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High fall incidence and fracture rate in elderly dialysis patients

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ABSTRACT

Background: Although it is recognised that the dialysis population is ageing rapidly, geriatric complications such as falls are poorly appreciated, despite the many risk factors for falls in this population. The objective of this study was to determine the incidence, complications and risk factors for falls in an elderly dialysis population.

Methods: A one-year observational study of chronic dialysis patients aged ≥ 70 years. At baseline, patient characteristics were noted and during follow-up the vital parameters and laboratory values were recorded. Patients were questioned weekly about falls, fall circumstances and consequences by trained nurses.

Results: 49 patients were included with a median age of 79.3 years (70-89 years). During follow-up 40 fall accidents occurred in 27 (55%) patients. Falls resulted in fractures in 15% of cases and in hospital admissions in 15%. In haemodialysis (HD) patients, the mean systolic blood pressure (SBP) before HD was lower in fallers compared with non-fallers (130 vs. 143 mmHg). Several patients in the lower blood pressure category received antihypertensive medication. For every 5 mmHg lower SBP (before HD) the fall risk increased by 30% (hazard ratio (HR) 1.30, 95% CI 1.03-1.65, p = 0.03). Furthermore, fall risk increased by 22% for every 10 pmol/l rise of parathyroid hormone (HR 1.22, 95% CI 1.06-1.39, p = 0.004).

Conclusions: Elderly dialysis patients have a high incidence of falls accompanied by a high fracture rate. Given the high complication rate, elderly patients at risk of falling should be identified and managed. Reduction of blood pressure-lowering medication might be a treatment strategy to reduce falls.

KEYWORDS

Falls, elderly, geriatric, fracture, dialysis

INTRODUCTION

The dialysis population is ageing rapidly in Western Europe and North America.[1-4] An ageing dialysis population is associated with specific geriatric issues such as falls.[5] Falls result in more need for long-term institutional care, functional decline and hospitalisations.[6-9] In the Netherlands, the numbers of fall-related hospital admissions among older adults more than doubled between 1981 and 2008.[10] For community-dwelling adults aged ≥ 65 years the annual fall incidence is 30%, and 15% of them fall at least twice a year.[11-13] The elderly dialysis population forms a high-risk population given the high prevalence of risk factors for falls, such as polypharmacy, multiple comorbidities including diabetes mellitus and cardiovascular disease, peripheral neuropathy, autonomic dysfunction, orthostatic hypotension, functional decline and cognitive impairment.[14-19] Nevertheless, falls in elderly dialysis patients is a poorly studied topic. Only two longer term (one year) and two shorter term (6 months) prospective studies have been performed to investigate the fall rate in the haemodialysis (HD) population. These studies suggested a fall rate of 26-47% in HD patients of different age categories,[20-23] and an increased risk of death in subjects who experienced one or more falls.[23,24]

Because of the high fall rate in the elderly dialysis population compared with the normal population and the associated adverse consequences, it is important to determine potential modifiable risk factors to define preventive strategies. We therefore started a two-centre prospective study to determine the incidence of falls and complications in an elderly HD and peritoneal dialysis (PD) population, and to identify potential modifiable risk factors for falls.

MATERIALS AND METHODS

Study participants

A prospective observational cohort study design was used for this two-centre study. All patients aged ≥ 70 years on

1 January 2011 who were receiving chronic HD or PD therapy were approached to participate in the study. The study was deemed exempt of review by the Institutional Review Board of the hospital, because of the non-interventional study design and no extra burden for the patients to be included.

Baseline assessment

Patient characteristics were collected at baseline using a formal study protocol. Data about medical history, comorbidities, causes of end-stage renal disease, type of dialysis, hours and frequency of dialysis, and medication use were abstracted from electronic chart records at baseline. Data abstraction of comorbidities was structured according to pre-specified categories, based on their known association with fall risk. The same structured method was applied for medication use, using pre-specified categories of medication that are specifically related to dialysis (phosphate-binding medication, vitamin D), or related to a higher risk of falls (all other medication categories). A structured interview with each participant was performed to record living circumstances, self-reported cognitive status (i.e. memory complaints, yes or no), fall risk factors (e.g. problems with keeping balance, yes or no) and functional status. A Barthel index measuring ten basic aspects of self-care and physical dependency was recorded.[25,26] The score ranges from 0-20, with a score of 20 meaning no limitations in activities of daily living (ADL).

