SHORT REPORT

Frail elderly patients with dementia go too fast

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The reason why patients with dementia fall more often and sustain more fractures than patients without dementia remains unclear. Therefore, the relationship between dementia and gait velocity as a marker for mobility and falls in a cohort of frail elderly (mean age of 77.3 years) inpatients was assessed. Patients with dementia were expected to walk slower than patients without dementia. A trend was indeed observed: absolute gait velocity of 0.59 m/s in patients with dementia (n=63) versus 0.65 m/s in patients without dementia (n=62; p=0.19). After adjustment for parkinsonism and walking aids, however, patients with dementia walked 0.44 m/s faster than patients without dementia (p=0.02). Probable explanations are frontal lobe disinhibition and lack of insight, causing patients with dementia to walk relatively too fast in the context of their frailty. Therefore, the high risk of falls in dementia may be partially explained by the loss of control of gait velocity.

Compared with cognitively normal elderly people who fall, elderly patients with dementia have a two-fold higher rate of falls, sustain more fractures and have a reduced life expectancy.¹ The reason why elderly patients with dementia fall remains incompletely understood. Gait disorders, which are an important risk factor for falls, are common in elderly people with dementia and can even precede non-Alzheimer's dementia.² Walking velocity is an important quantitative measure of gait. Walking slowly may index the severity of the underlying gait or balance disorder, but may also reflect a purposeful adaptation to reduce the risk of falls.³ Previous research showed that relatively healthy elderly people with dementia walk slower than elderly people without dementia.⁴ A slow gait velocity is also associated with frailty, admittance to a nursing home and death.^{5,6} Therefore, we predicted that in frail elderly patients with dementia, gait velocity would be reduced even further compared with non-demented frail elderly people.

METHODS

Patients

Of 201 patients consecutively admitted to an acute geriatric or old-age psychiatric ward, we included a cohort of 125 elderly patients (72 women) with a mean age of 77.3 years (SD 7.7). Reasons for exclusion were inability to walk 10 m without personal assistance (n=33), inability to understand simple instructions because of delirium or other reasons (n=19), or both (n=13), logistical reasons (n=9) and refusal to participate (n=2). Patients or their proxies gave written informed consent. In 63 patients, a geriatrician diagnosed dementia according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision criteria,⁷ and subsequently diagnosed probable Alzheimer's disease (n=31), probable vascular dementia (n=17), fronto-temporal dementia (n=4), Lewy body dementia (n=2) or other types of dementia (n=9)

according to internationally accepted criteria (criteria of National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et l'Enseignement en Neurosciences and National Institute of Neurological and Communication Disorders and Stroke-Alzheimer's Disease and Related Disorders Association, criteria of McKeith *et al*⁸ for Lewy body dementia and Manchester Lundbeck criteria for frontotemporal dementia).

Gait measurements

Gait velocity was measured with an electronic walkway (Gaitrite, MAP/CIR, Clifton, New Jersey, USA). This 5.6-m-long, 0.9-m-wide walkway consists of sensor pads (12.7 mm apart from each other) connected to a computer. Patients walked twice at comfortable speed and twice while counting backwards from 45 (dual-task condition). All patients counted first without walking to test if they had understood the task. They counted out loud. Because the focus of our study was the association between dementia and gait velocity, we did not record counting rate and errors.

Analysis

The baseline gait characteristics of patients were summarised as mean (SD) and differences between the two groups were tested with independent t tests. We calculated proportional dual-task costs in gait velocity as the percentage of change from baseline in gait velocity after addition of the dual task. Because we aimed at investigating gait in frail elderly people, we did and could not exclude patients with diseases other than dementia. We used multiple regression analysis to adjust for variables that potentially disturbed the relationship between dementia and gait velocity. The multiple regression analysis made the patients in both groups "equally frail", so the association between dementia and gait velocity could be investigated in two otherwise comparable groups. On the basis of the literature, these potentially disturbing variables were use of a walking aid, fear of falling (yes/no question), history of falls in the year before admission, number of drugs used, age, score on a comorbidity index (Cumulative Illness Rating Scale—Geriatrics),⁹ score on the motor section of the Unified Parkinson's Disease Rating Scale and an activities of daily living measure (Barthel Index). Thereafter, in the multiple linear regression model, we tested whether these variables indeed were confounders in this study—that is, whether these variables caused a change in the regression coefficient of dementia on gait velocity. The variables included in the final multiple regression model were, apart from dementia, Unified Parkinson's Disease Rating Scale, use of a walking aid and activities of daily living score. We ensured that the requirements for linear regression models were fulfilled and used log transformation for skewed distributions. Significance for all regression models was accepted at p<0.05.

RESULTS

Patient characteristics are summarised in table 1.

