CHANGES IN THE VALUES OF SERUM BIOCHEMICAL PARAMETERS OF PATIENTS UNDERGOING DIALYSIS

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Abstract. *Chronic kidney disease (CKD) is closely monitored due to its high prevalence, the high cost of the renal replacement therapy (RRT) and comorbidities – especially cardiovascular diseases, as well as due to the asymptomatic nature of the disease to advanced stages. The most real method for assessing the performance of renal replacement therapy is the rate of patient survival. In Romania, the treatment through haemodialysis is dominant (80%), while kidney transplant is used to a lower degree (13%). As for their survival, the patients undergoing transplants present the lowest mortality rates, while haemodialysis and peritoneal dialysis present similar rates of survival, both lower than the one for transplants. The application of a certain haemodialysis technique and strategy, individualized according to the patient's particularities, must be strictly guided by clinical and paraclinical parameters. This implies a regular cadence of investigations, differentiated according to the patient's clinical condition and to how long they have been undergoing dialysis. The results of quantitative determinations from patients diagnosed with chronic kidney disease, undergoing dialysis, were centralized and analysed. All the biochemical parameters the study was focused on were determined through the usual methods in the clinical laboratory. Serum creatinine revealed an average of about eight times higher in men (9.96 mg/dL±2.54,) and six times in women, respectively (8.23 mg/dL±2.16) than the maximum value of the biological reference range (1.2 mg/dL). Serum urea presented an average of 131.97mg/dL±21.02 (306.90% compared to the maximum value of the reference range) in men and 139.01mg/dL±33.56 in women (323.27% compared to the maximum value of the reference range). The two parameters suggest strong perturbation of the renal function, with a drastic decrease in glomerular filtration. The high serum levels of potassium, highly depressed heart function and decreased alkaline reserve, all point to the same thing. In addition, probably because of the erythropoietin deficit, the haemoglobin values were 78.29% in men and 80.81% in women respectively, compared to the normal biological minimum value that suggests the onset of anaemia in all patients. The distribution of patients by age categories revealed that in men it mostly appeared between the ages of 50 and 59, while in women between 40 and 49.*

Keywords*: Chronic kidney disease, haemodialysis, glomerular filtration, serum creatinine, serum urea*

INTRODUCTION

Chronic kidney disease (CKD) is recognized as a public health problem worldwide. The global prevalence estimated of CKD is 13.4% (11.7-15.1%) and the number of patients with a kidney disease in the final stage, in need of renal replacement therapy is estimated between 4.902 and 7.083 million. Through its effect on the cardiovascular risk and the necessity of renal replacement therapy, CKD directly affects global morbidity and mortality. The overall increase of this disease is mainly due to the increase in the prevalence of diabetes, hypertension, obesity and aging. In some areas around the world, other causes such as infections, plant toxins and the environment are still frequent. The large number of deaths due to poor access to renal replacement therapy in developing countries, as well as the increase in the number of final stage patients in the future, will mean a substantial financial burden even for the richest countries. The cost-effectiveness of prevention strategies to reduce the burden of disease should be assessed in relation to local development and economic resources (JI-CHENG LV & LU-XIA ZHANG, 2012). CKD is considered a matter of public health in Romania,

too, due to its high prevalence (10%), among the highest values in Europe; the estimated number of adult patients with CKD was 1.900.000 (https://www.spcaroldavila.ro/wp-content/uploads/2015/09/2013_Raport-RO2013.pdf).

CKD patients have associated conditions such as diabetes, hypertension, cardiovascular diseases, and mortality is twice as frequent in these patients, which indicates the need for multidisciplinary care. In addition, there have been described two distinct social groups that require tailored prevention programs: female patients who live in rural areas with increased risk of CKD and male patients with CKD in urban areas with high mortality risk. (https://www.spcaroldavila.ro/wp-content/uploads/2015/09/2013_Raport-RO2013.pdf).

