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Achievement of guideline targets in elderly patients on hemodialysis: a multicenter study

Nada Dimković[1,2] · Ljubica Djukanović[1] · Jelena Marinković[1] · Živka Djurić[2] · Violeta Knežević[3] · Tatjana Lazarević[4] · Stanimir Ljubenović[5] · Rodoljub Marković[6] · Violeta Rabrenović[7]

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Abstract
Objectives Advanced age is associated with shorter survival on dialysis. The aim of the present study was to compare the adherence with KDOQI guideline targets and the association between mortality and satisfying the guidelines targets between hemodialysis patients aged 65 years and over and those younger than 65 years.
Methods Data were collected using a questionnaire sent to all 46 HD centers in Serbia with totally 3868 HD patients. The 24 centers responded and sent the data on all patients aged 18 years or older that were on regular HD for more than 3 months (2153 patients, 1320 males, aged 18–90 years). Data are presented in two groups: a group of patients younger than 65 years (1438, 66.8 %) and a group of patients aged 65 years and over (715, 33.2 %). The percentage of patients whose values failed to meet the targets recommended by KDOQI Clinical Practice Guidelines was calculated for dialysis dose (spKt/V), hemoglobin, serum phosphorus, serum calcium and plasma iPTH (150–300 pg/mL). Patients were followed from enrollment until their death, kidney transplantation, departure from the center or the end of the study.
Results Elderly patients were more likely to have hypertension, significantly lower systolic and diastolic blood pressure and smaller dialysis vintage than younger patients. They were less frequently treated with high-flux membranes and hemodiafiltration and they had significantly lower number of dialysis hours per week and significantly lower interdialytic weight gain. They used ESA and phosphate binders less frequently than younger patients ($p < 0.001$ and $p = 0.002$). Older patients had similar Kt/V as younger ones but they had significantly more frequent Hb level outside the target range than younger patients. During the year follow-up period, by using a Cox proportional hazards model it has been confirmed that age, dialysis vintage, weekly dialysis time and target values for Kt/V were significant independent predictors of time to death for younger patients and gender, dialysis vintage and iPTH were independent predictor of time to death for older patients.
Conclusion Despite less favorable dialysis prescription, older patients had similar Kt/V and less frequent deviations from the target values proposed by KDOQI for serum phosphorus and iPTH but more frequent deviation for Hb value as compared with younger patients. Risk factors for mortality differ between older and younger patients; out of five KDOQI targets, only Kt/V proved to be a significant risk factor for mortality for younger and iPTH for older patients.

Keywords Elderly on hemodialysis · KDOQI targets · Survival

✉ Nada Dimković
dim@eunet.rs

1 School of Medicine, University of Belgrade, Belgrade, Serbia

2 Clinical Department for Renal Diseases, Zvezdara University Medical Center, D. Tucovica 161, Belgrade 11 000, Serbia

3 Nephrology Department, Clinical Center Novi Sad, Novi Sad, Serbia

4 Nephrology Department, Clinical Center Kragujevac, Kragujevac, Serbia

5 Nephrology Department, Clinical Center Nis, Nis, Serbia

6 Nephrology Department, Clinical Center Zemun, Zemun, Serbia

7 Nephrology Department, Military Medical Academy, Belgrade, Serbia

Introduction

As elderly population continues to grow, diagnosis and treatment of renal diseases in elderly becomes the challenge of everyday nephrology practice. Patients over the age of 75 have higher incidence rates of end-stage renal disease (ESRD) than younger patients and constitute the fastest growing segment of the ESRD population worldwide [1]. Up to one-third of elderly patients with ESRD have four or more chronic health conditions when they reach ESRD [2] and many are not considered candidates for kidney transplantation. Thus, the vast majority of elderly patients with ESRD face the prospect of dialysis therapy for the remainder of their lives. HD does not always substantially prolong life among older adults. For example, in two studies, median survival was similar among geriatric patients receiving nondialytic management when compared with elderly patients who started HD after emergency referral or who had coexisting ischemic heart disease [3, 4]. Therefore it is of great importance to identify the factors that may have an impact on survival of elderly dialysis patients.

