The Association between White Matter Lesions, Stroke and Activities of Daily Living – The MEMO Study on the KORA Platform Augsburg

Zusammenhang zwischen Läsionen der weißen Gehirnsubstanz, Schlaganfall und dem Alltagsleben – Die MEMO-Studie auf der KORA-Plattform Augsburg

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Zusammenfassung

Moderne Bildgebungsverfahren zeigen, dass vaskuläre Veränderungen des Gehirns bei Älteren häufig sind. Ihre klinische Bedeutung, vor allem von subkortikal gelegenen Läsionen der weißen Hirnsubstanz, wird kontrovers diskutiert und ihre funktionellen Auswirkungen sind unklar. Wir haben die Prävalenz von großen Läsionen in der weißen Hirnsubstanz und die des Schlaganfalls, basierend auf Kernspintomographiekriterien und auf einem Schlaganfallfragebogen, bei 268 Teilnehmern der Augsburger Senioren-Studie erhoben. Die Studie ist ein Nachfolgeprojekt des MONICA Surveys S2 (1989/90) und hat die Beziehungen beider Arten von vaskulären Veränderungen des Gehirns zu Einschränkungen bei Alltagsaktivitäten ausgewertet. Die Prävalenz von großen Läsionen der weißen Substanz betrug 37,0% (n=69), die aller Schlaganfälle oder transitorisch ischämischer Attacken 19,4% (n=52) und die beider Arten von Läsionen 12,0%. Probanden mit beiden Läsionstypen schnitten in den geriatrischen Untersuchungstests signifikant schlechter ab und hatten deutlichere Einschränkungen in ihren Alltagsfunktionen. Vaskulär bedingte Veränderungen des Gehirns haben eine hohe Prävalenz in der älteren Allgemeinbevölkerung und messbare Auswirkungen auf die funktionalen Fähigkeiten von Betroffenen.

Schlüsselwörter

White matter lesions · Prävalenz · Alltagsaktivitäten

Abstract

Modern brain imaging methods have shown that vascular brain changes are a frequent finding in elderly individuals. The clinical relevance of subcortical white matter lesions is subject of debate, their impact on the functional status of those affected unclear. We assessed the prevalence of large white matter lesions and stroke, defined by Magnetic Resonance (MRI) criteria and by questionnaire reports, among 268 participants of the Memory and Morbidity in Augsburg Elderly Study, a 1997/98 follow up project of the MONICA survey S2 (1989/90), and evaluated the association of both types of brain changes with limitations in activities of daily living. The prevalence of large white matter lesions was 37% (n = 69), that of any stroke or TIA 19.4% (n = 52) and 12% (n = 32) were affected by both brain changes. The latter group performed significantly worse in geriatric performance tests and had considerable impairments in their daily functioning. Vascular brain changes are very prevalent in older populations and have a measurable and considerable impact on functional capabilities of those affected.

Key words

White matter lesions · prevalence · activity of daily living

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Introduction

Subcortical white matter lesions (WML) are a common finding on brain imaging of older individuals [1, 2]. They are related to stroke, especially to lacunar stroke, and share some of the major stroke risk factors like hypertension [3]. The pathogenesis of WML, their clinical relevance and their relation to cerebrovascular diseases, however, is not well understood. The vast majority of these lesions are located subcortical and in the periventricular areas. Their prevalence increases strongly with age raising the question to what extend, if at all, they represent 'normal ageing'. WML detection is the domain of magnetic resonance imaging (MRI), since computed tomography (CT) can only show large lesions. But due to logistical reasons and high costs MRI is rarely used in population studies. Thus, very few studies have evaluated the influence of the complex relationship between WML and stroke on the daily life of affected individuals. Aim of our study was to analyze the impact of WML and stroke on activities of daily living in a population-based study of the elderly from Southern Germany

Methods

The MEMO Study is a follow-up project of a subsample of the 1989/1990 World Health Organization Monitoring Trends and Determinants in Cardiovascular Disease (MONICA) Survey (S2) in Augsburg [4]. The study was performed 1997/98 on the KORA platform (Cooperative Health research in the Region of Augsburg) and the Central Hospital of Augsburg. MEMO examines cognitive function and risk factors for neurologic diseases in the elderly [5 – 8]. It is part of the European multi-center 'Cardiovascular Determinants of Dementia' (CASCADE) Study [9]. The Study was restricted to the age group 65 years and older. The overall response rate was 60.6 %, yielding 385 participants. All participants received a face to face interview for medical histories and a standardized neurologic examination. Activities of daily living were asked for 10 basic (ADL, e. g. bathing or dressing) and 8 more complex instrumental activities of daily living (IADL, e. g. doing own finances, shopping) according to the scale by Lawton and Brody [10, 11]. Answers were subsequently summarized in two dichotomized variables indicating any ADL and IADL help needs. Three geriatric performance tests, frequently used in geriatric assessment scales, were done by each participant.

