

The Relation between the Serum Calcium Level and the Complication Incidence in Haemodialysis Uremic Patients

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ABSTRACT

The mineral metabolism disorder is the most influential factor of the morbidity and mortality incidence of haemodialysis uremic patients. The second most influential factor is the infection, which is the most frequent complication with an undesirable outcome. In recent times, the relation of the increased serum calcium and phosphorus level on the one hand, and the morbidity and mortality of that population in case on the other, has been observed. However, insufficient professional and scientific thought has been given to the relation of the lower serum levels of the aforementioned minerals and the morbidity and mortality incidence. We have researched the relation between lower serum calcium level (hypocalcaemia) and the complication incidence, especially infection. Throughout the time period of 18 months, 120 haemodialysis uremic patients were observed and 76 (63.3%) of them had serum calcium level below the lower threshold of referent values (9.0–9.5 mg/dL). In the patients with a lower serum calcium level (hypocalcaemia) a significant infection incidence ($\chi^2=3.99$; $p=0.0468$), a significant sepsis incidence ($\chi^2=8.016$; $p=0.04$), a significant total complication incidence ($p<0.05$) were determined, as well as a higher vascular access local infection incidence, but without statistically significant research results of this relation ($\chi^2=0.098$; $p=0.7598$). We are of the belief that the incidence of the vascular access local infection should be examined on a greater number of patients; therefore, the significance of the examined relation in such an instance would be expected. The total infection incidence in all 120 observed patients is 3.8 for 100 months. It is to be concluded that the research findings indicate the association regarding the appearance of low serum calcium concentration (hypocalcaemia) and an increased complication incidence, especially the inflammation that leads to the requirement of further research in order to decrease morbidity, and consequently also the mortality of the observed population of patients by means of programmed therapy approach.

Key words: chronic renal failure, haemodialysis, hypocalcaemia, complications

Introduction

The mortality rate of haemodialysis uremic patients is even nowadays unacceptably high, and it is in many ways higher than in any other human population, and almost 20% of them die^{1–3} annually, in spite of better technology regarding haemodialysis and a better understanding of biochemistry and pathophysiology in the organism of patients with terminal kidney failure^{4–9}. Formerly, upon the implementation of haemodialysis in the treatment of patients with kidney failure, more attention was paid to the influence on the organs and to the skeletal system¹⁰ whereas lately, more attention is paid to the in-

fluence of such condition to the general morbidity and mortality^{11–14}. The research attention is more directed towards the determination of risk factors, which are responsible for the morbidity and mortality. Block et al.¹ have put these risks factors into two different groups. The first group is comprised of those, which cannot be influenced, and according to Block et al.¹ they include demographic factors, concomitant states and nutritive insufficiency. The second group is comprised of serum haemoglobin concentration, intensity and the scope of dialysis, as well as mineral disorders metabolism, such as

calcium and phosphorus. According to Block et al.¹ these mortality risk factors can be influenced, and in such a way decreasing morbidity and mortality. We are of the opinion that alongside the mentioned risk factors in the second group, that is, among those that can be influenced, the serum albumin level should also be included^{15,16}.

Up till recent times, minute attention was paid to the mineral metabolism disorders⁵ in the research of the morbidity and mortality risk factors in patients with terminal renal insufficiency, even though the mineral disorder, alongside with infection, is the most efficient factor in morbidity, as well as a general and cardiovascular mortality incidence of such patients^{9,11,17–20}. The second most influential factor in the morbidity and mortality incidence is infection. Debates are held regarding the way in which the infection could influence the morbidity and mortality, as well as the mineral metabolism disorder, that is, calcium and phosphorus. An adequate explanation still awaits to be given.

The subject of this research is the relation between the serum calcium concentration and the complication incidence, especially the infection of the haemodialysis uremic patients. According to Block et al.¹ the conception serum mineral concentration disorder belongs to the correctable risk factors for morbidity and mortality. The aim is to study the relation between the low serum calcium concentration (hypocalcaemia) and the complication incidence, particularly of the infection as the most frequent complication and the most influential factor on morbidity and mortality of this population of patients.