Survival is an important parameter of successful treatment of elderly ESRD patients and as expected, advanced age is associated with shorter survival on dialysis. Integrated prognostic models may take into account a number of factors to establish a risk profile for older patients undergoing dialysis. In addition to patient demographic information and laboratories, the instruments may include comorbidities, changes in comorbidity score over time, functional status/frailty, health-related quality of life (HRQOL) and either the patient's or clinician's prediction of survival [5–9]. The elderly have many comorbid conditions and most of them die of diseases that were present at the start of dialysis [10]. Independent predictors of poor survival among old patients were older age, poor nutritional status, inactivity, late referral for dialysis and significant comorbidity [11].

Numerous guidelines defined standards of dialysis with the aim to improve results of HD treatment and patient outcomes. The publication of these guidelines was followed by a number of studies on the levels of guideline adherence [12–16]. However, information on the achievement of targeted guidance relating to the aging population lacking. At the same time, it is not clear if achieving of the current guidelines affect the survival of elderly dialysis patients. Therefore, the aim of the preset study was to compare the adherence with KDOQI guideline targets and the association between mortality and satisfying the guidelines targets between hemodialysis patients aged 65 years and over and those younger than 65 years.

Methods

The current study analyzed data of 2153 patients on regular HD in 24 centers which accounts for about 56 % of all hemodialysis population in Serbia. Data were collected using a questionnaire sent to all 46 HD centers in Serbia with totally 3868 HD patients. The 24 centers responded and sent the data on all patients aged 18 years or older that were on regular HD for more than 3 months on January 1 2010. Out of 2281 patients whose data were obtained 2153 (1320 males, aged 18–90 years) with complete data were included in the study. The study was approved by The Ethics Committee of Zvezdara University Medical Center and appropriate patient consent was obtained at all study centers.

For comparison, the data are presented in two groups, a group of patients younger than 65 years (1438, 66.8 %) and a group of patients aged 65 years and over (715, 33.2 %). Data on patient demographic characteristics, medical history, HD treatment and laboratory data were obtained from medical records at the onset of the study. Based on these data the percentage of patients whose values failed to meet the targets recommended by KDOQI Clinical Practice Guidelines was calculated in the following areas: dialysis dose (spKt/V > 1.2), anemia (hemoglobin >110 g/L), serum phosphorus (1.1–1.8 mmol/l), serum calcium (2.1–2.4 mmol/l) and plasma iPTH (150–300 pg/mL) [17]. We selected KDOQI guidelines for analysis since it was mainly used up to 2012 when KDIGO guidelines became accepted.

Hemoglobin, serum levels of urea, phosphorus calcium, albumin were measured by routine laboratory tests and iPTH by (Diagnostic Product Corporation, USA). Measured calcium was corrected for level of serum albumin with the following formula: Corrected total calcium (mmol/L) = TCa (mmol/L) + 0.8 [40 (g/L) − albumin (g/L)]. Dialysis dose (spKt/V) was calculated from values of blood urea nitrogen pre- and post-dialysis, body weight and dialysis duration using the second generation Daugirdas formula [18]. Patients were followed from enrollment until their death, kidney transplantation, departure from the center or the end of the study on December 31, 2012.

Descriptive statistics were presented as mean values and standard deviation (SD) for the continuous variables, or as frequencies for categorical variables. Pearson correlation coefficients were used to detect correlation among variables. Univariate Cox proportional hazards analysis was used to select variables significantly associated with the risk of time to death. As independent variables patient age, gender, primary kidney disease, dialysis modality (HD/hemodiafiltration), duration of HD treatment (years), HD hours/week, Kt/V, hemoglobin, serum calcium, phosphorus, iPTH, systolic blood pressure, interdialytic weight gain, iron therapy,

Table 1 Characteristics of patients and hemodialysis treatment at the onset of the study