MRI (Magnetic Resonance Imaging) scanning was performed in 268 participants (69 %) without contraindications with a Phillips 1.5 tesla machine at the department of radiology, Central Hospital of Augsburg. The MRI protocol included Proton Density (PD), T1, and T2 weighted images and scan reading was done by a single reader using an established rating scale. Subcortical WML were categorized by size (small < 3 mm, medium 3 – 10 mm, large > 10 mm). Stroke was defined either by MRI as the presence of a hypodense (T1, proton density) or hyperdense (T2) lesion on one or more scans, or clinically assessed with a stroke symptom questionnaire with subsequent validation by medical records [6]. Subsequently the study population was stratified according to the presence or absence of large WML (LWML) and clinically

and MRI-defined stroke or TIA. This approach resulted in 4 categories: individuals without LWML and stroke/TIA, those with LWML only, participants with stroke or TIA only and those with LWML plus stroke/TIA. In the statistical analysis adjustments of proportions were done with adjusted probabilities estimated in a logistic regression model, those for continuous variables with the adjusted means procedure following an ANOVA (Analysis of Variance) model.

Results

The sociodemographic and clinical characteristics of the 268 participants without MRI contraindications are shown in Table **1**. The overall prevalence of subcortical large white matter lesions was 37.7 %, increasing from 18.5 % in those 65 – 69 years to 53.4 % among participants 75 years and older. The prevalence of MRI defined stroke was 15.3 % with the majority of these being small, silent, lacunar type lesions of < 5 mm. The prevalence of stroke and TIA based on the assessment and validation of reported symptoms was 8.2 %, while the percentage of study participants with LWML and stroke or TIA was 11.9 %.

Table **1**   Sociodemographic and clinical characteristics (n = 268) of the MEMO study Augsburg 1997/98 (follow-up of a subsample of MONICA survey S2 1989/90)

age, years (median, range)	72 (65 – 83)
women, %	47.8
living with partner, %	69.8
years of education (median, range)	10 (8 – 17)
current smoker, %	9.7
history of hypertension[1], %	47.4
history of diabetes mellitus[2], %	8.6
history of myocardial Infarction[2], %	7.5
MRI defined LWML[3], %	37.7
MRI defined stroke, %	15.3
clinically defined stroke or TIA[4], %	8.2

[1] systolic blood pressure ≥ 160 mm Hg or diastolic blood pressure ≥ 95 mm Hg or actual blood pressure treatment; [2] selfreported; [3] LWML denotes subcortical large white matter lesions (> 10 mm); [4] assessment based on a stroke symptom questionnaire with subsequent validation of retrived medical records

Table **2** reports functional problems associated with each type of vascular brain change. Significant differences in ADL and IADL impairment, defined as help needs, between participants with specific types of vascular brain lesion were observed, even after adjustment for age and gender. Compared with individuals without vascular changes or clinical stroke evidence those with either LWML or stroke reported considerable more often IADL needs and bad health. However, among individuals with both type of brain changes the percentage with impairments was almost twice as high compared to participants without changes. For two of the three performance tests a gradual increase in the percentage of low performance across the four groups of individuals was observed. No differences between groups were found for the foot tapping tests.

rating scale	no LWL, no stroke* (n = 147)	only LWML* (n = 69)	only stroke* (n = 20)	LWML plus stroke* (n = 32)	p* (diff. between groups)
self rated bad health[1], %	18.1	26.9	20.2	45.2	0.005
activities of daily living					
ADL[2], %	24.7	32.0	19.9	47.7	0.04
IADL[3], %	32.1	33.3	38.0	56.0	0.03
performance tests					
tandem stand ≤ 10 sec, %	21.5	32.4	37.5	42.9	0.009
rising from chair < 10 sec, %	65.7	73.2	82.8	86.5	0.01
right foot tapping < 10 sec, %	29.3	25.2	34.2	20.9	0.51
left foot tapping < 10 sec, %	33.6	32.2	34.7	32.3	0.92

Table **2** Association between subcortical white matter lesions, stroke and activities of daily living in the MEMO Study Augsburg (n = 268)

* values adjusted for age and gender; [1] Answers 'fair' or 'poor' to the question 'In general, would you say your health is: '. The question has 5 answer options on a Lickert type scale (from 'excellent' to 'poor'). [2] ADL = activities of daily living, score dichotomized: no help needed vs. help needed in at least one of the items; [3] IADL = instrumental activities of daily living, score dichotomized: no help needed vs. help needed in at least one of the items

Discussion

Our findings support the increasing evidence from the few other population studies that subcortical white matter lesions are highly prevalent in the elderly general population. It also adds to the known fact that stroke and TIA are frequent findings in the elderly. The results show that large white matter lesions have a measurable and considerable impact on the daily life of those affected. The slightly larger effect of LWML compared to stroke on functional status was not statistically significant and can be explained by the fact that the majority of the events in the stroke only group were small and silent. In this study about one in 10 participants had both types of vascular brain changes. Especially this group had to a large extend restrictions in their ADL and IADL. Two of the three performance test were helpful in the differential assessment of functional capabilities between the groups.

We conclude that vascular brain changes are frequent findings and that they contribute to the explanation of functional differences in older age, especially in the absence of other major limiting diseases. Given the demographic changes in western societies early determination of vascular brain changes contributes to identification of individuals at risk for gradual functional decline.

Acknowledgement

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