The most real method for assessing the performance of renal replacement therapy is the rate of patient survival. From the point of view of their survival, the patients undergoing transplants present the lowest mortality rates, while hemodialysis and peritoneal dialysis present similar rates of survival, both lower than the one for transplants. The economic costs of renal replacement therapy methods are different: hemodialysis is the most expensive, followed by peritoneal dialysis and kidney transplant. As the rate of kidney transplant is still low in Romania, hemodialysis and peritoneal dialysis remain the most commonly used methods in renal replacement treatment, with a highly-debated survival rate, where the attending physician decides which method is to be used for each patient. Studies have shown that, in Romania, patients with hemodialysis have a lower survival rate during the first year of therapy and a higher survival rate in the following years, compared with the patients undergoing peritoneal dialysis (MIRCESCU ET AL., 2014). Similarly, in patients older than 65 who also suffer from diabetes, the survival rate was higher in the ones who underwent hemodialysis (SEOK ET AL., 2015). Other studies found a superior survival rate with peritoneal dialysis, even for a long period of therapy (RUFINO ET AL., 2011). Compared with the European method, in Romania hemodialysis treatment is dominant, (80% vs. 51%), and kidney transplant is used to a much lower rate (13% vs. 41%) (Român RR. Raportul Anual al Registrului Renal Român 2012. Bucureşti, România: Ministerul Sănătăţii – Spitalul Clinic de Nefrologie “Dr. Carol Davila” 2013.). The studies do not show significant differences between the survival rates of patients undergoing hemodialysis and the ones undergoing peritoneal dialysis.

According to the dates published by the Romanian Renal Registry, in Timiș County, in 2017, 383 patients underwent dialysis; of these, 377 received renal replacement therapy through hemodialysis and 6 through peritoneal dialysis. 54 deaths were recorded. According to the same data, there are 6 dialysis centers in Timiș County (3 in public institutions, 3 in private institutions) with 95 pieces of dialysis equipment, resulting a number of 4 patients for every device (https://www.spcaroldavila.ro/wp-content/uploads/2015/09/Raport2017Jud.pdf).

MATERIAL AND METHODS

Samples were collected from 31 patients (14 men and 17 women) diagnosed with chronic renal failure, in their third week of renal replacement therapy through hemodialysis. The samples of venous blood were collected in the vacutainer method, in sterile, separator gel test tubes, tightly sealed, of approximately 2.0 mL. After coagulation and sedimentation, the samples to be determined were centrifuged at 4000 rpm for 10 minutes. Following the centrifugation, the samples were scanned in order to identify the patient, to establish the parameters to be determined, and were placed in holders corresponding to Cobas 6000 analyzer, module c501, and then introduced into the analyzer to determine the characteristic biochemical parameters, and the results were stored and processed statistically. The profile of

the disease involves the determination of several biochemical parameters: serum creatinine, serum uric acid, serum calcium, serum urea, serum sodium and serum phosphorus.

RESULTS AND DISCUSSIONS

Administration of a hemodialysis strategy must be decided on in accordance with the patients' particularities, in correlation with their clinical and paraclinical parameters, tailored for each patient's clinical condition and the period of time elapsed since their first dialysis. A monitoring sheet is drawn up for the dialysis patient and the investigations are mainly aimed at: cardiovascular complications (HTA, atherosclerosis), hematological complications (anemic syndrome, hemorrhagic syndrome), endocrine-metabolic complications (renal osteodystrophy), neurological complications (uremic polyneuritis) (http://www.srnefro.ro/wp-content/uploads/2014/08/Ghid_dializa-MG_2003.pdf).

The investigation of the results of dialysis patients reveals that two of the parameters indicativ of renal function, serum creatinine and serum urea, have values that are outside the biological reference range (table 1, table 2).