	Total (No, %)	<65 years (No, %)	≥65 years (No, %)	p^a
Number pt	2153	1438 (66.8)	715 (33.2)	
Gender				
Males	1320 (61.3)	898 (62.5)	422 (59.0)	0.122
Age, years—range	18–90	18–64	65–90	
Mean ± SD	59.0 ± 12.5	52.3 ± 9.3	72.4 ± 4.9	0.000
Etiology of ESRA				
Glomerulonephritis	370 (17.3)	329 (22.9)	41 (5.7)	0.000
TIN (without Balkan nephropathy)	118 (5.4)	69 (4.8)	48 (6.7)	
Balkan nephropathy	90 (4.2)	38 (2.6)	52 (7.3)	
Hypertensive nephropathy	540 (25.1)	335 (23.2)	205 (28.7)	
Diabetic nephropathy	276 (12.8)	204 (14.3)	73 (10.2)	
Polycystic kidney disease	168 (7.8)	116 (8.1)	52 (7.3)	
Other	396 (18.4)	245 (17.1)	151 (21.1)	
Unknown	195 (9.0)	102 (7.0)	93 (13.0)	
Blood pressure, mmHg mean ± SD				
Systolic	136 ± 21	137 ± 21	134 ± 20	0.011
Diastolic	77 ± 10	78 ± 10	76 ± 10	0.000
Dialysis vintage, years				
Range	0.5–35	0.5–35	0.5–25	
Mean ± SD	5.3 ± 5.3	5.7 ± 5.7	4.1 ± 4.2	0.000
Dialysis modality				
Low flux	956 (44.4)	488 (34.0)	467 (65.3)	0.000
High flux	858 (39.8)	643 (44.7)	215 (30.1)	
Hemodiafiltration	339 (15.8)	307 (21.3)	33 (4.6)	
Dialysis, number/week	2.9 ± 0.3	2.9 ± 0.3	2.8 ± 0.4	0.000
Dialysis, hours/week	11.8 (1.9)	11.9 ± 1.8	11.4 ± 1.9	0.000
<9 h/week	213 (9.9)	107 (7.7)	106 (15.7)	0.000
9–12 h/week	1608 (78.2)	1104 (79.9)	504 (74.7)	
>12 h/week	235 (10.9)	170 (12.3)	65 (9.6)	
Missing data	97	57	40	
ID weight gain, kg				
Range	0–9	0–9	0.3–6	
Mean ± SD	2.8 ± 1.1	2.9 ± 1.2	2.6 ± 0.9	0.000

ESRD end-stage renal disease, *ID* interdialytic

[a] According to Chi-square, *t* or Mann–Whitney test where appropriate

blood transfusion, use of phosphate binders and calcitriol were used. Variables number of HD weekly, erythropoietin stimulating agents (ESA) dose/week, duration of ESA treatment (years), product of calcium and phosphorus were not included in analysis due to colinearity. Significant variables in univariate analysis ($p < 0.10$) were tested in a multivariate Cox models using the backward stepwise method. The p values of <0.05 were considered as statistically significant. Models were adjusted for patient age, gender and duration of HD treatment (years).

All analyses were performed using the SPSS statistical software package (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp).

Results

The study involved 2153 patients with mean age of 59 years. Characteristics of patients and HD treatment at the onset of the study are presented in Table 1. Elderly patients were more likely to have hypertension than younger patients who had more frequently glomerulonephritis as a primary renal disease. Also, older patients had significantly lower systolic and diastolic blood pressure and they had smaller dialysis vintage than younger patients. Dialyzers with synthetic membranes were used in all patients included in the study and 340 (15.7 %) of patients were on hemodiafiltration. Older patients were less frequently treated with high-flux membranes and

