Dementia Associates with Undermedication of Cardiovascular Diseases in the Elderly

A Population-Based Study

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Key Words

Dementia co-morbidity • Hypertension • Stroke

Abstract

Objective: To compare medication use in patients suffering from cardiovascular disease with and without dementia. **Subjects:** All inhabitants aged 75 and older in Lieto, Finland (n = 462, participation rate 82%). **Measurements:** Direct standardised assessments of dementia and cardiovascular diseases. Quantification of drug use by self-report and by prescription and drug container checks. **Results:** In multivariate analyses, the odds ratio for demented cardiovascular patients receiving any cardiovascular medication (use vs. non-use) was 0.31 (95% confidence interval 0.12–0.82). Compared to the non-demented, demented stroke patients were treated less often with antithrombotic agents (p = 0.041) and demented hypertensive patients less often with β -blockers (p = 0.045). **Conclusion:** Demented cardiovascular patients, even mildly to moderately demented, were prescribed fewer evidence-based cardiovascular medications than non-demented patients.

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Introduction

Epidemiological studies have demonstrated that many evidence-based medications for cardiovascular diseases are underused by elderly people living in a community [1–5], in institutions [5, 6] or in sheltered housing [7]. Studies on cardiovascular drug use in relation to cardiovascular morbidity have shown that cognitive impairment is an additional risk for older patients for not being treated: Aspirin or warfarin are prescribed more seldom for demented patients at discharge from hospital after ischaemic stroke compared to cognitively intact patients [8], fewer demented patients with congestive heart failure (CHF) receive angiotensin-converting enzyme (ACE) inhibitors compared to non-demented ones [6], fewer community-dwelling demented elderly persons are prescribed lipid-lowering agents [3], β -blockers [1] and ACE inhibitors [1] than non-demented ones, and patients with vascular dementia are less likely to use aspirin after stroke and more likely to be without pharmacological treatment for hypertension than patients with milder cognitive impairment [5].

However, there are only few population-based studies on demented patients' cardiovascular medication use in multiple simultaneous cardiovascular diseases [1, 5, 9], a situation characteristic of old age. Furthermore, most data on demented patients' cardiovascular morbidity in pharmaco-epidemiological studies are based on self-reports [3, 9], medical reviews [5] or assessments of occasional cardiovascular diseases [1]. In this study, we assessed the occurrence of 6 cardiovascular diseases – hypertension, coronary heart disease (CHD), atrial fibrillation (AF), stroke, hypercholesterolaemia and diabetes – by standardised methods and identified patients with CHF from medical reviews to examine the use of cardiovascular medications in these conditions. The aim was to describe if dementia was associated with less intensive treatment of cardiovascular diseases recognised as risk conditions for cognitive decline [10–13].

Subjects and Methods

This study was a part of the longitudinal epidemiological study of older people in Lieto, a semi-industrialised municipality in south-western Finland [14, 15]. In this study, the cross-sectional data collected in 1998–1999 were used. Written informed consent was obtained from all participants or their representatives. The Joint Committee on Ethics of the University of Turku approved the study protocol.

All residents aged 65 years or more, living in Lieto (12% of the population; $n = 1,596$), were invited to participate in random order. Of those eligible, 63 died before they could be examined, and 273 refused or did not respond leaving 1,260 participants (82%). Participants aged 75 years or older were included in this study ($n = 462$; 166 men and 296 women).