Table 1

Changes in serum biochemical parameter values in male patients

Patient	Age (years)	Serum uric acid (mg/dL)	Serum creatinine (mg/dL)	Serum urea (mg/dL)	Serum calcium (mg/dL)	Serum phosphorus (mg/dL)	Serum potassium (mmol/L)	Serum sodium (mmol/L)	Alkaline reserve (mmol/L)	Serum iron (µg/dL)	Serum ferritin (ng/mL)	HGB	MCHC	RDW
1.	34	8.1	6.67	114.6	9.31	5.46	3.97	138	23.5			8.8	33.1	12.8
2.	63	7	6.1	114.1	8.24	3.34	4.33	145	20.8			11.6	34.3	12.5
3.	51	8	13.07	137.4	8.04	9.24	5.61	133	14.9	40.25	18.18	13	31.4	16.9
4.	54	5.6	10.2	128.5	8.04	3.69	5.82	140	20.5	130.41	2553	10.3	33.3	14.6
5.	48	5.9	7.45	143	8.44	4.52	6.73	132	22.9	34.55	1780	10.7	32.9	14.7
6.	34	7	12.44	114.3	8.75	7.14	5.27	136	19.7	47.34	538	10.5	33.9	13.5
7.	50	6	12.75	120	9.07	4.41	5.18	173	19.4			9.7	34.2	14.3
8.	50	5.7	6.53	109.2	9.34	5.36	4.35	140	18.7			13.4	33.8	13.2
9.	40	5.9	12.6	112.3	9	2.9	5.4	137.4	18.7			10.9	34.4	13.2
10.	40	7	9.5	138.7	9.5	6.2	5.3	140	23.3			8.7	33.1	14.4
11.	60	6.1	8.09	127.4	9.63	4.21	4.96	135	20.8	115.63	175.1	11.3	33.5	13.6
12.	68	6.4	10.49	165.8	8.65	6.32	6.55	137	16			8.9	32.8	14.2
13.	43	6.6	12.09	142.6	9.24	4.27	4.96	140	21.1			9.6	33.1	13.8
14.	51	5.9	11.1	179.7	9.3	4.7	5.8	136	20.4			10.7	31.9	18.5
Average		**6.51**	**9.93**	**131.97**	**8.89**	**5.12**	**5.30**	**140.17**	**20.05**	**73.63**	**1012.85**	**10.57**	**33.24**	**14.3**
Standard deviation		**0,80**	**2.54**	**21.02**	**0.53**	**1.67**	**0.78**	**10.01**	**2.48**	**45.60**	**1104.22**	**1.43**	**0.86**	**1.61**
Minimum		**5.6**	**6.1**	**109.2**	**8.04**	**2.9**	**3.97**	**132**	**14.9**			**8.7**	**31.4**	**12.5**
Maximum		**8.1**	**13.07**	**179.7**	**9.63**	**9.24**	**6.73**	**173**	**23.5**			**13.4**	**34.4**	**18.5**
% maximum normal values (*minimum)		**93**	**827.5**	**306.27**	**88.9**	**113.77**	**103.92**	**96.66**	***91.13**	**38.15**	**253.21**	***78.29**	**94.97**	**96.62**
Biological reference range / unit of measurement		**3.4-7 mg/dL**	**0.7-1.2 mg/dL**	**13-43 mg/dL**	**8.06-10 mg/dL**	**2.5-4.5 mg/dL**	**3.5-5.1 mmol/L**	**136-145 mmol/L**	**22-29 mmol/L**	**59-193 µg/dL**	**30-400 ng/mL**	**13.5-16.9 g/dL**	**32.4-35g/dL**	**11.6-14.8 %**

below the minimum reference values | above the minimum reference values

Creatinine, the break-down product of the creatine synthesized by the liver, gives an approximation of the rate of glomerular filtration, because any disturbance of renal function

reduces the excretion of creatinine, causing an increase in serum creatinine (https://www.synevo.ro/shop/creatinina-serica/). The normal values of serum creatinine are between 0.7 and 1.2 mg/dL. Determination of serum creatinine in investigated patients revealed an average of approximately eight times higher in men (9.96 mg/dL±2.54, 827.5% higher than the maximum value of the reference range) (Table 1, Fig. 1) and six times in women, respectively (8.23 mg/dL±2.16, which is 685.83% higher than the maximum value of the reference range) (Table 2, Fig. 1)). In 35.71 % of the dialyzed men, the creatinine value is very close to the maximum values obtained (13.07 mg/dL), and of the dialyzed female patients, 17,64% present values that are close to the maximum values obtained (11.95 mg/dL).

