with nx_1 (p=0.0003 and p=0.023) and nx_2 (p=0.016 and 0.013).

Conclusions

Our results suggest that continuous and punctuate WMHs reflect different pathophysiological mechanisms underlying cerebromicrovascular disease in diabetes and hypertension. Hypertension is associated with more severe WMHs while no significant effect of diabetes on WMHs was observed. Balance control during quiet standing is preserved in diabetic, HTN and control subjects without history of falls. Both continuous and punctuate WMHs influence dynamic balance indices. Further analyses are needed to evaluate whether localization of WMHs within certain brain areas may affect balance control.

References: [1] Wahlund et al. Stroke 32 1318-1322,2001; [2] Novak et al. Diabetes Care 29, 1529-1534,2006; [3] Collins, J.et al .Phys.Rev.Lett., 73, 764-767.,1994

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