Patients and Methods

120 haemodialysis uremic patients treated in the dialysis ward of the University Hospital Mostar, were included into this study. The aim of the research was to determine the relation between the serum calcium level and the complication incidence, with special reference to the relation with infections. The patients were chosen randomly, and only those patients with established AV-fistulae on the forearm, and who at the moment of beginning of the research did not exhibit any signs of local infection of the vascular access nor clinical symptoms nor laboratory findings, which would confirm sepsis. In addition, only those patients who at the moment of commencing the research did not have any signs of some other complication, which would put the vascular access and the life of a patients in danger, were chosen for the research in case. The patients were observed throughout the period of 18 months and all of them, alongside other blood tests in time intervals of 3 month, underwent relevant blood tests for examining the relation between the infection and the mineral disorder, as well as for the illustration of the observed patients' biological status of the organism.

Throughout the handling of the patients, the referent values of the serum calcium level, as well as phosphorus have been set, with a slight deviation, as it was done by Block and associates (2004) in their study. The referent

calcium levels in this study range from 9.0 mg/dL to 9.9 mg/dL, and phosphorus levels range from 4.0 mg/dL to 5.0 mg/dL. It should be pointed out that various authors in their reports state the calcium and phosphorus referent values in a vast range, which for calcium are generally from 8.5 mg/dL to 10.5 mg/dL, and from 3.5 mg/dL to 6.5 mg/dL for phosphorus.

Research was conducted in such a way that the values of serum calcium and phosphorus levels, determined in each individual patient, were compared to the complication incidence, to the incidence of total infection, sepsis and vascular access infection. In the illustration of the infection incidence, the incidence of the infection episode was also determined in each individual patient. In today's understanding of the relation between the serum values of the mentioned parameters the incidence of pathological changes in the organism, the accepted point of view is that there is no separate impact of the serum level of each examined parameter (calcium, phosphorus and parathormon) onto the biological functions of a healthy organism, yet their influence onto the functions of the organism with chronic renal failure has been particularly accentuated. The change of the serum level of one parameter causes the changes of the other two parameters, with subsequent effects on the organs and systems. Due to the network of serum relations and the effect on the organism of these three parameters, we are of the opinion that the research results of the relation between calcium metabolism disorder and complication incidence in haemodialysis uremic patients can also indirectly represent an illustration of phosphorus and parathormon disorders.

Descriptive statistics have been used in the basic evaluation of the numerical data in order to determine the mean values, the standard deviation and the span. Categorical data has been shown by the frequency of appearance as well as their proportion, that is, their percentage. In the statistical analysis we have used the Chi-square test. The statistical significance has been regarded on the level of importance $p \leq 0.05$. that is with 95% of relevance threshold. For the analysis of the collected data we have used the application program Statistics version 8.0. whereas the graphic presentation has been made in Excel.

Results

Table 1 illustrates the distribution of patients regarding the age and sex, whereas pathological conditions which caused terminal kidney failure (ESRD) are shown in Table 2. There it can be seen that the most common cause for kidney failure was hypertensive nephrosclerosis, and then interstitial nephritis followed by glomerulonephritis, whereas other pathological conditions were represented less.

Table 3 shows the co-morbidity again. Some of these co-morbid conditions, such as diabetic nephropathy, contribute as a self-acting agent to actively increase the morbidity and mortality of haemodialysis uremic patients.

TABLE 1
DISTRIBUTION OF PATIENTS ACCORDING TO AGE AND SEX

Age (years)	Male	Female	Total
11–20	–	1	1
21–30	3	–	3
31–40	8	6	14
41–50	10	7	17
51–60	23	13	36
61–70	10	7	17
71–80	15	13	28
81–90	–	3	3
91–100	1	–	1
Total	70	50	120

Table 4 illustrates the primary locations of infection as well as the number of patients with the infection. In the right column of the table, the number of patients with an isolated micro-organism of infection, that is, the kind of the micro-organism is shown. Therefore, it is evident that in some infectious patients the micro-organism is not isolated, whereas clinical signs and laboratory results have confirmed the presence of the infection. As it has become apparent from the shown data, the respiratory infection is the most common infection present in observed patients. It is followed by vascular approach infection, that is, localised infection of the vascular approach, which also represented the original point of sepsis alongside other points mentioned in the table.

