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FACTORS ASSOCIATED WITH VARIOUS ARTERIAL CALCIFICATIONS IN HAEMODIALYSIS PATIENTS

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A b s t r a c t: *Background:* Haemodialysis (HD) patients are at increased risk of the development of arterial intimal (AIC) and medial calcification (AMC). The aim of our study was to analyze the association between the pre-defined potential risk factors and the status of various arterial calcifications in our HD patients.

Methods: In a cross-sectional study of 150 patients (91 male, mean age 54.55 ± 12.46 yrs, HD duration 104.77 ± 68.02 mths) we first determined the presence of AIC and AMC using plain radiography of the pelvis. We then compared the percentages of different radiogram findings in patients stratified according to various cut-off levels or the codes of each clinical and biochemical parameter (mean value of one year laboratory data recorded in the files).

Results: We determined arterial calcifications in 77.3% of our patients (AIC in 45.3%, AMC in 32%). The significantly higher frequencies of arterial calcifications of both groups (AIC and/or AMC) and isolated AIC presence were found in patients older than 55 at inclusion and 45 at the start of treatment with HD, with a serum C-reactive protein (CRP) > 4.5 mg/L, predominantly of male gender with diabetes. The patients with a significantly higher occurrence of arterial calcifications had lower percentages of total serum calcium (Ca) levels but within the K/DOQI guideline recommendations. Also, we found a significantly higher proportion of isolated AIC presence in the group of patients with corrected total serum Ca levels > 2.35 mmol/L and serum intact parathyroid hormone (iPTH) levels out of the range proposed by K/DOQI guidelines. In parallel, a significantly higher percentage of absence of arterial calcifications (ACA) was obtained in the patients with corrected total serum Ca levels < 2.35 mmol/L, body mass index (BMI) < 23 kg/m^2, mean pulse pressure < 60 mmHg, blood leucocytes < 6.5 × 10^{9}L and serum triglycerides < 1.8 mmol/L. Finally, we found a significantly higher presence of isolated AMC in patients with mean Kt/V < 1.3 (poor dialysis adequacy),

serum triglycerides > 1.8 mmol/L and outside K/DOQI guideline achievements for corrected total serum Ca. In the 12 month period data analyzed, there were no significant differences in other risk factors such as the dose of prescribed calcium carbonate and vitamin D_3, serum levels of albumin, cholesterol, phosphate (P) and Ca × P product.

Conclusions: AIC and AMC were frequently present in our HD population. Age, gender, BMI, diabetes, pulse pressure, dialysis adequacy, serum CRP, triglycerides, Ca and iPTH, as well as blood leucocyte levels were associated with the occurrence of arterial calcifications in our HD patients.

Key words: haemodialysis, arterial calcifications, risk factors.

Introduction

The association between uraemia and increased risk of arterial calcifycations has been documented in many investigations [1]. Arterial calcifications are a major and independent contributory factor to the high cardiovascular morbidity and mortality of haemodialysis (HD) patients [1–3]. HD patients are at especially increased risk of both arterial intimal (AIC) and medial calcifycation (AMC) [4]. While AIC is associated with atherosclerosis (development and calcification of the atherosclerotic plaques), general atherosclerotic factors that are not specifically attributed to HD [2, 4, 5] and occlusive lesions, AMC (arteriosclerosis, Mönckenberg's mediosclerosis) is characteristically associated with diabetes mellitus, advanced chronic kidney disease, HD and its duration [2, 6–8]. Recently, mediosclerosis was demonstrated to be an active cellular process similar to bone formation, assumed not only to be a result of passive extraskeletal calcification [9, 10]. However, the pathogenesis of AMC in HD patients remains uncertain and further information about the possible factors associated with arterial calcifications are needed in order to better prevent and control cardiovascular disease development [11, 12].

Previously it has been reported that AMC in its typical form does not obstruct the arterial lumen and is considered to be clinically insignificant [2]. Recently, AMC was found as a major cause of arterial stiffness that contributes to left ventricular dysfunction and heart failure [4, 5]. Moreover, AMC in HD patients was found to be associated with atherosclerosis, intimal plaques and occlusive lesions, and considered to be an established marker of future cardiovascular risk [8, 9, 13].

AMC observed with predilection in muscle type of arteries (femoral and uterine), has already been differentiated from AIC by postero-anterior radiography of the pelvis [2, 3]. At present, this method allows a distinction between AIC and AMC which is not possible with other techniques.