Table 2 Treatment of anemia and mineral metabolism disorders

Treatment	Total (No, %)	<65 years (No, %)	≥65 years (No, %)	*p*
Total number of patients	2153	1438	715	
Iron use, No (%)	994 (46.2)	689 (48.0)	304 (42.5)	
Oral	247 (11.5)	173 (12.4)	74 (10.4)	0.242
Intravenous	747 (34.7)	516 (35.6)	230 (32.2)	0.082
ESA use, No (%)	1402[a] (65.1)	965(67.2)	436 (61.0)	0.000
ESA dosage, U/week (mean ± SD)[a]	3574 ± 2601	3543 ± 2528	3623 ± 2745	0.664
Transfusion, No (%)	269 (16.8)	163 (15.3)	106 (19.9)	0.565
Units/year	0.72 ± 2.44	0.61 ± 2.18	0.93 ± 2.88	0.027
Phosphate binders use, No(%)	1446 (67.2)	981 (68.3)	465 (65.0)	
$CaCO_3$	1354 (63.0)	912 (63.5)	442 (61.8)	0.002
Other	92 (4.2)	69 (4.8)	23 (3.2)	
Vit. D3 metabolites use, No (%)	827 (38.4)	549 (76.8)	278 (38.9)	
$1alphaD_3$	525 (24.4)	339 (47.4)	186 (26.0)	0.334
$1,25\ D_3$	302 (14.0)	210 (29.4)	92 (12.9)	

[a] 378 of patients were treated with darbepoetin alfa and the others used epoetin. Dose of darbepoetin was multiplies by 200 before calculation of mean value

Table 3 Mean values (± SD) of variables whose adherence to guideline target was examined

	Total (No, %)	<65 years (No, %)	≥65 years (No, %)	*p*
Single pool Kt/V, No	1736	1176	560	
Mean ± SD	1.24 ± 0.31	1.25 ± 0.32	1.23 ± 0.27	0.083
Hemoglobin, g/L, No	1812	1219	591	
Mean ± SD	102 ± 17	103 ± 17	99 ± 16	0.000
S-phosphorus, mmol/L, No	1781	1203	576	
Mean ± SD	1.58 ± 0.56	1.64 ± 0.57	1.45 ± 0.49	0.000
S-calcium, mmol/L, No	1772	1198	572	
Mean ± SD	2.31 ± 0.29	2.30 ± 0.29	2.31 ± 0.25	0.231
S-iPTH, pg/mL, No	1292	872	420	
Mean ± SD	407.8 ± 512.4	440.5 ± 533.5	337.5 ± 457.2	0.001

hemodiafiltration and they had significantly lower number of dialysis hours per week and significantly lower interdialytic weight gain compared to younger patients.

Table 2 shows that 65.1 % of patients were treated with erythropoietin stimulating agents (ESA), most of them with epoetin and 378 (17.6 %) with darbepoetin alpha. Older patients used ESA less frequently than younger patients ($p < 0.001$). Intravenous iron was used by 34.7 % and oral iron by 11.5 % of all patients with no significant difference between age groups. The number of patients who received blood transfusions did not differ significantly between groups but older patients received significantly more units of blood per year than younger patients. Phosphate binders were used more frequently by younger patients ($p = 0.002$, mainly calcium carbonate). There was no difference in the use of vitamin D metabolites among the age groups.

Results presented in Table 3 show the mean values of Kt/V, hemoglobin, serum phosphorus, calcium and iPTH levels among the groups. There were no difference between the groups in hemoglobin and serum calcium level. The number/percentage of patients outside the target range are presented in Figs. 1 and 2. Substantial percentage of patients was outside the target ranges. Older patients had similar Kt/V as younger ones but they had significantly more frequent deviation for Hb level (Fig. 1), serum phosphorus and iPTH (Fig. 2) outside the target range than younger patients. Namely, elderly had iPTH and serum phosphorus below the lower limit of normal more frequently than younger patients.

During the year follow-up period, 576 (26.7 %) patients died, 44 (2 %) were transplanted, 69 (3.2 %) were lost from the follow-up and 1464 remained on regular HD. We used a Cox proportional hazards model to investigate the association between mortality and satisfying the guidelines targets. When targets for Kt/V, hemoglobin, serum phosphorus, calcium and iPTH were included in multivariate Cox model, age, dialysis vintage, weekly dialysis time and target values for Kt/V were found to be the significant independent predictors of time to death for younger patients and gender, dialysis vintage and iPTH were independent predictor of time to death for older patients (Table 4).