Follow-up

During the follow-up of one year, vital parameters (blood pressure, heart rate, weight before and after HD, and ultrafiltration volume) were recorded on a monthly basis for routine clinical evaluation. Haemoglobin, haematocrit, creatinine, albumin, calcium, and phosphate were also recorded every month, and parathyroid hormone and 25-OH vitamin D every three months. These data were abstracted from the electronic records. Participants were monitored for accidental falls using weekly interviews in the HD units by trained dialysis nurses. The PD patients were interviewed weekly by telephone and after three months on a monthly basis. Details of falls were recorded using a pre-specified form including time, circumstances, pre-fall symptoms, (un)consciousness, injuries and any healthcare attention sought.

Definition of a fall and fall characteristics

A fall was defined as an event which resulted in a person coming to rest inadvertently on the ground or another lower level and can, for example, be due to stumbling, loss of balance, or loss of consciousness due to syncope. A fall as a consequence of paralysis as in stroke or an epileptic seizure was not included in the definition. Complications of falls were categorised in no complications, major complication (defined as a fracture), death, and minor complications (all other complications). Falls in HD patients were categorised as occurring on 'a non-HD day, 'a HD day before a HD session', or 'a HD day after a HD session'. The location of falls was categorised as at home, outside home or elsewhere.

Statistical analysis

Demographic data were summarised using the mean and standard deviation (SD) for normal distributed continuous variables, the median and interquartile range (IR) for non-normal distributed continuous variables, and percentages for categorical data. For the analyses of non-baseline measured variables, i.e. laboratory measures and dialysis-related measurements, mean values were calculated of the whole follow-up period (non-fallers), or until the first fall incident in fallers. We performed a sensitivity analysis by exclusively using the last measurement before a fall of the non-baseline measured variables in fallers. Univariate comparisons of baseline characteristics between fallers and non-fallers were made using the independent t-test or Mann-Whitney test for continuous variables. Categorical variables were analysed by univariate comparisons between fallers and non-fallers using the Fisher's exact test.

Fall incidence was determined as the number of falls that occurred during the study divided by person-years of follow-up. Potential risk factors were chosen a priori, based on acknowledged risk factors for falls in the general population, or were selected as potential dialysis-specific risk factors. Potential risk factors were first tested in a standard univariate analysis. To analyse the primary outcome (time to the first fall accident) all potential risk factors reaching a p value ≤ 0.10 were included in a multivariate Cox regression survival model. Potential risk factors were analysed stepwise in the survival analysis: 1. unadjusted; 2. adjusted for age and gender; 3. adjusted for age, gender and the other potential risk factors. Cox regression survival analysis was checked for the proportional hazard assumption. Patients who fell only once were compared with frequent fallers using a t-test or Mann-Whitney test for continuous variables and Fisher's exact test for categorical variables. All statistical analyses were performed using SPSS version 20. A p value of less than 0.05 was considered to be significant.

RESULTS

Study population

Forty-nine patients were asked to participate and all of them gave written consent. Baseline characteristics of the participating patients are presented in *table 1* overall, and stratified for fall status during follow-up. Of the 49 mainly Caucasian participants, with a median age of 79.3 years (range 70-89), 42 (86%) patients received HD and seven patients PD. One-third (16) of the patients reported