The aim of the present study was to analyze the association between the previously established clinical and biochemical potential factors at risk for the

development of arterial calcifications and the occurrence of different arterial calcifications in our HD patients.

Patients and methods

Patients

In a cross-sectional study we examined 150 patients (91 male, mean age 54.55 ± 12.46, range 26–85) being at least 12 months on HD (104.77 ± 68.02, range 14–313 mths). All patients underwent careful evaluation of their hospital and outpatient records. The standard care of our patients in the analyzed period of 12 months consisted of bicarbonate dialysis with 1.75 mmol/l calcium (Ca), use of low-flux synthetic membranes, epoietin and regular iron supplementation to maintain haemoglobin levels between 110 and 120 g/l, and the use of calcium carbonate ($CaCO_3$) as a sole phosphate (P) binder in order to maintain serum P levels below 1.8 mmol/L. The duration of HD was individualized to 4–5 hrs thrice weekly to control body fluids and blood chemistries. The levels of body mass index (BMI), dialysis adequacy (Kt/V), prescription of vitamin D_3 (μg/weekly) and $CaCO_3$ (g/day), systolic (SBP) and diastolic blood pressure (DBP) (taken on the same day as the monthly biochemistry) were extracted from the patients' files over a period of 12 months prior to the arterial calcification detection, time-averaged for the statistical analysis. Brachial pulse pressure (PP) and mean arterial pressure (MAP) were calculated by the appropriate formula [PP = SBP – DBP and MAP = DBP + (SBP – DBP)/3], respectively. The association of other potential traditional risk factors such as age at inclusion, age at start of HD, gender, HD duration, anti hepatitis C virus (HCV) antibodies and smoking habits with different arterial calcifications, were also analyzed.

Biochemistry

The first week pre-dialysis haemoglobin, leukocyte, serum Ca and P, albumin, triglycerides, total cholesterol, HDL, LDL cholesterol and C-reactive protein (CRP) were assessed monthly. Serum-intact parathyroid hormone (iPTH) and ferritin were measured every 4 months. It is of note that the values of biochemical data considered in the present study were time-averaged for all the above-mentioned measurements over a 12-month period prior to the arterial calcifications evaluation.

Arterial calcification detection

All patients underwent soft-tissue postero-anterior native radiographs of the pelvis in the recumbent position to confirm the presence or absence of arte-

rial calcifications. The arterial calcifications present were classified as AIC (discrete intimal-like plaques with irregular and patchy distribution), or AMC (uniform linear railroad track-type, angiogram-like) (Figures 1 and 2) [2]. Two independent observers, blinded to the clinical data, analyzed arterial calcifications with an inter-observer concordance of 95.1%. The patients were classified according to the various types of arterial calcification findings as AIC, AMC and absence of arterial calcifications (ACA) patients.

Figure 1 – Femoral arteries with AIC
Слика 1 – Интимални калцификации во феморалните артерии

Figure 2 – AMC of the iliac arteries
Слика 2 – Калцификации во медијата на илијакалните артерии

Statistical analysis

Variables were expressed as frequencies and percentages for discrete parameters, and mean values ± standard deviation (SD) for normally distributed continuous parameters.

Patients were divided into 2 groups as a result of various predefined cut-off levels of each parametric variable and different codes of the nonparametric variables that may be responsible for arterial calcifications development, respectively. Fifty-five years of age at inclusion, 45 years at the start of HD, 85 months of HD duration, 1.3 of Kt/V (dialysis adequacy), 150 mmHg for SBP, 85 mmHg for DBP, 100 mmHg for MAP, 60 mmHg for PP, 23 kg/m^2 for BMI, 3.0 g Ca/daily for $CaCO_3$, 115 g/L for haemoglobin, 6.5×10^9/L for leukocyte, 38.5 g/L for serum albumin, 2.35 mmol/L for corrected total serum Ca, 1.5 mmol/L for serum P, 3.5 mmol/L for Ca × P product, 150 pg/ml for iPTH, 1.8 mmol/L for triglycerides, 0.95 mmol/L for HDL, 2.6 mmol/L for LDL and 4.6 mmol/L for total cholesterol, 600 mg/L for ferritin and 4.5 mg/L for CRP were determined as cut-off values. Gender, vitamin D_3 treatment, smoking habits, diabetes, presence of anti-HCV antibodies, as well as Ca, P, Ca × P product and

iPTH levels K/DOQI guideline achievement (0-no, 1-yes) were used as categorical variables.