The study protocol consisted of an interview, a visit to the laboratory and a clinical examination [15, 16]. An interview was carried out by one of the two specially trained nurses of the research team, and it comprised demographic data and data on multiple items of the participant's physical, mental and social health. Weight and height were measured. Blood pressure was measured with a mercury sphygmomanometer after a 5-min rest with the subject in a sitting position. The mean value of 2 measurements was used. The participants were also asked to report all prescription medications used during the previous 7 days (both regular drugs and drugs taken when needed), and prescription forms and drug containers were checked. A close informant or nursing staff were interviewed if a participant was unable to provide information. Medications were coded according to the Anatomical Therapeutic Chemical (ATC) classification system recommended by the World Health Organization [17]. If a person was entitled to special refund of costs of medications from the Finnish National Health Insurance (NHI), it was recorded. The Health Insurance Scheme covers all permanent residents of Finland, all prescription medicines and some over-the-counter medicines when prescribed by a physician. Special drug reimbursements are paid for medication of 43 defined chronic illnesses, and to be eligible to receive

these the patient must obtain a certificate from his or her doctor to confirm the nature of the illness and the need for medication.

During the visit to the laboratory, blood specimens for numerous laboratory tests were drawn after a 12-hour fast. The laboratory analyses were carried out in the Central Laboratory of Turku University Hospital. A 12-lead resting electrocardiogram was taken and ECG findings were coded according to the Minnesota code for resting ECG [18].

Research physicians (M.L. or R.I.), both experienced general practitioners, reviewed the primary-care medical records of the participants for the maximum time found, and registered medications used and all diagnosed diseases and other relevant medical conditions. Diagnoses were coded according to the 10th revision of the International Statistical Classification of Diseases and Related Health Problems [19]. They also carried out clinical examinations, in which all information from the interviews and medical records as well as the results of the laboratory tests were available. Medications used by the participants were reviewed again in the examinations. People living in institutions or being treated in hospitals during the study were examined in the respective places. Thirty-nine home visits were also made.

Diagnostic Criteria for Cardiovascular Diseases

Hypertension. The person had the diagnosis in the medical records and/or was entitled to reimbursements from the NHI for hypertension medication and/or had systolic blood pressure ≥ 160 mm Hg and/or diastolic blood pressure ≥ 100 mm Hg.

Coronary Heart Disease. The person had the diagnosis in the medical records and/or had a history of coronary by-pass operation or angioplasty and/or was entitled to reimbursements from the NHI for CHD medication and/or had ischaemic ECG findings (major/moderate Q/QS item as a sign of myocardial infarction, and/or a minor Q/QS item, S-T depression, T wave inversion or left bundle branch block as a sign of possible CHD).

Congestive Heart Failure. The person had the diagnosis in the medical records and/or was entitled to reimbursements from the NHI for CHF medication.

Atrial Fibrillation. The person had the diagnosis in the medical records and/or had AF at ECG.

Stroke. The person had the diagnosis in the medical records and/or had a subjective history of stroke with neurological symptoms persisting for more than 24 h, verified in the clinical examination.

Hypercholesterolaemia. The person had the diagnosis in the medical records and/or was treated with lipid-lowering agents (ATC code C10) and/or had a fasting serum total cholesterol concentration ≥ 6.5 mmol/l.

Diabetes. The person had the diagnosis in the medical records and/or was treated with antidiabetic agents (ATC code A10) and/or had a fasting plasma glucose level ≥ 7.0 mmol/l.

Cardiovascular medications were defined as ATC groups C01 (cardiac glycosides, anti-arrhythmics, nitrates), C02 (antihypertensives), C03 (diuretics), C04 (peripheral vasodilators), C07 (β -blockers), C08 (calcium channel blockers), C09 (ACE inhibitors, angiotensin II receptor blockers), C10 (lipid-lowering agents) and B01 (antithrombotic agents).

Diagnostic Procedures for Dementia

A 2-stage design was applied to assess the occurrence of dementia [15, 16]. First, the Mini Mental State Examination was

Table 1. Prevalence (%) of cardiovascular diseases in a population aged ≥ 75 by dementia status

Cardiovascular disease	Persons with dementia (n = 94)	Persons without dementia (n = 368)	p value	OR
Hypertension	51.1	66.9	0.022	0.55 (0.34–0.92)
CHD	57.5	50.5	0.484	1.19 (0.73–1.95)
CHF	23.4	12.2	0.158	1.57 (0.84–2.94)
AF	21.3	12.0	0.045	1.93 (1.02–3.66)
Stroke	37.2	7.6	<0.001	7.25 (3.88–13.70)
Hypercholesterolaemia	26.6	29.9	0.453	1.25 (0.70–2.22)
Diabetes	18.1	16.3	0.587	1.19 (0.63–2.27)