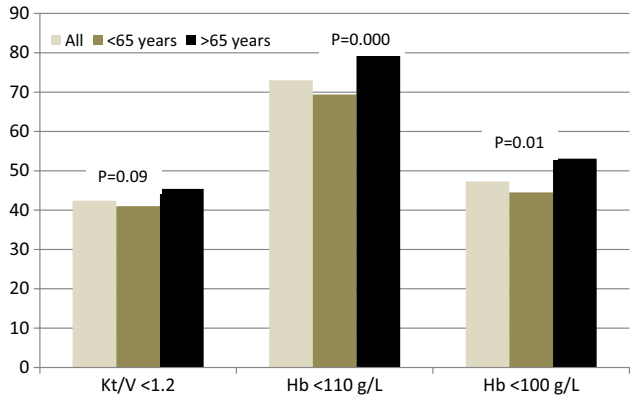

Fig. 1 Proportion of patients within or outside guidelines targets for Kt/V and hemoglobin level at the outset of the study

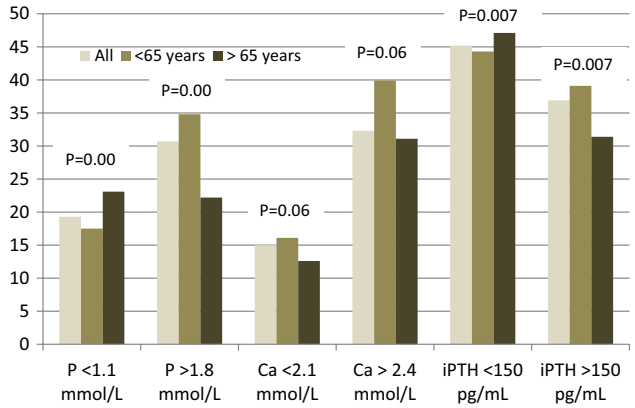

Fig. 2 Proportion of patients within or outside guidelines targets for serum phosphorus, calcium and iPTH at the outset of the study

Discussion

Although elderly patients account for an increasing fraction of patients on renal replacement therapy worldwide, it is not clear whether dialysis prescription for the elderly should be different than that of younger ones. At the same time, it is not clear if risk factor for mortality on dialysis differ regard to patients' age. Numerous national and international studies were undertaken to find out the proportion of patients failing to meet guidelines targets as well as the association of guidelines compliance and patients' outcome [14, 15, 19, 20]. The most of these studies were carried out in developed countries. In recent years, the number of papers presenting epidemiological data on RRT in developing countries increased, but papers on the results of HD treatment and compliance with guidelines in developing countries are scarce, particularly for elderly population [21, 22].

This multicenter study compared 1438 patients younger than 65 years with 715 patients 65 years old and above in their adherence with KDOQI guidelines targets in five crucial HD practice areas: dialysis dose, anemia, serum phosphorus, serum calcium and iPTH. We selected KDOQI guidelines for comparative analysis since they were traditionally used by HD centers until 2012 when KDIGO guidelines started to be adopted as a daily practice.

Older patients had shorter dialysis sessions, lower interdialytic weight gain and used low-flux membranes more frequently than younger patients. Nevertheless, the older patients had similar Kt/V as younger patients, significantly lower phosphorus and iPTH and less frequent deviations from the target values proposed by KDOQI for serum phosphorus and iPTH than younger patients. However, the

Table 4 Multivariate Cox proportional hazard model included guidelines target values as independent variables and confounders

Variable	<65 years $n = 1436$; 285 dead		≥65 years $n = 715$; 291 dead		Total stratified by age categories $n = 2151$; 576 dead	
	HR (95 % CI)	*p*	HR (95 % CI)	*p*	HR (95 % CI)	*p*
Gender	0.81 (0.59–1.09)	0.167	**0.73 (0.55–0.97)**	**0.035**	**0.78 (0.62–0.95)**	**0.015**
Age, years	**1.03 (1.01–1.05)**	**0.000**	1.02 (0.99–1.05)	0.063	**1.03 (1.01–1.04)**	**0.000**
Dialysis vintage	**0.55 (0.51–0.51)**	**0.000**	**0.54 (0.48–0.59)**	**0.000**	**0.55 (0.51–0.59)**	**0.000**
Hours of HD/week	**0.91 (0.83–0.98)**	**0.024**	1.01 (0.92–1.09)	0.930	0.96 (0.91–1.02)	0.185
Kt/V > 1.2	**0.61 (0.45–0.81)**	**0.001**	1.06 (0.80–1.40)	0.670	**0.81 (0.67–0.99)**	**0.041**
Hb > 110 g/L	0.76 (0.55–1.03)	0.081	1.01 (0.72–1.42)	0.949	0.87 (0.69–1.10)	0.260
S-phosphorus, 1.1–1.8 mmol/L	0.79 (0.61–1.04)	0.093	1.04 (0.79–1.37)	0.745	0.92 (0.76–1.12)	0.405
S-calcium, 2.1–2.4 mmol/L	0.83 (0.63–1.09)	0.188	1.03 (0.79–1.35)	0.789	0.92 (0.76–1.12)	0.415
iPTH, 150–300, pg/mL	0.73 (0.44–1.21)	0.223	**0.61 (0.37–1.00)**	**0.050**	0.72 (0.51–1.02)	0.068