The proportions of the presence or absence of arterial calcifications in both (AIC and/or AMC), as well as the percentage of an isolated arterial calcification (either AIC or AMC) status were compared among the determined groups of patients composed as a result of different levels and/or codes of the above-mentioned risk factors. The chi-square test was used to compare the proportion of the different arterial calcifications status as categorical parameters.

Statistical analysis was performed with the standard statistical package (SPSS for Windows, release 13.0). A P value < 0.05 was considered statistically significant at a two-tailed level.

Results

We determined arterial calcifications in 116 (77.3%) patients. AIC was detected in 68 (45.3%) and AMC in 48 (32%) patients. Arterial calcifications absence (ACA) on plain radiograms of the pelvis was found in 34 (22.7%) patients.

The proportions between groups of patients (composed as a result of the different cut-off levels and/ or different codes) of the clinical risk factors with significant differences are listed in Table 1. The patients older than 55 at inclusion (mean age of 64.9 ± 6.3 years) showed a significantly higher presence of arterial calcifications in both (AIC and/or AMC), as well as an isolated presence of AIC in comparison with the younger patients' group (mean age of 44.5 ± 7.1 yrs). Similar results were found in patients older than 45 at the start of treatment with HD (mean age of 57.8 ± 8.8), diabetics and male patients in comparison with the younger group at this period (mean age of 33.7 ± 8.6 years), non-diabetics and female patients. The groups of patients stratified according to age, presence of diabetes and gender did not show significant differences in the proportion of AMC presentation. ACA was a significantly more frequent finding in groups of patients with BMI < 23 kg/m^2 (mean values of 20.9 ± 1.5 kg/m^2) and PP < 60 mmHg (mean levels of 45.9 ± 7.1 mmHg) than in patients with BMI $>$ 23 kg/m^2 (mean values of 26.9 ± 2.9 kg/m^2) and PP > 60 mmHg (mean levels of 75.9 ± 9.5 mmHg). We did not obtain significant differences between the groups of patients composed as a result of various BMI and PP levels when the proportion of the arterial calcifications in both (AIC and/or AMC), as well as an isolated AIC and AMC presence were compared. The proportion of AMC presence was significantly higher in patients with poor dialysis adequacy defined with Kt/V < 1.3 (mean values of 1.13 ± 0.11) than in patients with Kt/V levels $>$ 1.3 (mean values of 1.45 ± 0.13). The groups of patients stratified according to dialysis adequacy did not differ significantly in the proportion of arterial calcifications in both (AIC and/or AMC) and isolated AIC presence.

Table 1 – Табела 1

Proportions of arterial calcification status in clinical parameters with significant differences

Сооднои на артериските калцификати кај клиничките параметри кои покажаа статистички значајни разлики