Urea, the main nitrogenous end product of aminoacid metabolism, is mainly eliminated through glomerular filtration; 40-60% rediffuses in the blood in close relation with the tubular flux and to the antidiuretic hormone (ADH) (MASUD ET AL., 2002; WEINER ET AL., 2015).

Table 2

Changes in serum biochemical parameter values in female patients

Patient	Age (years)	Serum uric acid (mg/dL)	Serum creatinine (mg/dL)	Serum urea (mg/dL)	Serum calcium (mg/dL)	Serum phosphorus (mg/dL)	Serum potassium (mmol/L)	Serum sodium (mmol/L)	Alkaline reserve (mmol/L)	Serum iron (µg/dL)	Serum ferritin (ng/mL)	HGB	MCHC	RDW
1.	76	5.9	6.4	84.3	9.4	5	4.8	139	21.9			11.7	31.6	**14.8**
2.	52	7	9.45	145.9	8.33	8.38	6.7	140	20.9			11.5	33.1	**13.9**
3.	49	6.2	8.18	118.4	9.25	3.68	7.36	139	24.8			10.6	32.7	**13.5**
4.	57	6	9.8	186	8.14	8.12	4.6	139	16.9			10.8	33.3	**14.5**
5.	46	5.8	11.95	199.9	9.18	10.41	6.81	136	1.4	98.31	109.5	9.2	32.2	**14.8**
6.	42	5.1	11.4	175.3	8.1	6.2	5.5	135.7	14.8	48.9	330.6	11.1	31.8	**15.1**
7.	80	5.3	5.2	95.4	8.32	6.1	4.13	139	22.4			10.4	32.3	**16.6**
8.	64	4.8	7.78	132.4	7.64	6.34	5.08	137	26.8	57.42	204.80	9.7	31.7	**15.9**
9.	66	6.4	7.59	152	9.22	6.02	6.26	136	21	74.14	2855	11.3	32.5	**15.2**
10.	48	6.2	8.36	133.6	8.66	5.78	4.9	140	19.7	79.99	389.3	10.7	32.7	**13.1**
11.	51	7.4	9.99	120.8	8.59	7.05	5.65	140	20.4	90.98	260.8	11.3	30.9	**17.6**
12.	55	4.9	7.87	165.8	9.3	6.93	6.73	137	18.3			11.8	32.2	**15**
13.	41	5	6.51	135.1	8.9	6.45	4.6	139	20.9			10.3	32	**14.4**
14.	21	6.1	5.4	86.7	9.14	4.08	5.43	138	17			10.9	29.7	**13.9**
15.	49	6.9	7.1	114.5	8.28	5.04	5.69	138	20.8			13.1	31.9	**15.4**
16.	55	5.1	11.51	161.6	8.08	6.51	5.49	142	15.3			10.8	31.6	**14.6**
17.	37	6.5	5.42	155.6	8.34	5.61	4.32	142	18.2			10.3	33	**12.3**
Average		**5,91**	**8.23**	**139.01**	**8.63**	**6.33**	**5.53**	**138.62**	**18.91**	**74.95**	**691.66**	**10.91**	**32.07**	**14.74**
Standard deviation		**0,78**	**2.16**	**33.56**	**0.53**	**1.61**	**0.95**	**1.89**	**5.48**	**19.05**	**1064.27**	**0.88**	**0.87**	**1.26**
Minimum		**4,8**	**5.2**	**84.3**	**7.64**	**3.68**	**4.13**	**135.7**	**1.4**	**48.9**	**109.5**	**9.2**	**29.7**	**12.3**
Maximum		**7.4**	**11.95**	**199.9**	**9.4**	**10.41**	**7.36**	**142**	**26.8**	**98.31**	**389.3**	**13.1**	**33.3**	**17.6**
% maximum normal values (*minimum)		**84.42**	**685.83**	**323.27**	**86.3**	**140.66**	**108.43**	**95.6**	***85.95**	**38.83**	**172.91**	***80.81**	***98.98**	**99.59**
Biological reference range / unit of measurement		**3.4-7 mg/dL**	**0.7-1.2 mg/dL**	**13-43 mg/dL**	**8.06-10 mg/dL**	**2.5-4.5 mg/dL**	**3.5-5.1 mmol/L**	**136-145 mmol/L**	**22-29 mmol/L**	**59-193 µg/dL**	**30-400 ng/mL**	**13.5-16.9 g/dL**	**32.4-35g/dL**	**11.6-14.8 %**