Table 5 illustrates the minimum, the maximum, and the mean values, as well as the standard deviation of the observed serum level variables in all 120 patients. The table clearly shows that the mean value of serum calcium concentration is 8.94 mg/dL, the lowest value is 5.24 mg/dL and the highest is 13.12 mg/dL, whereas the stan-

dard deviation value is 0.84 mg/dL. The distribution of patients according to the serum calcium level, as well as the relation between the serum level and the inflammation incidence are illustrated in Table 6. From the first column in Table 6, it is evident that 76 (63.3%) patients had a serum calcium level below the lower threshold of the set referent values (9.0 mg/dL – 9.9 mg/dL), 39 (32.5%) of them within the threshold, and 5 (4.2%) of them above those values. In addition, it is evident from the same table that 48 (40.0%) out of the 120 (100.0%) observed patients had an infection. Out of those 48

TABLE 2
PATHOLOGICAL CONDITIONS WHICH CAUSED TERMINAL KIDNEY FAILURE (ESRD)

Cause of renal insufficiency	Total of patients
Hypertensive nephrosclerosis	35
Interstitial nephritis	27
Glomerulonephritis	21
Diabetic nephropathy	12
Chronic pyelonephritis	11
Polycystic kidney	6
Obstructive uropathy	5
Unknown	3
Total	120

TABLE 3
THE INCIDENCE OF CONCOMITANT DISEASES

Comorbidity	Number of patients	%
Cardiovascular diseases	51	42.5
Diabetes mellitus	12	10.0
Carcinoma	5	4.2
Others	2	1.7

TABLE 4
THE ILLUSTRATION OF THE PRIMARY LOCATION OF INFECTION AND THE KINDS OF ISOLATED MICRO-ORGANISMS IN OBSERVED PATIENTS WITH INFECTION

Primary spot of patients	Number of infection	Isolated micro-organism	Number of patients with micro-organism	%
Vascular approach	15	Staphylococcus epidermidis	4	26.6
		Staphylococcus aureus	6	40.0
Infection of respiratory system	16	Streptococcus pneumoniae	1	6.2
		Klebsiella pneumoniae	2	12.4
Infection of urinary system	9	Escherichia coli	3	33.3
		Enterococcus species	2	22.2
		Streptococcus pyogenes	1	25.0
Infection of skin and soft tissues	4	Streptococcus aureus	2	50.0
		Staphylococcus epidermidis	1	25.0
		Staphylococcus epidermidis	2	100.0
Endocarditis	2	Staphylococcus epidermidis	2	100.0
Others	2	–	2	–
Total	48	–	24	

(100.0%) patients with infection, 39 (81.25%) patients had a serum calcium level below 9.0 mg/dL, 9 (18.75%) of them within referent values, whereas none of the patients with an infection had the serum calcium level above upper threshold of referent values, that is, above 9.9 mg/dL. The results of the comparison of the hypocalcaemia incidence between the patients with an infection and those without an infection are given in the appendix to the Table 6. It is evident that there is a significant difference regarding the frequency of inflammation in patients with a serum calcium level below 9.0 mg/dL and those above 9.9 mg/dL ($\chi^2=3.99$, $p=0.0468$). Therefore, in the patients with a serum calcium level below 9.0 mg/dL, the infection is much more frequent.

Table 7 illustrates the relation between the serum calcium level and sepsis. There it is evident that out of 120 (100.0%) patients, 40 (33.3%) of them had sepsis. Out of those 40 (100.0%) patients with sepsis, 32 (80.0%) patients had a serum calcium level below the lower threshold for the referent calcium levels, that is, below 9.0

mg/dL, and 8 (20.0%) of them had serum calcium level within referent values, whereas none of the patients belonging to the group of patients with an increased serum calcium level, in other words, above 9.9 mg/dL, had sepsis. The results of the comparison of the hypocalcaemia incidence between the patients with sepsis and those without are illustrated in the appendix of Table 7. It is evident that there is a significant difference in the frequency of sepsis in those patients with a serum calcium level lower than 9.0 mg/dL, those with the level between 9.0 mg/dL and 9.9 mg/dL (referent values), as well as those above 9.9 mg/dL ($\chi^2=8.016$, $p=0.04$). The sepsis incidence is considerably higher in the patients with a lower serum calcium level than in those patients with a higher level.