Age at inclusion	**≥ 55** years / **n = 73**	**< 55** years / **n = 77**	**P**
Presence of arterial calcifications (yes / no)	68 / 5	48 / 29	< 0.02
Absence of arterial calcifications (yes / no)	5 / 68	29 / 48	0.000
Presence of AIC (yes / no)	45 / 28	23 / 54	< 0.002
Presence of AMC (yes / no)	23 / 50	25 / 52	NS
Age at start of HD	**≥ 45** years / **n =77**	**< 45** years / **n = 73**	**p**
Presence of arterial calcifications (yes / no)	69 / 8	47 / 26	< 0.05
Absence of arterial calcifications (yes / no)	8 / 69	26 / 47	0.000
Presence of AIC (yes / no)	42 / 35	26 / 47	< 0.05
Presence of AMC (yes / no)	27 / 50	21 / 52	NS
Gender	**male / n = 91**	**female / n = 59**	**P**
Presence of arterial calcifications (yes / no)	80 / 11	36 / 23	< 0.03
Absence of arterial calcifications (yes / no)	11 / 80	23 / 36	0.000
Presence of AIC (yes / no)	49 / 31	19 / 40	< 0.02
Presence of AMC (yes / no)	31 / 49	17 / 42	NS
body mass index	**< 23** kg/m^2 / **n = 76**	**> 23** kg/m^2 / **n = 74**	**P**
Presence of arterial calcifications (yes / no)	53 / 23	63 / 11	NS
Absence of arterial calcifications (yes / no)	23 / 53	11 / 63	< 0.03
Presence of AIC (yes / no)	31 / 45	37 / 37	NS
Presence of AMC (yes / no)	22 / 54	26 / 48	NS
Pulse pressure	**> 60** mmHg / **n = 75**	**< 60** mmHg / **n = 75**	**P**
Presence of arterial calcifications (yes / no)	64 / 11	52 / 23	NS
Absence of arterial calcifications (yes / no)	11 / 64	23 / 52	< 0.02
Presence of AIC (yes / no)	37 / 38	31 / 44	NS
Presence of AMC (yes / no)	27 / 48	21 / 54	NS
Dialysis adequacy	**Kt/V < 1.3 / n = 78**	**kt/V ≥ 1.3 / n = 72**	**P**
Presence of arterial calcifications (yes / no)	62 / 16	54 / 18	NS
Absence of arterial calcifications (yes / no)	16 / 62	18 / 54	NS
Presence of AIC (yes / no)	31 / 47	37 / 35	NS
Presence of AMC (yes / no)	31 / 47	17 / 55	< 0.05
Diabetes mellitus	**yes / n = 25**	**no / n = 125**	**P**
Presence of arterial calcifications (yes / no)	25 / 0	91 / 34	< 0.05
Absence of arterial calcifications (yes / no)	0 / 25	34 / 91	0.000
Presence of AIC (yes / no)	16 / 9	52 / 73	< 0.04
Presence of AMC (yes / no)	9 / 16	39 / 86	NS

We did not obtain significant differences between the proportion of arterial calcifications either in both (presence/absence) or as an isolated presence of AIC/AMC when compared in various groups of patients divided according to the various cut-off levels/different codes for other clinical parameters such as HD duration, SBP, DBP, MAP, doses of prescribed $CaCO_3$ and vitamin D_3, anti HCV antibodies and smoking habits.

The proportions between groups of patients composed as a result of different cut-off levels and/or different codes of biochemical risk factors with significant differences are listed in Table 2.

The patients with blood leucocytes < 6.5×10^9/L (mean values of 5.42 ± 068 × 10^9/L) had a significantly higher proportion of ACA, with a similar proportion of arterial calcifications either of both or as an isolated AMC and AIC presence in comparison with patients with blood leucocytes > 6.5×10^9/L (mean levels of 7.69 ± 1.09 × 10^9/L). A significantly higher proportion of ACA and a lower frequency of AMC presence were obtained in patients with serum triglycerides < 1.8 mmol/L (mean levels of 1.33 ± 0.33 mmol/L) when compared with patients having serum triglycerides levels > 1.8 mmol/L (mean levels of 2.92 ± 1.06 mmol/L). Patients with serum CRP > 4.5 mg/L (mean values of 11.8 ± 9.8 mg/L) had significantly higher frequencies of arterial calcifications in both (AIC and/or AMC) and isolated AIC presence, as well as a lower frequency of ACA, in comparison with patients having serum CRP < 4.5 mg/L (mean values of 2.21 ± 1.13 mg/L). A significantly lower proportion of ACA and higher frequency of the AIC presence were found in patients with corrected total serum Ca levels > 2.35 mmol/L (mean values of 2.48 ± 0.1 mmol/L) in comparison with corrected total serum Ca < 2.35 mmol/L patients (mean levels of 2.20 ± 0.10 mmol/L). The patients with corrected total serum Ca within the K/DOQI guideline recommended range were found with significantly lower frequency of arterial calcifications in both (AIC and/or AMC) and isolated AMC presence, as well as with a higher proportion of ACA than patients with corrected total serum Ca out of the range proposed by K/DOQI guidelines. We did not find significant differences in AIC presence between those two groups of patients with different serum Ca – K/DOQI achievement. Finally, our results showed significantly higher AIC presentation in patients outside the range recommended by the K/DOQI guidelines. When divided according to the various cut-off levels of parameters such as blood haemoglobin, serum albumin, ferritin, HDL, LDL and total serum cholesterol, serum P, iPTH and Ca × P product, there were no significant differences between the groups of patients. The same pattern was observed when the K/DOQI guideline achievement for serum P and Ca × P product was compared among the various groups.