below the minimum reference values | above the minimum reference values

Urea in the blood and urine varies in direct proportion to the protein diet and is inversely proportional to cellular anabolism during the states of growth, pregnancy, convalescence. Increased values of serum urea indicate a significant alteration in glomerular filtration rate. Serum urea presented abnormal values: an average of 131.97mg/dL±21.02 (306.90% compared with the maximum value of the reference range) in men and

139.01mg/dL±33.56 in women (323.27% compared with the maximum value of the reference range) (Fig. 1). Given that the lab data indicate an increase in blood urea to 50-150 mg/dL in cases of significant impairment of renal function, we can classify patients in the group of subjects in this category, corroborating the serum creatinine values. Moreover, two dialyzed male patients (representing 14.28% of the total number) and seven dialyzed female patients (41.17% of the total number) present values of serum urea within the range 150-250 mg/dL, which indicates severe impairment of the glomerular function. A protein diet must be monitored and adjusted permanently, because studies show that hemodialysis determines an acceleration of protein catabolism (KO ET AL., 2017).

Hyperuricemia, together with high values of creatinine and urea, is an indicator of kidney failure. Recent studies have shown that, irrespective of the protein levels in the diet, hyperuricemia determines an increase in the rate of mortality among dialyzed patients (ZAWADA et al., 2020). In dialyzed male patients, the mean value of serum uric acid was 6.51mg/dL±0.80 (93% of the maximum value of the reference range), and in dialyzed female patients it was 5.91 mg/dL±0.78 (84.42% of the maximum value of the reference range) (Fig. 1); these values were within the reference range, (3.4-7 mg/dL) with only one exception (7.4 mg/dL in a female patient).

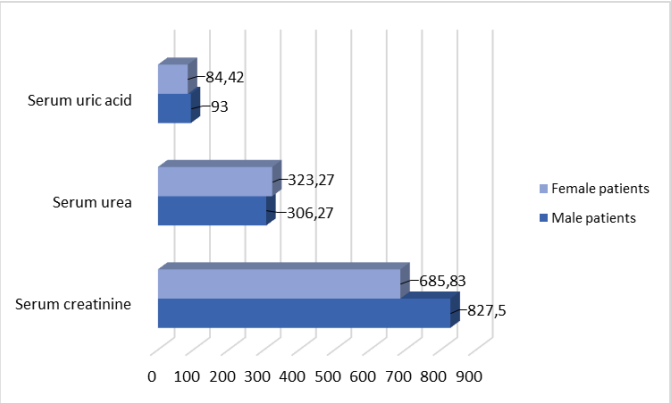

Figure 1. Percentage representation of mean serum creatinine, serum urea and serum uric acid in dialysis patients

Abnormalities of phospho-calcium and bone metabolism occur early in chronic kidney disease, they continue through the progressive loss of renal functions and may be influenced by therapeutic interventions (http://www.srnefro.ro/wp-content/uploads/2014/08/Ghid_HPTH_2005.pdf). Current monitoring guidelines for dialysis patients suggest a frequency of monitoring of biochemical parameters of bone mineral metabolism, happening weekly at the beginning of the therapy, twice a month in the first three months and then monthly. The objectives of monitoring are to maintain biochemical parameters within normal limits correlated with the stages of chronic renal disease and to establish the corrective therapeutic intervention.