The Relation between the serum calcium level and incidence, except for infection and other complications is shown in Table 8. As it is apparent from the aforementioned table, complications arose in 59 (49.16%) out of 120 (100.0%) patients. 44 (74.57%) of the 59 (100.0%) pa-

TABLE 5
RESULTS OF BLOOD TESTS (THE MAXIMUM, THE MINIMUM AND THE MEAN VALUES AS WELL AS STANDARD DEVIATION) OF VARIABLES

Variables	\bar{X}	Minimum	Maximum	Standard deviation
Serum Calcium mg/dL	8.94	5.24	13.12	0.84
Serum proteins g/L	63.46	30.6	85.1	6.93
Serum albumins g/L	36.6	20.2	50.1	3.8
C-reactive proteins mg/L	12.31	0.1	191.8	21.05
Serum ferritin μ g/L	169.05	4.43	1119	206.58
Haemoglobin g/L	102.61	59.0	160	17.83
Urea prior to dialysis mmol/L	21.3	5.2	44	5.16

TABLE 6
THE DISTRIBUTION OF PATIENTS ACCORDING TO THE SERUM CALCIUM LEVEL AND THE RELATION BETWEEN THE SERUM LEVEL AND THE INFECTION INCIDENCE

Serum Calcium level (mg/dL)	Number of patients				Patients with the infection	
	Total of patients	With infection	Without infection	The number of infection episodes		
				1	2	
<7.0	17	8	9	8	2	
7.0–7.9	15	11	4	11	3	
8.0–8.9	44	20		24	20	
9.0–9.9	39	9		30	9	
10.0–10.9	5	–	5	–	–	
>11.0	–	–	–	–	–	
Total	120 (100%)	48 (40%)	72 (80%)	48	8	
Serum calcium level (mg/dL)		The number of patients with an infection	The number of patients without an infection	χ^2	p	
<9.0		48	72	3.99	0.0468	
>9.9		0	5			

TABLE 7
THE RELATION BETWEEN THE SERUM CALCIUM LEVEL AND THE SEPSSES INCIDENCE

Serum calcium level (mg/dL)	Number of patients			
	With sepses	Without sepses	Total	%
<7.0	6	11	17	64.7
7.0–7.9	8	7	15	46.7
8.0–8.9	18	26	44	59.1
9.0–9.9	8	31	39	74.5
10.0–10.9	–	5	5	100.0
>11.0	–	–	–	–
Total	40 (33.3%)	80 (66.6%)	120 (100.0%)	

Serum calcium level (mg/dL)	Number of patients with sepses	Number of patients without sepses	χ^2	p
<9.0	32	44		
9.0–9.9	8	32	8.016	0.04
>9.9	–	5		

tients with complications had a serum calcium level below 9.0 mg/dL, whereas 15 (25.42%) of them had a calcium level within the referent values, that is, between 9.0 mg/dL and 9.9 mg/dL. The difference is 49.15% and it is statistically significant ($p < 0.05$).

15 (12.5%) patients out of 120 (100.0%) exhibited an inflammation of the vascular access. The relation between the vascular access inflammation incidence and the serum calcium level was observed as shown in Table 9, 12 (80.0%) out of 59 (100.0%) patients with the infection of vascular access had, as shown in Table 9, a serum calcium level below 9.0 mg/dL, and 3 (20.0%) of them had a serum calcium level within the referent values, whereas the inflammation of this localisation and the type was not exhibited among the patients with a serum calcium level above 9.9% mg/dL. In this relation it has been established that the inflammation of the vascular access was exhibited only among the patients with hypocalcaemia, and not even once in those patients with hypercalcaemia. The results of the comparison of the vascular access inflammation incidence difference between the pa-

tients with a serum calcium level below 9.0 mg/dL and those patients with serum calcium level above 9.9 mg/dL are shown in the appendix of Table 9. There is no significant difference between the observed groups ($\chi^2 = 0.098$; $p = 0.7598$).