Table 1 Patient characteristics on admission at a geriatric or old-age psychiatry department

	Diagnosis of dementia	
	Yes	No
Number of patients	63	62
Age (years), mean (SD)	79.8 (7.4)**	74.7 (6.5)
Women, n (%)	35 (56.5%)	37 (58.7%)
Total score CIRS-G, mean (SD)	10.9 (3.3)	9.9 (3.2)
Number of drugs used, mean (SD)	5.7 (2.9)*	7.1 (3.3)
Use of psychotropic drug(s), n (%)	46 (73%)**	59 (95%)
MMSE score, mean (SD)	18.5 (5.3)**	25.3 (4.1)
Barthel ADL Index score, mean (SD)	14.2 (3.7)**	16.2 (3.1)
Fear of falling, n (%)	27 (43.5%)	29 (46.0%)
Fall(s) in previous year, n (%)	27 (46.6%)*	15 (30.0%)
Walking aid during measurements, n (%)	36 (58.1%)**	20 (31.7%)
UPDRS-motor section score, mean (SD)	9.9 (6.9)*	8.1 (5.9)
Hand grip strength (kg) (n = 96), mean (SD)	19.7 (8.8)*	24.9 (10.3)

ADL, activities in daily living; CIRS-G, Cumulative Illness Rating Scale—Geriatrics, a comorbidity index; MMSE, Mini-Mental State Examination; UPDRS, Unified Parkinson's Disease Rating Scale. * $p < 0.05$; ** $p < 0.01$.

Patients with dementia walked at a mean gait velocity of 0.59 m/s (SD 0.26) and patients without dementia at 0.65 m/s (SD 0.31) ($p = 0.19$). Stride length was comparable in patients with dementia (0.78 m) and patients without dementia (0.85 m) (SD 0.28), but the mean stride length variability (coefficient of variation) was 9% in patients with dementia versus 5.8% in patients without dementia ($p = 0.004$). Walking with a dual task decreased gait velocity in both groups (to 0.47 m/s (SD 0.21) in patients with dementia and to 0.58 m/s (SD 0.31) in patients without dementia, $p = 0.03$ between groups) and increased stride length variability (to coefficient of variation 11.5% (SD 13.4) in patients with dementia and to 7.6% (SD 9.4) in patients without dementia, $p = 0.06$). Proportional dual-task costs for gait velocity were 19.0% (SD 22.6%) in patients with dementia and 13.6% (SD 25.4%) in patients without dementia ($p = 0.22$). Only one patient with Parkinson's disease and dementia showed gait festination.

After adjustment for parkinsonism, use of walking aids and activities of daily living functioning, dementia was independently and positively associated with gait velocity (table 2). Moreover, analysis of the adjusted gait velocity showed that patients with dementia now walked relatively

faster (by 0.44 m/s) than patients without dementia ($p = 0.01$).

The effect of dementia on gait velocity was also present while walking with a dual task. The variance in gait velocity explained by the regression models was 42% with dual task and 48% without dual task.

DISCUSSION

The results unexpectedly showed the opposite of our prediction: although frail elderly patients with dementia walked slowly, they still walked relatively too fast, given their overall degree of physical impairment that should have warranted a much slower gait. Two explanations seem most likely. First, the relatively fast gait velocity in frail patients with dementia may reflect frontal lobe disinhibition or recklessness. Another explanation can be a lack of insight, because of which patients may not have adapted their behaviour to their cognitive and physical impairments. Other studies that assessed gait in patients with dementia found a slower gait velocity in these patients than in patients without dementia.^{4–10} A reason for the difference with earlier findings may be that these studies investigated gait in relatively healthy patients with dementia, without or with poorly described comorbidity, whereas our patients with and without dementia were frail (used a high number of drugs, had a high Cumulative Illness Rating Scale—Geriatrics score, slow mean gait velocity and low handgrip strength). Further, all five previous studies, as discussed in the review,^{4–10} used a case-control design, creating the possibility of biased outcomes because of incorrect selection of controls.

The absolute gait velocity measured in our patients with dementia corresponds with values reported for patients with moderate to severe dementia,^{11–12} but is slower than the gait velocity of elderly people transitioning to frailty¹³ and much slower than gait velocity in healthy elderly people (range 0.97–1.4 m/s).¹⁴ A limitation of our study is that we only measured gait variables at preferred walking speed, although it is known that several gait variables can vary with gait velocity. Measuring gait at several gait velocities, however, was not feasible in this frail population. Nevertheless, we were able to pick up well-known gait changes in this population, including both the reduced absolute velocity and the increased stride variability, which is an important marker of gait abnormalities.^{15–16}

The inappropriately fast gait in patients with dementia, in the context of their frailty, may partially explain the excessive

Table 2 Absolute, unadjusted values for gait velocity and multivariate regression models for gait velocity (m/s) with dementia, parkinsonism (UPDRS motor part), use of walking aids and functional performance (ADL) as independent variables

Absolute, unadjusted values	Gait velocity (m/s)					
	Without dual task		With dual task			
	Dementia, mean (SD)	No dementia, mean (SD)	Dementia, mean (SD)	No dementia, mean (SD)		
	0.59 (0.26)	0.65 (0.31)	0.47 (0.21)	0.58 (0.31)		
Multiple linear regression analysis						
Independent variables	Gait velocity	SE	p Value	Gait velocity	SE	p Value
Intercept	+0.22	0.17	0.20	+0.004	0.17	0.98
Dementia	+0.44	0.18	0.02	+0.48	0.18	0.01
UPDRS score	−0.01	0.003	0.00	−0.01	0.04	0.02
Walking aid	−0.13	0.04	0.00	−0.16	0.04	0.00
ADL score	+0.04	0.01	0.00	+0.04	0.11	0.00
Dementia×ADL score	−0.03	0.01	0.02	−0.03	0.01	0.01
Explained variance (R ²)	0.48			0.42		

ADL, activities in daily living; UPDRS, Unified Parkinson's Disease Rating Scale.

fall rate in frail elderly patients with dementia. This finding opens avenues to future intervention studies.

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