Table 2 – Табела 2

Proportions of arterial calcification status in biochemical parameters with significant differences

Сооднои на артериските калцификации кај биохемиските параметри кои покажаа статистички значајни разлики

Blood leucocytes	**< 6.5** × 10^9/L / **n = 71**	**≥ 6.5** × 10^9/L / **n = 79**	**p**
Presence of arterial calcifications (yes / no)	49 / 22	67 / 12	NS
Absence of arterial calcifications (yes / no)	22 / 49	12 / 67	< 0.02
Presence of AIC (yes / no)	29 / 42	39 / 40	NS
Presence of AMC (yes / no)	20 / 51	28 / 51	NS
Serum triglycerides	**≤ 1.8** mmol/L / **n = 74**	**> 1.8** mmol/L / **n = 76**	**p**
Presence of arterial calcifications (yes / no)	52 / 22	64 / 12	NS
Absence of arterial calcifications (yes / no)	22 / 52	12 / 64	< 0.04
Presence of AIC (yes / no)	35 / 39	33 / 43	NS
Presence of AMC (yes / no)	17 / 57	31 / 45	< 0.03
Serum C-reactive protein	**> 4.5** mg/L / **n = 74**	**≤ 4.5** mg/L / **n = 76**	**p**
Presence of arterial calcifications (yes / no)	68 / 6	48 / 28	< 0.03
Absence of arterial calcifications (yes / no)	6 / 68	28 / 48	0.000
Presence of AIC (yes / no)	42 / 32	26 / 50	< 0.02
Presence of AMC (yes / no)	26 / 48	22 / 54	NS
Corrected total serum calcium (Ca)	**> 2.35** mmol/L / **n = 79**	**≤ 2.35** mmol/L / **n = 71**	**p**
Presence of arterial calcifications (yes / no)	67 / 12	49 / 22	NS
Absence of arterial calcifications (yes / no)	12 / 67	22 / 49	< 0.02
Presence of AIC (yes / no)	44 / 35	24 / 47	< 0.03
Presence of AMC (yes / no)	23 / 56	25 / 46	NS
Serum Ca in K/DOQI recommendations	**yes / n = 123**	**no / n = 27**	**p**
Presence of arterial calcifications (yes / no)	89 / 34	27 / 0	< 0.04
Absence of arterial calcifications (yes / no)	34 / 89	0 / 27	0.000
Presence of AIC (yes / no)	54 / 69	14 / 13	NS
Presence of AMC (yes / no)	35 / 88	13 / 14	< 0.04
Serum iPTH in K/DOQI recommendations	**yes / n = 37**	**no / n = 113**	**p**
Presence of arterial calcifications (yes / no)	26 / 11	90 / 23	NS
Absence of arterial calcifications (yes / no)	11 / 26	23 / 90	NS
Presence of AIC (yes / no)	11 / 26	57 / 56	< 0.03
Presence of AMC (yes / no)	15 / 22	33 / 80	NS

Discussion

Since cardiovascular events are the most common cause of death in HD patients, the occurrence of arterial calcifications is an extremely important cardiovascular risk factor for those patients [2, 9]. In line with previous reports [2, 14], the results of this study confirm that arterial calcifications in HD patients are rather frequent, implying the need for an early arterial calcification screening in chronic kidney disease patients even in the pre-dialysis period. The proposed screening method is easily available and has a high cost-effectiveness ratio for the diagnosis and follow-up, which might be considered as a good standard for implementation in routine clinical practice.