OR and 95% CI (in parentheses) for persons with dementia after adjustment for age and sex. p values calculated using logistic regression analysis.

performed to screen cognitive functioning, and the cut-off point of 23/24 was used for further evaluation. Persons with a Mini Mental State Examination sum score of 24–30 having a previous history of a dementing disorder in their medical records or clinical suspicion of dementia in the interview or clinical examination were also included in the second stage. In the case of institutionalised or hospitalised patients, caregivers or nursing staff were interviewed. The interview was semi-structured and covered the items of the Hachinski Ischaemic Scale [20] and the Clinical Dementia Rating (CDR) Scale [21]. The latter was used to stage the severity of the dementia. Finally, dementia was assessed in the clinical examination according to the DSM-IV criteria [22], the diagnosis of possible Alzheimer's disease according to the NINCDS-ADRDA criteria [23] and the diagnosis of possible vascular dementia according to the NINDS-AIREN criteria [24]. In cases of disagreement, a consensus was reached between the research physicians and the geriatrician (I.R.).

Statistical Analyses

The χ^2 , Mann-Whitney U or two-sample t test was used to compare the characteristics of cardiovascular patients with and without dementia. The associations between dementia and the cardiovascular medication use in specific diseases were analysed using binary logistic regression with adjustment for age and sex. Multivariate logistic regression was applied to investigate the effect of dementia status, age (continuous variable), sex, education, smoking, independence in activities of daily living, stroke, AF, and systolic and diastolic blood pressure (continuous variables) on use of cardiovascular medications (use vs. non-use). The associations between the severity of dementia and the amount of cardiovascular medications (ordinal dependent variable) were analysed using cumulative logistic regression. The results of logistic models were quantified by calculating odds ratios (OR) or cumulative OR with 95% confidence intervals (CI). p values less than 0.05 were considered significant. SAS software, version 8.2 (SAS Institute Inc., Cary, N.C., USA), was used.

Results

Prevalence of Cardiovascular Diseases

At least 1 cardiovascular disease was diagnosed in 409 persons (88.5%). Ninety-four persons (20.3%) were diagnosed as having dementia (40 with Alzheimer's diseases, 35 with vascular dementia, 6 with Parkinson's disease and dementia, 2 with Lewy body dementia, 2 with hydrocephalus and 9 with varying aetiologies). Nine demented and 44 non-demented participants did not have any of the cardiovascular diseases, 19 and 91 had one, 22 and 119 had two, 22 and 77 had three, 18 and 29 had four, 4 and 5 had five, and 0 and 3 had six cardiovascular diseases, respectively. Demented persons were more likely to have AF (OR 1.93; 95% CI 1.02–3.66) and stroke (OR 7.25; 95% CI 3.88–13.70), and less likely to have hypertension (OR 0.55; 95% CI 0.34–0.92) than their age- and sex-matched controls (table 1).

Characteristics of Cardiovascular Patients

Of the 409 patients with cardiovascular diseases, 85 persons had concomitant dementia: 38 persons mild, 22 moderate and 25 severe dementia. Demented cardiovascular patients were older than non-demented ones, and more than half of them were in long-term institutional care (table 2). The demented ones had lower blood pressure levels and they also used more medications.