Table 1. *Baseline characteristics*

	All patients (n = 49)	Fallers (n = 27)	Non-fallers (n = 22)	P[a]
Mean age at start of study (± SD)	79.1 ± 4.4	79.0 ± 4.5	79.3 ± 4.5	0.83
Men (%)	35 (71%)	19 (70%)	16 (73%)	0.56
Type of RRT - Haemodialysis - Peritoneal dialysis	 42 7	 22 5	 20 2	 0.44
Mean duration on RRT in months (SD)	35.7 ± 32.9	38.4 ± 33.4	32.4 ± 32.9	0.73
Living circumstances - Own residency, independent - ADL and/ or IADL help - Nursing home	 19 25 5	 9 (33%) 16 (59%) 2 (7%)	 10 (46%) 9 (41%) 3 (14%)	 0.42
Cause of end-stage renal disease - Vascular - Glomerular - Interstitial - Urological - Unknown	 34 4 7 3 1	 20 (74%) 3 (11%) 3 (11%) - 1 (4%)	 14 (63%) 1 (5%) 4 (18%) 3 (14%) -	 0.22
History of - Diabetes mellitus - Hypertension - Cardiovascular disease - Peripheral vascular disease - Cerebrovascular disease - Polyneuropathy - Visual impairment - Movement disorders - History of depression	 17 30 32 6 10 5 2 10 4	 10 (37%) 17 (63%) 20 (74%) 2 (7%) 5 (19%) 2 (7%) - 5 (19%) 2 (7%)	 7 (32%) 13 (59%) 12 (55%) 4 (18%) 5 (23%) 3 (14%) 2 5 (23%) 2 (9%)	 0.77 1.0 0.23 0.39 0.74 1.0 0.20 0.74 1.0
Barthel ADL score, mean (IR)[b]	19 (2)	19 (2)	19 (2)	0.75
Subjective cognitive deficits (%)	16	9 (33%)	7 (32%)	1.0
Subjective depressive symptoms (%)	7	2 (7%)	5 (23%)	0.22
Subjective visual impairment (%)	9	5 (19%)	4 (18%)	1.0
Nutritional supplements (%)	14	7 (26%)	7 (32%)	0.76
Falls last year	13	8 (30%)	5 (23%)	0.75
Difficulties with - Balance - Walking - Standing up	 22 33 25	 14 (52%) 19 (70%) 14 (52%)	 8 (36%) 14 (64%) 11 (50%)	 0.39 0.76 1.0
Use of walking aid - None - Walking aid[#] - Wheel chair bound	 31 (63%) 15 (31%) 3	 16 (59%) 10 (37%) 1 (4%)	 15 (68%) 5 (23%) 2 (9%)	 0.46
Fear to fall	13	8 (30%)	5 (23%)	0.75
Alcohol consumption - None - 1-4 portions/ month - 1-4 portions/ week - 1-4 portions/ day	 30 3 4 12	 19 (70%) 1 (4%) 2 (7%) 5 (19%)	 11 (50%) 2 (9%) 2 (9%) 7 (32%)	 0.58
Medication use - ACE-i or ARBs - Beta blockers - Calcium channel blockers - Nitrates - Diuretics - Benzodiazepines - Opiates - Phosphate binding medication - Vitamin D - Active vitamin D	 17 28 20 8 21 19 8 38 15 42	 11 (41%) 14 (52%) 10 (37%) 6 (22%) 12 (44%) 9 (33%) 5 (19%) 21 (78%) 6 (22%) 23 (85%)	 6 (27%) 14 (64%) 10 (46%) 2 (9%) 9 (41%) 10 (46%) 3 (14%) 17 (77%) 9 (41%) 19 (86%)	 0.38 0.56 0.57 0.27 1.0 0.56 0.72 1.0 0.22 1.0

RRT = renal replacement therapy; ACE-I = angiotensin converting enzyme inhibitor; ARB = angiotensin receptor blocker; ADL= basic activities of daily living; IADL= instrumental activities of daily living; # walking aid includes holding onto a subject for support; [a] P values calculated by independent samples T-test, Mann-Whitney test, Fisher's exact or chi-square to compare fallers vs. non-fallers; [b] median value and interquartile range (IR) are given because of skewed distribution.

memory defects. More than half of the patients received help with ADL or instrumental ADL activities. After two months, one patient crossed over from PD to HD, and after 11 months a patient crossed over from HD to PD. In the analysis of blood pressure, heart rate, and ultrafiltration volume, both patients who crossed over were included in the HD group because they received HD most of the study year.

Follow-up of the study population

Four (8%) patients died (mean follow-up 6.8 months), and 12 (25%) patients were admitted at least once to the hospital for mainly acute care. Three patients (6%) moved from their residence to a care facility or nursing home.

Fall incidence

During the one-year follow-up period, 27 of 49 patients (55%) fell at least once. Of these fallers, 11 (41%) patients had multiple falls (range 2-3). Overall the fall incidence was 40 falls in 49 patients with 47.2 person-years of follow-up, an average of 0.85 falls/person-years of follow-up. In fallers, the fall incidence was 40 falls in 27 patients with 26.4 person-years of follow-up, an average of 1.51 falls/persons-year follow-up.

Fall characteristics

Twenty-three falls occurred at home, 14 outdoors, two in the dialysis centre and one in a nursing home. In HD patients, most falls (50%) occurred on non-HD days, nine (41%) on a HD day after dialysis and only two falls (9%) occurred on a HD day before dialysis.