The link between atherosclerotic non-specific, as well as HD specific, risk factors and arterial calcifications has been reported in many studies. In agreement with the results of previous investigations [1, 2, 11, 13, 15, 16], our patients with significantly higher frequencies of arterial calcifications in both (AIC and/or AMC) and isolated AIC presence were found to be older (over 55 yrs at inclusion and 45 yrs at the start of treatment with HD), predominantly male, diabetics and with an increased serum CRP (higher than 4.5 mg/L). Also, the significantly higher frequencies of the presence of arterial calcifications in both (AIC and/or AMC) obtained in the patients with a lower percentage of corrected serum Ca levels in K/DOQI guideline recommended levels were in line with previous reports [15, 17]. There is a body of reports indicating that decreeased and/or increased levels of iPTH contribute to the high Ca and P levels in the blood, which are on the other hand strongly associated with arterial calcifycation development. The significantly higher presence of an isolated AIC shown in our patients with serum Ca levels higher than 2.35 mmol/L and without serum iPTH within K/DOQI guideline recommended levels was in accordance with the above-mentioned and other reports [6, 9, 11, 16, 18]. Our findings of significantly higher percentages of ACA in patients who were younger (under 55 yrs at inclusion and 45 yrs at the start of HD), predominantly female, without diabetes and with higher percentages of K/DOQI guideline recommended levels for serum Ca, are supportive of the previous reports [11, 15, 17]. At the same time, our statistical analysis revealed that the ACA patients had lower corrected total serum Ca levels (< 2.35 mmol/L), lower PP (< 60 mmHg) and lower serum triglycerides (< 1.8 mmol/L), also confirming previously published reports [2, 11, 16, 19, 20]. The link between permanent low grade inflammation and the presence of arterial calcifications was confirmed in our dialysis (CRP > 4.5 mg/L) population as well [13, 16]. The published impact of higher BMI (visceral fat) on multiple risk factors in HD patients was also confirmed by our results of the significantly higher frequencies of ACA in lower (< 23 kg/m^2) BMI patients [21]. Our data on the significantly higher percentage of ACA in patients with lower blood leucocytes (< 6.5×10^9L) might be viewed as a counterbalan-

ced pathogenic link between the increased blood leucocytes (presence of infectious agents and inflammation) as a potential new non-traditional risk factor implicated in the development of the inflammatory atherosclerotic process and findings of vascular calcifications [22, 23].

Finally, our results of significantly higher percentages of isolated AMC in patients with higher serum triglycerides (> 1.8 mmol/L) and total serum Ca outside the range proposed by K/DOQI guidelines, are in line with previous reports [2]. The significantly higher presence of AMC in patients with lower Kt/V (< 1.3) also supports the already known probability that even a small increase in the HD adequacy improves the cardiovascular outcome in HD patients [24, 25]. For a possibly better explanation of our finding that AMC presence was associated with poor HD adequacy (decreased Kt/V < 1.3) further statistical evaluation with multiple regression analysis is needed.

In addition, our statistical analysis did not confirm a previously reported difference between the various patient groups in terms of HD duration, smoking habits, blood pressure (SBP, DBP, MBP) parameters and serum (HDL, LDL, total) cholesterol [1, 2, 12, 26]. In addition, our results did not support the association of atherogenesis with HCV infection (anti HCV antibodies) and iron overload (increased serum ferritin concentration) in HD patients [27, 28]. Furthermore, the analysis of our serum albumin results was not in line with the hypothesis that malnutrition favours atherosclerosis and mortality in HD patients [29]. Interestingly, our study did not confirm even the previously reported association between the presence of arterial calcifications and the intake of a high dose of $CaCO_3$ and vitamin D_3 [6, 30, 31], or the other HD specific risk factors for the development of arterial calcifications such as serum P and Ca × P product [16, 32, 33]. Possible explanations of these results might be the short data-analyzing period for those parameters, or relatively good control of these results with relatively low doses of calcium based phosphate binder [34]. Thus, a possible explanation of these results might be the high achievement of the proposed K/DOQI guidelines referent ranges for the serum P and Ca × P product in the period of evaluation [17]. Furthermore, a possible explanation could be the regular supplementation upon a strict indication and precautionary treatment with $CaCO_3$ and vitamin D [30, 31]. Hence, the present results might confirm that besides the P metabolism, blood pressure and serum cholesterol control, there might be plenty of other promoters and/or inhibitors involved in the development of arterial calcifications [10, 14, 15, 35].

It is important to underline also that timely management of the above-mentioned factors may have been beneficial in the prevention of arterial calcifications in our patients. The absence of an association between our findings and some traditional arterial calcification risk factors should encourage us in further achievement of the established standards and proposed guidelines

for dialysis adequacy and mineral and bone metabolism through a careful monitoring of the intake of Ca salts and vitamin D, as well as further strict control of smoking habits, serum cholesterol, nutritional markers, HCV infection prevention and an efficient blood pressure control. The management of these factors should exert a provision in the prevention and/or retardation of the development and progression of arterial calcifications in this population at risk.