Most Common Medications

When compared with non-demented patients, demented cardiovascular patients used significantly more antidepressants, minor analgesics, opioids, sulphonamides and trimethoprim, and fewer non-steroidal anti-inflammatory drugs after adjustment for age and sex (ta-

Table 2. Characteristics of patients with cardiovascular diseases by dementia status

Characteristic	Cardiovascular patients with dementia (n = 85)		Cardiovascular patients without dementia (n = 324)	
	n	%	n	%
Women	59	69	212	65
Widowed, divorced or unmarried	66*	78	184	57
Six years or less of education	66	78	222	69
Living in institution	45**	53	3	1
Current smoker	4	5	14	4
Serum cholesterol level ≥ 6.5 mmol/l	22	26	84	26
	Mean	SD	Mean	SD
Age, years	84.4**	5.7	79.8	4.4
MMSE sum score ¹	14.9**	7.7	27.1	2.5
ADL sum score ²	2.6**	1.8	4.8	0.6
IADL sum score ³	1.6**	2.5	7.2	2.3
Body mass index	23.5**	4.9	26.9	4.6
Systolic blood pressure, mm Hg	148**	27	164	23
Diastolic blood pressure, mm Hg	75*	14	81	11
Number of medications in use	6.2*	3.4	5.0	3.3
Number of cardiovascular diseases ⁴	2.6	1.2	2.2	1.1
Number of diagnoses in medical records	8.8*	3.4	7.3	3.2

* $p < 0.05$, ** $p < 0.001$.

¹ Mini Mental State Examination, range 0–30; a higher score indicates better cognitive functioning.

² Five items of the Activities of Daily Living, range 0–5; a higher score indicates better performance.

³ Nine items of the modified Instrumental Activities of Daily Living, range 0–9; a higher score indicates better performance.

⁴ Hypertension, CHD, CHF, AF, stroke, hypercholesterolaemia and diabetes.

ble 3). Polypharmacy (more than 5 medications) was more common among the demented (59 vs. 38%; $p = 0.002$). Of the demented and non-demented cardiovascular patients, 16 and 77 did not use any of the cardiovascular medications defined in this study, 40 and 124 used 1–2 medications, 23 and 86 used 3–4 medications, and 6 and 37 used 5–8 medications, respectively.

Medications in Cardiovascular Diseases

After adjustment for age and sex, two statistically significant differences were found in cardiovascular medication use: fewer demented hypertensive patients were treated with β -blockers compared to non-demented hypertensive patients, and fewer demented stroke patients received antithrombotic medication compared to non-demented stroke patients (table 4).

Associations between Dementia and the Use of Cardiovascular Medications

In multivariate analyses, the OR for demented cardiovascular patients receiving any cardiovascular medication (use vs. non-use) was 0.31 (95% CI 0.12–0.82) when compared to non-demented patients (table 5). There was no association between dementia and use of any specific medication used for cardiovascular diseases. Stroke and AF were associated with the use of antithrombotic agents and any cardiovascular medication. Stroke, AF, higher diastolic blood pressure and female sex were associated with the use of diuretics.

Amount of Cardiovascular Medications by Severity of Dementia

To study the association between severity of dementia and the number of cardiovascular medications in use (categorised as 0, 1–2, 3–4 or ≥ 5 medications), a multi-

Table 3. The most frequently used medications (with more than 6% users) by demented and non-demented cardiovascular patients according to the ATC classification index

Medication and ATC code	Cardiovascular patients with dementia (n = 85)		Cardiovascular patients without dementia (n = 368)	
	n	%	n	%
Antithrombotic agents (B01A)	34	40.0	113	34.9
NSAIDs (M01A)	19*	22.4	111	34.3
Potassium-sparing diuretics (C03E)	31	36.5	93	28.7
Nitrates in ischaemic heart disease (C01D)	23	27.1	95	29.3
β -Blockers (C07A)	13	15.3	88	27.2
Hypnotics and sedatives (N05C)	23	27.1	74	22.8
Anxiolytics (N05B)	17	20.0	51	15.7
Cardiac glycosides (C01A)	18	21.1	36	11.1
Antidepressants (N06A)	29**	34.1	22	6.8
Calcium antagonists, cardioselective (C08D)	9	10.6	40	12.4
ACE inhibitors (C09A)	5	5.9	41	12.7
Minor analgesics and antipyretics (N02B)	15*	17.7	29	9.0
Laxatives (A06A)	18	21.2	22	6.8
Thyroxin (H03A)	12	14.1	27	8.3
Peptic ulcer and reflux drugs (A02B)	14	16.5	25	7.7
Antiglaucoma preparations and miotics (S01E)	6	7.1	31	9.6
Calcium antagonists, angioselective (C08C)	7	8.2	29	9.0
Potassium (A12B)	6	7.1	27	8.3
Antigout preparations (M04A)	6	7.1	27	8.3
Oral antidiabetics (A10B)	8	9.4	24	7.4
Sulphonamides and trimethoprim (J01E)	15**	17.7	16	4.9
Loop diuretics (C03C)	8	9.4	20	6.2
Antipsychotics (N05A)	15**	17.7	13	4.0
Opioid analgesics (N02A)	13*	15.3	15	4.6