Discussion

The incidence of kidney diseases is increasing and there are more patients with terminal kidney failure⁷ and the mortality of haemodialysis uremic patients is high^{1–3} even today. In the last decade, research has been conducted in order to establish and determine the risk factors for such high morbidity and mortality^{11–14}. There are numerous factors that participate in the increased morbidity and mortality of dialysis patients, and lately a lot of attention has been placed on infections and the mineral metabolism disorder. In recent times, a lot of attention has also been given to the research of the influence of increased serum calcium and phosphorus levels onto the morbidity and mortality of this population of pa-

TABLE 8
THE RELATION BETWEEN THE SERUM CALCIUM LEVEL AND THE COMPLICATION INCIDENCE

Serum calcium level (mg/dL)	Complications						Total
	Inflammation	Thrombosis	»Steal« syndrome	Monomyelic neuropathy	Pseudo-aneurisms	Bleeding serum	
<7.0	8	–	–	–	–	–	8
7.0–7.9	11	3	–	–	–	–	14
8.0–8.9	20	1	–	–	–	1	22
9.0–9.9	9	4	–	–	1	1	15
10.0–10.9	–	–	–	–	–	–	–
>11.0	–	–	–	–	–	–	–
Total	48	8	0	0	1	2	59

TABLE 9
THE RELATION BETWEEN THE SERUM CALCIUM LEVEL AND THE VASCULAR ACCESS INFECTION INCIDENCE – THE NUMBER OF INFECTION EPISODES

Serum calcium level (mg/dL)	Number of patients		Patients with an infection	
	With infection of the vascular access	Without infection of the vascular access	the number of infection episodes	
			1	2
<7.0	3	14	1	1
7.0–7.9	5	10	4	–
8.0–8.9	4	40	4	–
9.0–9.9	3	36	3	–
10.0–10.9	–	5	–	–
>11.0	–	–	–	–
Total	15	105	12	1

Serum calcium level (mg/dL)	Patients with an infection of the vascular access	Patients without an infection of the vascular access	χ^2	P
<9.0	12	64	0.098	0.7598
>9.9	0	5		

tients. In dissecting such a relation, an issue of establishing the conditions and parameters that cause the oscillation of serum levels and mineral disorders arise, which then has an effect on morbidity and mortality. Particularly these moments, which alongside the conditions for terminal kidney failure cause the mineral metabolism disorder, which establish the basis for the increased morbidity and mortality by far. These are the risks factors that Block et al.¹ mention, which according to them can be influenced, and consequently, reduce morbidity and mortality.

The influence of the serum calcium and phosphorus concentration onto the frequency of complications in dialysis patients, as the most influential factor, did not gain the position it deserves in research. The question arises, whether, and in what way, does the serum calcium and phosphorus disorder in dialysis patients influence the complications' occurrence, and consequently infection, as the most frequent complication, which is the second most influential factor in the high morbidity and mortality of this population of patients. Accordingly, the second most influential factor in morbidity and mortality is infection. The discussions regarding the manner in which the infection could affect the morbidity and mortality, as well as the mineral metabolism disorders are held. The issue is whether the infection and the mineral metabolism disorder, as the two most influential factors in morbidity and mortality incidence, act in synergy. Whether mineral metabolism disorders, in this case calcium and phosphorus, create suitable conditions for infection occurrence, which would then lead to an increased morbidity and mortality, is also one of the issues. Whether, and in what stage, do these two parameters, that is, the infection and the calcium and phosphorus metabolism disorder appear in unison by chance, or is there any cause-effect