Conclusion

The frequent presence of arterial calcifications in our HD patients recommends screening for arterial calcifications in chronic kidney disease patients with native radiographs of the pelvis even in the pre-dialysis stage. The present results suggest a few emerging risk factors for the occurrence of arterial calcifications, especially of AIC in our HD patients, such as age older than 55, male gender, diabetes, as well as higher CRP (> 4.5 mg/L), blood leucocytes (> 6.5×10^9L), corrected total serum Ca (> 2.35 mmol/L), serum triglycerides (> 1.8 mmol/L), PP (> 60 mmHg) and BMI (> 23 kg/m^2). The achievement of K/DOQI guidelines for serum Ca and iPTH is important for the prevention of development of arterial calcifications. The management of these risk factors may be beneficial in the prevention of development of arterial calcifications in this population at risk. Improving the dialysis adequacy (Kt/V > 1.3) is important for the prevention of AMC development. The absence of a link between our findings and some traditional and HD specific risk factors for the development of arterial calcifications might suggest that a period of data analysis longer than 12 months is required in order to evaluate the possible role of these risk factors.

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Резиме

ФАКТОРИ АСОЦИРАНИ СО РАЗЛИЧНИТЕ ВИДОВИ НА АРТЕРИСКИ КАЛЦИФИКАТИ КАЈ ПАЦИЕНТИТЕ НА ХЕМОДИЈАЛИЗА

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Вовед: Пациентите на хемодијализа (ХД) се со зголемен ризик за развој на калцификати и во интимата (АИК) и во медијата (АМК) од артериските крвни садови. Целта на оваа студија беше да ја анализира поврзаноста меѓу претходно дефинираните потенцијални ризик фактори за развој на артериските калцификати (АК) со присуството на различните видови на АК кај нашите пациенти на ХД.

Методи: Во пресечна студија со учество на 150 ХД пациенти (91 маж, со средна возраст од 54,55 ± 12,46 години, на ХД просечно 104,77 ± 68,02 месеци) прво со нативни радиограми на карлицата го одредивме присуството на АК (АИК и АМК). Потоа ги споредивме процентите на присутните/отсутните различни видови на АК меѓу пациентите поделени во 2 групи согласно различните кодови на ненумеричките или различно одредените пресечни нивоа на бројчаните клинички и биохемиски (средни вредности на лабораториските податоци од последните 12 месеци) параметри.

Резултати: Ние утврдивме АК кај 77,3% од нашите ХД пациенти (АИК кај 45,3% и АМК кај 32%). Значајно повисок процент на присуство на АК (АИК и/или АМК) како и изолирано присуство на АИК беше најдено кај пациентите постари од 55 години при вклучување во студијата и постари од 45 години при започнување на третманот со ХД, со серумски Це-реактивен протеин над 4,5 мг/Л, од машки пол и кај дијабетичарите. Значајно почесто присуство на АК имаа и пациентите чиј коригиран тотален серумски калциум (Ca) не беше во границите на K/DOQI препорачаните вредности. Исто така ние најдовме значајно повисок процент на изолирано присуство на АИК кај пациентите со коригиран тотален серумски Ca над 2,35 ммол/Л и со серумски нивоа за интактен паратироиден хормон надвор од референтните вредности на K/DOQI препораките. Паралелно, значајно повисок процент на отсуство на АК беше утврден кај пациентите со коригиран тотален серумски Ca под 2,35 ммол/Л, индекс на телесна маса под 23 кг/м^2, среден пулсен притисок под 60 ммХг, леукоцити во крвта под 6,5 × 10^{9}Л и серумски триглицериди под 1,8 ммол/Л. Ние најдовме значајно почесто присуство на АМК кај пациентите со послаба дијализна адекватност (со вредности за Kt/V

под 1,3), серумски триглицериди над 1,8 ммол/Л и вредности за коригиран тотален серумски Са надвор од K/DOQI препораките. Анализата на 12-месечниот период во однос на препишаната доза на калциум-карбонатот и витаминот $Д_3$, серумските нивоа на албуминот, холестеролот, фосфатот и Са-фосфат производот, не даде значајни разлики во процентите на присутните АК меѓу групите на пациенти.

Заклучок: АК (АИК и АМК) се многу чести кај нашите ХД пациенти. Возраста, полот, индексот на телесната маса, дијабетот, пулсниот притисок, дијализната адекватност, серумските нивои на Це-реактивниот протеин, триглицеридите, Са, интактниот паратироиден хормон, како и бројот на крвните леукоцити беа поврзани со почесто присуство на АК кај нашите ХД пациенти.

Клучни зборови: хемодијализа, артериски калцификати, ризик фактори.

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