The difference between the groups is calculated using logistic regression analysis after adjustment for age and sex. * $p < 0.05$, ** $p < 0.001$. NSAID = Non-steroidal anti-inflammatory drug.

variate logistic regression analysis was carried out with the same independent factors as earlier. The cumulative OR for mildly to moderately demented patients receiving a growing number of medications was 0.39 (95% CI 0.20–0.76), and for severely demented ones it was 0.50 (95% CI 0.19–1.34).

In order to estimate if there were more previously unrecognised (and thus untreated) cardiovascular diseases in demented elderly subjects explaining their cardiovascular undermedication, the sum of 'new' cases of hypertension, CHD, AF, stroke, hypercholesterolaemia and diabetes first diagnosed in this study was counted (data not shown). After adjustment for age and sex, there was no statistically significant difference found between the groups ($p = 0.211$).

Discussion

Cardiovascular multimorbidity was common among the aged. Demented cardiovascular patients were prescribed less evidence-based cardiovascular medications for treatment of cardiovascular diseases than non-demented patients. Even mildly to moderately demented cardiovascular patients received less intensive treatment. Demented stroke patients were treated more seldom with antithrombotic agents, and demented hypertensive patients more seldom with β -blockers than patients without dementia. Overall medication of cardiovascular diseases was suboptimal in both demented and non-demented older people.

The strength of our study lies in direct structured assessments of both dementia and cardiovascular diseases. The population-based setting with high participation

Table 4. Numbers of patients with cardiovascular diseases, and numbers and percentages of those using cardiovascular medications by dementia status

Medical condition and medication	Cardiovascular patients with dementia (n = 85)		Cardiovascular patients without dementia (n = 324)		p value	OR (95% CI)
	n	%	n	%		
Hypertension	n = 48		n = 246			
Diuretics	19	40	101	41	0.503	0.79 (0.40–1.57)
β-Blockers	6	13	72	29	0.045	0.38 (0.15–0.98)
Calcium channel blockers	11	23	57	23	0.853	0.93 (0.42–2.04)
ACE inhibitors	5	10	39	16	0.673	0.80 (0.28–2.27)
CHD	n = 54		n = 186			
Acetylsalicylic acid	17	31	54	29	0.650	1.18 (0.58–2.39)
β-Blockers	12	22	62	33	0.341	0.69 (0.33–1.47)
Calcium channel blockers	11	20	43	23	0.609	0.81 (0.36–1.81)
ACE inhibitors	3	6	33	18	0.096	0.34 (0.09–1.21)
Nitrates	21	39	87	47	0.135	0.60 (0.30–1.17)
CHF	n = 22		n = 45			
ACE inhibitors	2	9	14	31	0.393	0.45 (0.07–2.78)
Diuretics	19	86	33	73	0.377	1.97 (0.44–8.85)
Cardiac glycosides	9	41	19	42	0.523	0.68 (0.21–2.20)
β-Blockers	4	18	10	22	0.884	1.11 (0.26–4.69)
AF	n = 20		n = 44			
Warfarin	5	25	19	43	0.262	2.65 (0.48–14.49)
Any antithrombotic agent (including warfarin)	9	45	25	57	0.180	2.88 (0.61–13.51)
Stroke	n = 35		n = 28			
Any antithrombotic agent (including warfarin)	19	54	24	86	0.041	0.26 (0.07–0.94)
Hypercholesterolaemia	n = 25		n = 110			
Lipid-lowering agents	1	4	16	15	0.546	0.512 (0.06–4.54)
Diabetes	n = 17		n = 60			
Acetylsalicylic acid	4	24	17	28	0.199	0.36 (0.07–1.71)
ACE inhibitors	3	18	8	13	0.334	2.28 (0.42–12.20)