relation in the occurrence and interaction of these two parameters in this population of patients? Whether the regulating serum calcium and phosphorus concentration could reduce the infection incidence, as well as the morbidity and mortality? What is the relation between these two most influential factors, that is, mineral metabolism disorder and infection as the most frequent complications for morbidity as well as total and cardiovascular mortality of dialysis patients, are some of the issues only to be instigated in practice and science. There are certain indications that open the possibility of a unison effect of infection and serum calcium disorders onto the morbidity and mortality of this population of patients^{17,18,21–24} and there is a presumption that it is just a case of accompanying simultaneous occurrences of these phenomena. Young et al.⁹ determined a higher mortality incidence in patients with extreme calcium concentration values in dialysis. In this study, we would like to determine the relation between the serum calcium concentration and total complication incidence, total inflammation, sepsis and vascular access localised infection, that is to determine whether the changes of serum calcium concentration in the observed population of patients influence the complication incidence, to what degree, and especially that of infection. Is the simultaneous manifestation of these two parameters throughout the haemodialysis treatment, if it was successfully proven by this study, coincidental findings or does this imply a possible connection between the serum calcium concentration changes and complication incidence?

The research topic of this study is therefore the relation of disorders between the serum calcium level and the complication incidence in dialysis patients, with a special reference to infections as the most frequent complication. It is surprising that a relation between the low

serum calcium concentration and the morbidity and mortality incidence has still remained insufficiently recognised in practice, and consequently subjected to thorough research. Leafing through medical journals we have come across to only one article that deals with such a relation. Gulati et al.²⁴ in their research determined a statistically significant relation of hypocalcaemia and the infection incidence, and they considered it, besides other things, the infection risk factor. They also mention that they had not come across any other published scientific articles that deal with such a relation. All the attention is directed to the relation between hypercalcaemia and morbidity and mortality^{6,7,11,17,18,20–22}. Foley et al.²⁵ in their early research found a significantly increased morbidity and mortality ratio even in the dialysis patients with lower serum calcium levels. Nakai et al.²⁶ and Osawa²⁷ whose work is much more recent also mention this. Thus, in the aforementioned circumstances, both in practice and in science regarding the comprehension of the relation between low serum calcium level and high morbidity and mortality incidence in the observed population of patients in particular, gave us an incentive, amongst other things, to subject such a relation to research.

It is evident from Table 5 that there is a great difference between the highest and the lowest serum calcium value in observed patients, where the lowest value was 5.24 mg/dL and the highest 13.12 mg/dL. It has been determined that 39 (32.5%) of the observed patients had a serum calcium concentration within referent values, that is, between 9.0 mg/dL and 9.9 mg/dL, whereas 76 (63.3%) of the patients were below these values, and 5 (4.2%) were higher than these values. These results are somewhat different from the reports of other authors^{9,27}. It is important to point out that comparisons are more difficult due to the differently set of referent values of the calcium throughout the research of other authors. Therefore, it is apparent that from a therapy approach to the patients undergoing the programme of chronic haemodialysis, a homeostatic calcium disorder in the sense of hypocalcaemia should be taken into consideration in order to reduce both morbidity and mortality. Neither science nor the practice pay as much attention to this relation as they should. The change of the serum calcium concentration was the trigger of the metabolic changes of other minerals and pathological conditions, hence it deserves further studies in determining a therapy approach to the phenomenon of the mineral metabolism disorder, both in a sense of hypercalcaemia and hypocalcaemia, in order to create possibilities to reduce the morbidity and mortality of haemodialysis uremic patients.

The infection incidence (Table 6) is significantly higher in patients with hypocalcaemia ($\chi^2=3.99$; $p=0.0468$). The same relation was shown in the relation between the sepsis incidence and serum calcium level, as it was illustrated in Table 7; in other words the sepsis incidence is considerably higher in patients with a serum calcium level below 9.9 mg/dL, than among those patients with a calcium level above this value ($\chi^2=8.016$; $p=0.04$). The total complication incidence (Table 8), among the pa-

tients with hypocalcaemia is higher than in those patients with serum calcium level within referent values, and the difference is 49.15%, which is statistically significant ($p<0.05$). The examined relation between the serum calcium level and the vascular access local infection incidence illustrates in the same way that infection was more frequent in patients with hypocalcaemia than in those patients with a serum level above the upper threshold of the referent values 9.9 mg/dL. However, this difference is not statistically significant ($\chi^2=0.098$, $p=0.7598$). The research results in the first three examined relations that is, the total infection incidence, sepsis and total complications on the one hand, and the calcium level on the other, showed that hypocalcaemia can be viewed as a participant in increased morbidity, and consequently in the mortality of haemodialysis uremic patients. The fact that the results of the established relation between hypocalcaemia and vascular access infection (Table 9), and the determined difference is apparent, and yet are not statistically significant, can be supported by the fact that a small number of cases were taken into the examination of this relation, in order to determine the real relation between hypocalcaemia and vascular access local infection incidence.