Fall-related injuries and consequences

Twenty-one of the 40 (53%) falls were complicated by minor complications (e.g. wounds, bruises or contusions). Six falls (15%) were complicated by fractures (three hip fractures, two ankle fractures, and one wrist fracture). Among fallers, there was a trend that patients who experienced a fracture were longer on dialysis treatment (67.4 months vs. 31.8 months, p = 0.06). No significant differences in complications between HD and PD patients were found. Six of the 40 falls (15%) led to a visit by a general practitioner, 11 (28%) falls led to a hospital visit of which six patients were admitted to the hospital, and one patient sought medical attention in the dialysis unit; so the total number of falls that required medical help was 18 (45%).

Risk factors for falling

Data of medical history, functional status, medication use and vital and laboratory parameters were compared for fallers vs. non-fallers by univariate analysis. A significant difference was found between fallers and non-fallers for mean systolic blood pressure (SBP) before dialysis in HD patients ($p < 0.05$) (*table 2*). Medication use at baseline was compared between fallers and non-fallers as well as the total number of medications, but no significant differences were found. Five medication categories were left out of the analysis, because the number of users was < 5, namely antidepressants, anticonvulsants, digoxin, alpha blockers, and antiarrhythmic medication. A tendency towards a difference in mean parathyroid hormone (PTH) was found; however, this was not significant (p = 0.07). The fall in mean SBP after HD when compared with pre-HD was not significantly different in fallers compared with non-fallers (7 ±16 mmHg vs. 3 ±11 mmHg, p = 0.68). Using Cox regression survival analysis, in the final fully adjusted model every 5 mmHg lower mean SBP before HD increased the risk of falling by 30% (HR 1.30, CI 1.03-1.65, p = 0.03). For every 10 pmol/l higher mean PTH the risk of falling increased by 22% (HR 1.22, CI 1.06 - 1.39, p = 0.004) (*table 3*). In the sensitivity analysis, by using the last measurement before the first fall incident in fallers, the multivariate Cox regression model yielded the same results (SBP before HD: HR 1.17, CI 1.03-1.33, p = 0.02; SBP after HD: HR 0.98, CI 0.88-1.08, p = 0.63; PTH: HR 1.20, CI 1.04-1.38, p = 0.01).

Frequent fallers

Eleven patients (23%) fell more than once. Compared with patients who fell only once, these frequent fallers less often used alfacalcidol (64% vs 100%, p = 0.02) and had a higher median PTH (39.4 pmol/l-IR 60.5 pmol, vs. 22.9 pmol/l-IR 19.8 pmol/l, p = 0.03).

DISCUSSION

The main finding of this observational study among chronic HD and PD patients of ≥ 70 years is that 55% of the patients experienced at least one fall during one year of follow-up. A large number of patients, 41%, had two or more falls. Fifteen percent of the falls were complicated by a fracture. A lower SBP before dialysis (in HD patients) and a higher PTH were identified as risk factors for falling. For every 5 mmHg lower SBP before dialysis the risk of falling increased by 30% and for every 10 pmol/l higher PTH, the risk of falling increased by 22%.

The fall rate of 55% in our population with a mean age of 79 years is high, compared with the one-year fall rate of 32-41% in the community-dwelling elderly aged ≥ 80 years.[9,11,27,28] The fall incidence in our study is more similar to numbers observed in nursing home residents of 50%.[29] In a chronic HD population, Cook *et al.* found a fall rate of 47% over a median of 468 days in patients with a mean age of 74.4 years.[20] Three other prospective studies have been performed among HD patients. First, Roberts *et al.* found that 38% of the 32 patients aged ≥ 65 years fell during six months of follow-up.[21] Second, Desmet