Bold values indicate significant independent predictors of time to death for younger and for older patients

older patients had significantly lower mean Hb level that was more frequently below targets than younger ones.

Number of patients in Serbia failing to meet Kt/V target significantly decreased during the past decade [16]. According to present analysis, the mean Kt/V in total cohort of hemodialysis patients was 1.24 ± 0.31 and 42.4 % of patients had Kt/V below 1.2 without significant difference between two age groups. It is worth mentioning that more than half of patients in both groups had their Kt/V above 1.2, the minimally adequate dose proposed by KDOQI guidelines. Our data are in agreement with DOPPS study where there were no differences between older and younger patients in delivered dialysis dose as measured by single Kt/V [23]. As in our cohort of patients, they observed that shorter dialysis duration in elderly and maintenance of a satisfactory dialysis dose can be partially explained by the lower dry weight, lower lean body mass and low serum albumin which were common in the elderly group. By using Cox proportional hazards model, we confirmed that target Kt/V was found to be significant independent predictor of time to death but only in younger group of patients. The question arises whether elderly patient may better tolerate uremia than younger patients due to decreased metabolic demand and lower total energy expenditure, physical activity expenditure and lower resting energy expenditure that younger patients [24]. As in all studies based on questionnaire, this one lacks some parameters that may give a better explanation for current Kt/V such as residual renal function, vascular access patency and patients' compliance to dialysis time. The fact that ~45 % of elderly have their Kt/V less than that proposed by guidelines obliges us to find out all the factors that are responsible for it and to correct them for the benefit of patients' outcome.

Percentage of patients who fell within K/DOQI recommended range for serum phosphorus (50 %) and iPTH (18 %) was comparable with those in the DOPPS studies [13–25]. However, serum phosphorus was significantly lower in older than in younger patients and significantly lower percentage of older patients received phosphate binders. Having in mind the similar Kt/V in two groups, we believe that elderly are more compliant with prescribed diet and that they are more prone to malnutrition than younger patients. Similar findings about serum phosphorus and iPTH were published by Yavuz et al., who observed negative correlation between serum phosphorus level and age in patients on chronic peritoneal dialysis. They proposed that it may originate from age-related changes in nutrition and eating habits. Elderly suffer from many comorbid conditions all contributing to malnutrition and low phosphorus level. Indeed, serum phosphorus level positively correlated with serum albumin level. This finding is of great importance since malnutrition is risk factors for morbidity and mortality in dialysis patients and may contribute to low turnover bone disease known to be more frequent in elderly on dialysis. It should be taken into account when prescribing dialysis solution and anti-phosphate drugs for patients with advanced age [26]. Similar data are observed by DOPPS study where authors suggested that low serum albumin and phosphorus were major mortality risk factor [27]. Percentage of patients who achieved targets for serum calcium was similar in both age groups and higher than in DOPPS studies but similar to results presented in some recent studies [14–28]. Special attention should be paid to calcium intake in elderly, as the risk of bone loss is high in the older population [29]. Since dietary calcium intake is generally associated with phosphorus intake, calcium supplements should be prescribed if possible. In our HD population like in many others [14–30] low iPTH level represents twice the bigger problem than severe hyperparathyroidism while the opposite is found in some other countries [31]. By comparing two age groups we confirmed that low parathyroid hormone (<150, g/mL) levels were more common whereas higher parathyroid hormone (>300 pg/mL) was less common in the elderly group. It is well known that apart from numerous factors, older age is a risk factor for low turnover bone disease [32]. There is disagreement about the significance of this finding but according to some data, very few patients with low/normal iPTH had related symptoms (pain and fractures) and their morbidity and mortality did not differ from those patients with a high initial iPTH level [32]. Numerous studies found a significant relationship between serum levels of phosphorus, calcium, PTH and mortality [33–35]. However, several meta-analyses reported conflicting data about increased level of mineral metabolism indices and patients' survival [36–38]. Using multivariate Cox proportional hazard model we found none of three parameters (serum calcium, phosphorus and iPTH) were significant predictors of death in younger patients. In elderly, only being outside target range for iPTH was proved to be significant independent predictor of death.