At the end of the completed programmed research of the relation between the serum calcium level and complications in haemodialysis uremic patients, the concisely laid out achieved results are as follows:

1. 76 (63.3%) patients had a serum calcium concentration below the lower threshold of referent values (9.0 mg/dL – 9.9 mg/dL), 39 (32.5%) of them within the limits, and 5 (4.2%) of them above those values;
2. 48 (40.0%) out of 120 (100.0%) patients had infection. The infection incidence is significantly higher in patients with hypocalcaemia ($\chi^2=3.99$; $p=0.0468$);
3. Out of 48 (100.0%) patients with infection, 40 (89.6%) of them had sepsis. The sepsis incidence is significantly higher in patients with hypocalcaemia ($\chi^2=8.016$; $p=0.04$);
4. The incidence of total complications is significantly higher in patients with hypocalcaemia ($p<0.05$);
5. The incidence of vascular access infection is significantly higher in patients with hypocalcaemia. However, the difference is not statistically significant ($\chi^2=0.098$, $p=0.7598$);
6. The total infection incidence in all 120 observed patients is 3.8 episodes for 100 patients months.

Conclusion

The serum changes and mineral metabolism disorders are the most prominent factor in the morbidity incidence, as well as general and cardiovascular mortality of haemodialysis uremic patients. It has been determined that the complication incidence, especially those of infection is increased in the patients with hypocalcaemia, as the most frequent and the most influential complication in the increased morbidity and mortality of observed patients.

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ODNOS SERUMSKE RAZINE KALCIJA I INCIDENCIJE KOMPLIKACIJA U BOLESNIKA LIJEČENIH KRONIČNOM HEMODIJALIZOM

SAŽETAK

Poremećaj metabolizma minerala je najutjecajniji čimbenik u incidenciji morbiditeta i mortaliteta bolesnika liječenih kroničnom hemodijalizom. Drugi je utjecajni čimbenik upala koja je najčešća i najpogubnija komplikacija. Zadnje je vrijeme promatran odnos povišenih serumskih razina kalcija i fosfora s jedne te morbiditeta i mortaliteta s druge strane u te populacije bolesnika, dok je ipak nedovoljno stručne i znanstvene pažnje posvećeno odnosu niže serumске razine kalcija (hipokalcemija) i incidencije komplikacija, posebno upale. Promatrano je kroz 18 mjeseci 120 bolesnika liječenih kroničnom hemodijalizom i njih 76 (63,3%) je imalo serumsku razinu kalcija ispod donje granice referentnih vrijednosti (9,0–9,5 mg/dL). U bolesnika s nižom serumskom razinom kalcija (hipokalcemija) utvrđena je značajna incidencija upale ($\chi^2=3,99$; $p=0,0468$), značajna incidencija sepse ($\chi^2=8,016$; $p=0,04$), značajna incidencija ukupnih komplikacija ($p=0,05$), a uočena je i veća incidencija lokalne upale vaskularnog pristupa, ali bez statističke značajnosti postignutih rezultata ispitivanja tih odnosa ($\chi^2=0,098$; $p=0,7598$). Smatramo da je potrebno ispitati incidenciju lokalne upale vaskularnog pristupa na većem broju bolesnika pa bi tada i u ispitivanju tih odnosa, za očekivati je, bila izražena statistička značajnost. Sveukupna incidencija upale u svih 120 promatranih bolesnika je 3,8 na 100 bolesnikovih mjeseci. Zaključak: Postignuti rezultati ukazuju na udruženost u pojavljivanju niske serumске razine kalcija (hipokalcemija) i povećane incidencije komplikacija, posebno upale što ukazuje na potrebu daljnjeg istraživanja kako bi se programiranim terapijskim pristupom uspjelo smanjiti morbiditet, a onda i mortalitet promatrane populacije bolesnika.