Table 2. *Vital and laboratory measurements during follow-up*

	HD patients (n = 43)[a]	HD - Fallers (n = 23)	HD - Non-fallers (n = 20)	P[b]
Mean SBP before HD (mmHg) (±SD)	136 ± 22	130 ± 19	143 ± 22	0.04
Mean DBP before HD	70 ± 10	68 ± 11	71 ± 10	0.46
Mean SBP after HD	131± 19	127 ± 18	136 ± 19	0.10
Mean DBP after HD	66 ± 12	65 ± 13	67 ± 10	0.61
Mean HR before HD	74 ± 8	75 ± 8	74 ± 9	0.32
Mean HR after HD	76 ± 12	79 ± 13	73 ± 11	0.16
Mean ultrafiltration volume (ml)	1792 ± 582	1927 ± 635	1650 ± 496	0.12
	All patients	**Fallers**	**Non-fallers**	
Laboratory results (mean)				
- Haemoglobin (mmol/l) (±SD)	7.1 ± 0.5	7.1 ± 0.5	7.1 ± 0.4	0.75
- Haematocrit (%)	0.36 ± 0.03	0.36 ± 0.03	0.36 ± 0.02	0.87
- Calcium (mmol/l)	2.32 ± 0.19	2.31 ± 0.24	2.33 ± 0.12	0.75
- Phosphate (mmol/l)	1.66 ± 0.26	1.61 ± 0.29	1.71 ± 0.23	0.21
- Creatinine (µmol/l)	820 ± 223	834 ± 222	802 ± 228	0.62
- Parathyroid hormone (pmol/l)[c]	24.7 (22)	31.2 (28.9)	20.9 (24.2)	0.07
- Albumin (g/l)	33.5 ± 2.9	33.3 ± 2.5	33.7 ± 3.5	0.59
- 25-OH Vitamin D (nmol/l)	78 ± 27	75 ± 30	81 ± 23	0.45

SBP = systolic blood pressure; DBP = diastolic blood pressure; HD = haemodialysis; HR = heart rate; [a] Total of 43 HD patients (1 patient crossed from PD to HD); [b] P values calculated by independent samples T-test or Mann-Whitney test to compare fallers vs. non-fallers; [c] median value and interquartile range are given because of skewed distribution.

Table 3. *Cox regression analyses*

	Model 1 HR (95% CI)	p	Model 2 HR (95% CI)	p	Model 3 HR (95% CI)	p
Mean SBP before dialysis (*per 5 mmHg decrease*)	1.14 (1.01-1.27)	0.03	1.16 (1.02-1.31)	0.02	1.30 (1.03-1.65)	0.03
Mean SBP after dialysis (*per 5 mmHg decrease*)	1.08 (0.98-1.20)	0.14	1.09 (0.98-1.22)	0.12	0.88 (0.72-1.09)	0.24
Mean PTH (*per 10 pmol/l increase*)	1.16 (1.03-1.30)	0.02	1.16 (1.03-1.31)	0.02	1.22 (1.06-1.39)	0.004

SBP = systolic blood pressure; PTH = parathyroid hormone; Model 1 = crude; Model 2 = adjusted for age and gender; Model 3 = adjusted for age, gender and the other potential risk factors (SBP before dialysis, SBP after dialysis, PTH).

et al. found a fall rate of 34% in older HD patients (median age 72.4 years) of the validation unit during six months of follow-up.[22] Third, Abdel-Rahman *et al.* found a fall rate of 38% in 34 older dialysis patients (mean age 74 years) during one year of follow-up.[23] Most likely, the fall rates in Cook's and our study are more representative of the actual fall risk for elderly dialysis patients. The highest fall rate in our study compared with the aforementioned studies is most likely due to the older age of the participants in our study (mean 79 years).

The fracture rate in our study (15%) is high compared with that in community-dwelling elderly people, among which only 4-6% of falls result in fractures.[30] Previously, a fourfold higher incidence of hip fracture among Caucasian patients with end-stage renal disease (ESRD) than would be expected in the general population was reported by Alem *et al.*[31] These authors found an increase in incidence the longer patients were on dialysis, suggesting that there are cumulative exposures since the initiation of renal replacement therapy that predispose patients to a hip fracture. Our results seem to point in the same direction, because we found a trend towards a higher dialysis vintage in patients who experienced a fracture after a fall compared with fallers with minor or no complications. One of the reasons for the high fracture rate might be the decrease in bone mineral density and presence of mineral bone disease among dialysis patients.[32]

An important goal of our study was to identify potential modifiable risk factors of falls. In the HD patients we found that a lower SBP before dialysis was associated with a higher risk of falls. The relation between predialysis SBP and fall risk was also found by Cook *et al.*[20] A relatively low SBP might in itself be a risk factor for falls, but could also be a sign of a worse condition and prognosis in HD patients.[33,34] When the association is causal, SBP might be an easy risk factor to modify when patients are using

BP-lowering medication. Second, review of medication with adaptation of the use of antihypertensive agents, especially in patients with a low blood pressure or patients who have already experienced a fall, might decrease the fall rate in elderly dialysis patients. Of note, there is no literature on a 'safe' systolic blood pressure in elderly ESRD patients regarding fall risk. Studies are therefore needed to elucidate what an optimal systolic blood pressure range would be in elderly dialysis patients.