At the onset of the present study 73 % of patients had hemoglobin level below KDOQI target of 110 g/L and this percentage is lower than in most of developed countries [39–41], but similar or even higher than in developing countries [30, 42, 43]. That unfavorable result is the consequence of local policy since Serbian national health Found restricted target hemoglobin value between 10 and 11 g/dL. However, elderly had significantly lower mean hemoglobin value as compared to younger group of patients: 80 % of them had their Hb value below 110 g/dL and 53 % had Hb value below 100 g/dL—finding significantly unfavorable than in younger patients. Elderly are at higher risk of gastrointestinal disorders including gastritis, ulcer disease, diverticulosis, and carcinoma. Therefore they are of particular risk of bleeding while on hemodialysis

and it may potentially influence their Hb level. Even so, ESA were used less frequently in elderly than in younger patients. Although we have no data about comorbidity, we may speculate that Hb range in elderly was kept in the lower range of target due to more frequent cardiovascular morbidity including vascular access thrombosis. Patients from both groups who received ASE had similar dose of the drug. Unfortunately, body mass index (BMI) was not included in this analysis and ESA dose is difficult to comment between two age groups. We may expect that the elderly have lower BMI and the ESA dose appropriately lower than younger patients with higher BMI. In Europe, ANZ and North America, a higher percentage of elderly patients achieved the hemoglobin target value [23]. Also, elderly patients from that regions had lower erythropoietin resistance index than younger patients [23]. However, data from Japan have shown that patients with lower Hb tended to be older [44]. We did not observe a correlation between hemoglobin values and survival in either group of patients. However, authors from Japan confirmed the difference in the effect of Hb on survival between elderly and nonelderly population. Nonelderly patients had increased risk of death if they had Hb < 10 g/dL, whereas only for the <9 g/dL category among elderly population. The reason why low Hb had a weaker link to poorer survival could be related to the reduced activity in the elderly patients. Also, oxygen consumption in the elderly population is reported to be lower than in the younger as well as exercise capacity [44]. This is something that should be kept in mind when treating elderly patients.

By using Cox proportional hazard model, this study pointed out the difference in mortality risk factors in regard to age. While age, dialysis vintage, weekly dialysis time and target values for Kt/V were found to be the significant independent predictors of time to death for younger patients, gender, dialysis vintage and iPTH target values were proven as significant predictors for elderly patients.

This study should be viewed in light of its shortcomings. First, information on comorbid conditions was not available and adjusting for these conditions in the Cox models was not possible. Vascular access, residual renal function QoL could put more light on quality of treatment in two age groups. Differences in local medical practice prevent adequate comparison between patients from different regions (target Hb value). Age of the patients was different between our data and those of other authors which hampers the mutual comparison.

Conclusion

Despite less favorable dialysis proscription, older patients had similar Kt/V and less frequent deviations from the target values proposed by KDOQI for serum phosphorus and iPTH but more frequent deviation for Hb value as compared with younger patients. Risk factors for mortality differ between older and younger patients; out of five KDOQI targets, only Kt/V proved to be a significant risk factor for mortality for younger and iPTH for older patients. These findings have to be confirmed in the future to a larger number of patients.

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Compliance with ethical standards

Conflict of interest None.

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