OR and 95% CI for patients with dementia after adjustment for age and sex. p values calculated using logistic regression analysis.

rate and the inclusion of institutionalised people are also major advantages.

However, we do recognise potential limitations:

The diagnosis of dementia was clinical; neither an elaborate neuropsychological testing battery nor brain imaging were carried out. In order to strengthen the accuracy of the dementia diagnosis, we used the CDR scale as an instrument for staging the severity of dementia. The CDR scale has earlier been shown to be suitable for clinical screening of dementia in a Finnish elderly population [25].

A major limitation is also that we lacked data on cardiovascular patients' consultation rates, which may have contributed to the prescription of cardiovascular medications. In order to estimate this possible bias, we investigated the sum of earlier undiagnosed (and thus untreated) cardiovascular diseases but discovered no difference between the demented and non-demented patients. A further limitation is that we did not have data on compliance or the exact indications of prescribed cardiovascular medications. However, we clarified the medication use as best as we could. Among demented cardiovascular pa-

Table 5. Independent variables associated with the use of selected medications (use vs. non-use) in patients with cardiovascular diseases

Variable	Any cardiovascular medication ¹	Any antithrombotic agent	β -Blockers	ACE inhibitors	Lipid-lowering agents	Diuretics
Dementia	0.31 (0.12–0.82)	0.63 (0.29–1.35)	0.51 (0.22–1.19)	0.51 (0.15–1.69)	0.50 (0.04–5.75)	0.72 (0.34–1.52)
Age ²	0.98 (0.91–1.05)	0.98 (0.93–1.04)	1.05 (0.99–1.11)	1.07 (0.98–1.16)	1.16 (0.98–1.36)	1.02 (0.97–1.07)
Male sex	0.64 (0.36–1.14)	1.56 (0.95–2.55)	0.97 (0.58–1.63)	1.82 (0.97–3.45)	1.47 (0.57–4.13)	0.55 (0.34–0.91)
>6 years of education	0.98 (0.55–1.74)	0.86 (0.52–1.42)	1.38 (0.81–2.34)	0.46 (0.25–0.86)	0.82 (0.29–2.37)	0.84 (0.51–1.37)
Current smoker	0.62 (0.14–2.68)	0.82 (0.26–2.57)	1.05 (0.31–3.56)	0.93 (0.23–3.71)	0.81 (0.09–7.32)	1.25 (0.37–4.27)
Independent in ADL	2.42 (0.87–6.71)	0.77 (0.36–1.67)	0.86 (0.39–1.91)	0.61 (0.19–1.94)	0.28 (0.02–3.38)	1.81 (0.87–3.75)
Stroke	11.90 (2.65–52.63)	7.58 (3.65–15.87)	1.11 (0.52–2.37)	1.88 (0.74–4.81)	2.65 (0.64–10.87)	2.16 (1.06–4.41)
AF	25.64 (3.39–200.00)	2.95 (1.62–5.38)	1.57 (0.84–2.94)	2.03 (0.94–4.39)	1.33 (0.35–5.05)	3.18 (1.69–5.95)
Systolic blood pressure	1.02 (0.99–1.02)	1.00 (0.99–1.01)	1.01 (0.99–1.02)	1.01 (0.99–1.03)	1.01 (0.98–1.04)	1.00 (0.99–1.02)
Diastolic blood pressure	1.05 (1.02–1.09)	1.01 (0.99–1.04)	1.01 (0.98–1.04)	1.01 (0.98–1.05)	1.02 (0.96–1.09)	1.05 (1.02–1.08)

OR and 95% CI (in parentheses) from multivariate logistic regression analysis including all the variables shown. ADL = Activities of daily living, i.e. bathing, toileting, dressing, eating and getting out of bed; dichotomised as independent in all/dependent in 1 or more items.