In our study, among fallers with a mean SBP before HD of ≤ 130 mmHg (n = 10), the mean SBP before HD in fallers, seven of them still used BP-lowering medication. This suggests that medication use in geriatric dialysis patients can be optimised to lower their risk of falls. A second potentially modifiable risk factor is PTH, because we found that a higher PTH is also associated with a risk of falls. Muscle weakness and other neuromuscular symptoms may be present in patients with hyperparathyroidism,[35] and muscle strength and functional capacity have been shown to improve after parathyroidectomy even in 'asymptomatic patients'.[36,37] Third, a higher PTH concentration increased the risk of sarcopenia in the Longitudinal Aging Study Amsterdam.[38] Lowering PTH may therefore be a second treatment goal to lower fall incidence in elderly dialysis patients.

It is remarkable that no differences were found regarding medication use in fallers vs. non-fallers. We expected the use of psychoactive medication to be a risk factor, as is found in other studies.[9,39,40] An explanation might be that we only have baseline medication prescriptions for patients and the use of psychoactive medication might have been changed during the one-year follow-up.

The strengths of this study include the detailed information that was available regarding falls, medication use and complications. Second, in contrast to previous studies on this topic, we used Cox regression analysis to study potential risk factors for falling.[20-23] Because 'time to event' is an important factor when analysing fall risk, Cox regression analysis is to be preferred over logistic regression analysis, since this latter method does not take time-to-event into account. Third, we asked patients about falls frequently, because elderly subjects were often unable to recall falls over a longer period.[41] Fourth, this is the first study of fall incidents in a dialysis population of exclusively elderly patients.

Among the limitations of this study is the relatively small cohort size. However, even in this small cohort we found SBP and PTH as independent associated risk factors. Another limitation concerns self-reported functional status, mobility and cognition. Especially cognitive function impairment might be under-reported, because cognitive impairment often remains unrecognised in elderly dialysis patients.[42] A weakness in our analysis might be multiple testing. However, we studied pre-specified variables that are associated with fall risk in other populations, or dialysis-specific factors that might theoretically increase the risk of falls. Furthermore, only variables reaching a p value ≤ 0.10 were included in the multivariate model. Fourth, only variables collected during follow-up were significant predictors of fall risk. These measurements might be more accurate, as their mean over time was used, instead of the baseline variables that were collected only once. Because of the intrinsic variability in variables, this may result in impaired power to detect significant associations. However, repeated interviews with all of our patients during follow-up were not feasible. In addition, when we performed a sensitivity analysis using only single measurements immediately before a fall incident, similar results were obtained. This suggests that follow-up variables do indeed have more predictive value than baseline variables.

The high fall rate and high fracture rate after a fall that we found may have implications for the medical care of elderly dialysis patients. The elderly dialysis population already experiences a decline in functional status after the start of dialysis and falls increase the risk for further functional decline.[17] This makes prevention of falls and complications of falls desirable. Several single and multifactorial, healthcare-based strategies have proved to be effective in reducing the fall rate in clinical trials.[43-45] In the dialysis population only one study has been performed on fall prevention in an outpatient dialysis centre.[46] Heung *et al.* found that staff educational deficits and environmental hazards were the most significant risk factors for fall incidents. Through a targeted series of interventions, a marked reduction in fall risk was achieved.

In conclusion, elderly dialysis patients have a high fall incidence accompanied by a high fracture rate. Given the high complication rate, elderly patients at risk of falling should be identified and managed. A lower SBP before HD and a higher PTH were found to be associated risk factors for falls. Reduction in use of blood pressure-lowering medication might be a treatment strategy to reduce falls.

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DISCLOSURES

These data were presented at the Dutch Congress of Geriatrics ('s-Hertogenbosch, the Netherlands, 6-8 February 2013), the Dutch Nephrology Days (Veldhoven, the Netherlands, 26-27 March 2013) and the ERA-EDTA Congress (Istanbul, Turkey, 18-21 May 2013).

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