¹ ATC classification groups C01, C02, C03, C04, C07, C08, C09, C10, B01.

² For continuous variables the OR are given per 1-unit increase.

tients, systolic and diastolic blood pressure levels were lower, and the mean age was higher than among non-demented patients. In order to control these, we used logistic models adjusted for age and sex when comparing medication use between the groups, and in the multivariate analysis, we controlled systolic and diastolic blood pressures along with other variables.

When the diagnoses of CHF are based on clinical findings, false-positive cases are common in primary care [26]. Minor ischaemic changes on ECG, which were used as a sign for possible CHD in this study, are common also in older people with left ventricular hypertrophy and in digoxin users [27]. These two confounding factors may have caused an underestimation of the actual treatment of CHF and CHD, and may have skewed our results between demented and non-demented patients. Finally, this is a study of an old population living in south-western Finland and may not be representative of other populations where drug prescribing and non-prescribing patterns may be different.

Despite the sevenfold overpresentation of stroke in demented persons they were treated less intensively: only half of them received antithrombotic therapy compared to 86% of non-demented stroke patients. Prevention of stroke is also important in demented patients in the light of earlier findings: stroke plays an additive role in cognitive decline in patients with prestroke cognitive impairment [10, 12, 13, 28], and dementia prior to first-ever stroke is associated with severer stroke [29], which, in turn, predicts a poorer outcome and dependency after 1 year [28]. Long-term oral anticoagulation is recommend-

ed for patients with AF for secondary prevention of stroke [30]. In our material, less than half of AF patients without dementia, and only one fourth of those with dementia received oral anticoagulant therapy. Only slightly more than half of all AF patients received any kind of antithrombotic drug therapy. A community-based study in Sweden showed that recurrence of stroke was associated with prestroke dementia [28]. Our findings and earlier reports [8] suggest that insufficient secondary prevention of stroke in demented patients could be one explanation for this.

Why do doctors then fail to prescribe antithrombotics to their demented patients? Caution may be one explanation: demented elderly subjects are known to have an increased risk of trauma, which was also found in our Lieto study [16]. Cerebral amyloid angiopathy, which occurs in normal ageing but also in up to 80% in Alzheimer's disease (in association with neurofibrillary tangles) is increasingly being regarded as a cause of spontaneous non-hypertensive intracerebral haemorrhage in the aged [31, 32]. Also the increased risk of intracranial bleeding or subdural haematoma associated with brain atrophy [33] is an issue to be remembered while prescribing aspirin and related drugs to cognitively impaired patients.

Patients with CHD were undertreated: less than a third used acetylsalicylic acid or β -blockers, and only 15% ACE inhibitors. Our finding is in concordance with another Finnish population-based study, which also showed suboptimal use of several evidence-based cardiovascular drugs by elderly CHD patients [2]. In Sweden in

1997–1998, cognitively impaired cardiovascular patients were prescribed fewer β -blockers than their cognitively intact counterparts [1]. Despite not having the power to show a significant difference in the use of β -blockers between the demented and non-demented CHD patients (in 22 vs. 33%, respectively), we found that β -blockers were used more seldom for treatment of hypertension in demented patients. Again, the explanation for this lesser use of β -blockers may be caution when medications which can provoke bradycardia and cardiac arrhythmias leading to syncope are prescribed to demented elderly patients. This is probably true especially in patients with Lewy body dementia or Parkinson's disease with dementia (altogether 8 patients found in this study), where autonomic dysfunction with hypotension and syncopal episodes are very common [34]. However, in the Lieto study, dementia did not predict lower use of β -blockers in multivariate analysis.

The treatment of cardiac heart failure was conservative, being based mainly on diuretics. Only 9% of demented and 31% of non-demented CHF patients received ACE inhibitors, the cornerstone of the CHF drug therapy [35]. In a large study of over 86,000 CHF patients in long-term care in the USA (mean age 85 years), only 25% received ACE inhibitors, and especially demented patients were more likely to be non-treated [6]. In this study, however, dementia did not predict lower use of ACE inhibitors, but the number of CHF patients was small.

While demented elderly subjects were left without many evidence-based medications for cardiovascular diseases, at the same time significantly more drugs were prescribed for them than for their non-demented counterparts. More than half of the demented patients were exposed to well-known dangers of polypharmacy: possible adverse drug effects [14, 36] and inappropriate prescribing [37]. We have earlier reported that demented persons had higher rates of diagnosed psychotic disorders, stroke, transient ischaemic attack, Parkinson's disease, hip and other fractures and osteoporosis, and lower rates of sleeping disorders, glaucoma, presbycusis and arthrosis of the hip or knee [16]. This background morbidity explains some differences in general drug use between the groups, but not all. The wide use of psychotropics was remarkable in the demented elderly subjects: over 61% of them were on antidepressants, hypnotics, sleeping pills and/or antipsychotics compared to 36% of the non-demented ones. We hypothesise that undertreated medical illnesses, such as CHD or CHF in unsatisfactory balance, may produce behavioural symptoms in patients with impaired communication abilities,

which in turn are treated with more psycho-active drugs. The simultaneous over- and undermedication discloses that prescription patterns for demented patients are not necessarily adequately focused. In the future, more analytic studies on the quality of drug therapies – including also undermedication – in the demented elderly are needed.

More evidence is showing many vascular risk factors (hypertension, smoking, elevated serum cholesterol levels, diabetes, elevated homocysteine levels and cardiac abnormalities, especially AF) to be common for vascular dementia and Alzheimer's disease, the two most common causes of dementia [10, 12]. In order to delay or even prevent dementia, the timely management of these risk factors is of growing interest in ageing societies. In the oldest population, however, the impact of vascular risk factors is different [38–40], and for example elevated serum cholesterol levels are found to associate with a protective effect for the development of dementia in people aged 75 years or more [38]. Convincing evidence that cognitive decline can be prevented by cardiovascular risk management in the oldest population with high cardiovascular morbidity is missing so far [39–41]. A Finnish multifactorial cardiovascular disease prevention study in patients aged 75 years or more (the Drugs and Evidence-Based Medicine in the Elderly, DEBATE) has shown promising results that drug treatment of cardiovascular diseases can be improved without adverse effects on the quality of life of patients, and that some vascular risk factors can be reduced at the 1-year follow-up [42]. To what extent the optimum treatment of cardiovascular diseases can prevent older patients' cognitive decline (one of the secondary end points of the DEBATE study), and whether it is cost-effective, is to be seen [43]. The need of further prospective studies in this field is obvious.

Unfortunately, the cross-sectional design of this study does not allow us to draw any causal conclusions whether the less intensive treatment of cardiovascular risk conditions was a cause or a consequence of dementia. Aged, severely demented and institutionalised patients may be considered to be beyond all cardiovascular disease prevention strategies. We hypothesise that undermedication in all cases is not explained by possible nihilism or neglect as we know that more than half of the patients found to be demented in the Lieto study were not diagnosed by their own doctors to have dementia [15]. Prescribing medication for elderly people always requires weighing the potential benefits against the burdens imposed by the treatment [36, 44]. Nonetheless, we claim that a more adequate management of cardiovascular

symptoms even in severely demented people can increase the well-being of these dependent patients. In patients with mild or moderate dementia, cardiovascular risk conditions should be treated according to evidence-based recommendations as a part of the attempts to maintain cognitive and functional abilities and to delay institutionalisation.

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