Hormonal regulation of calcium and phosphorus metabolism is complex. The mutual relations between the small intestine, skeleton, kidneys and the endocrine system, in particular the parathyroid glands, maintain the homeostasis of calcium and phosphorus. Also, calcitonin, vitamin D3 estrogens, androgens are factors that influence calcium levels. The amount of protein in the blood affects calcium levels, as 45% of serum calcium is bound to protein. Thus, the decrease in serum albumin causes a decrease in total serum calcium

(https://www.synevo.ro/shop/calciu-seric/). The value of serum calcium was on average 8.89±0.53 mg/dL for men, within the limits of the biological reference range (8.06-10 mg/dL), except for the cases of two patients which presented slight hypocalcemia (8.04 mg/dL). In women, the average values of serum calcium were 8.63±0.53 mg/dL, within the biological reference range), except for one patient where the recorded value suggests hypocalcemia (7.64 mg/dL). Normocalcemia can be explained by the fact that the patients investigated in this study are at the beginning of renal function supplementation by hemodialysis, as the protein diet will be restricted, this condition may be canceled, patients enter hypocalcemia, and deficit correction therapy is required.

The mean value of serum phosphorus in men was 5.12±1.67 mg/dL (with a maximum of 9.24 mg/dL) and in women 6.33±1.61 mg/dL (with a maximum of 10.41 mg/dL). These values suggest hyperphosphatemia (for men 113.77% and for women 140.66% higher than the maximum value of the reference range) (Fig. 2). The correction of increased phosphatemia is made through the diet, correlated with the protein needs of the patient, in order not to favor malnutrition. Since the types of food that contain high quantities of phosphates are meat, fish, dairy products, wholemeal bread and sodas, the diet should be designed in such a way as to ensure adequate protein and energy intake but with the lowest level of phosphorus. Since kidneys are the main regulators of phosphorus homeostasia, increased serum phosphorus values indicate chronic kidney disease. However, serum phosphorus levels should always be assessed together with calcium levels, as there is an inverse relationship between the two elements: the increase of one of the two electrolytes in the blood determines the increase of the urinary excretion of the other electrolyte.

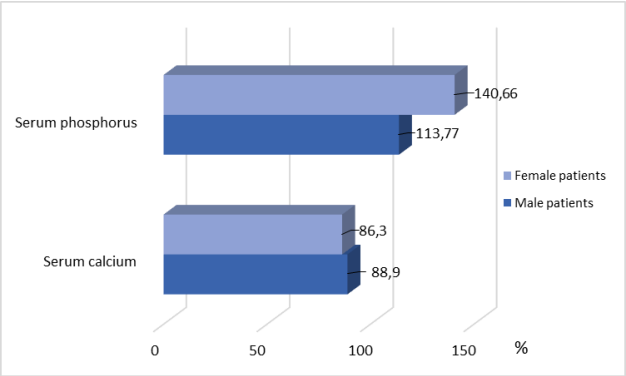

Figure 2. Percentage representation of mean serum calcium and serum phosphorus in dialysis patients

The investigation of the alkaline reserve as an assessment of the onset of acid-base imbalance revealed the installation of a metabolic acidosis, associated with chronic renal disease, due to decreased renal reabsorption/formation of $HCO3^{-}$ in all patients. The processing of data from dialyzed men reveals an average alkaline reserve value of 20.05 ± 2.48 mmol / L (91.13% compared to the minimum value of the biological reference range). In women, the mean value of the alkaline reserve was 18.91 ± 5.48 mmol / L (85.95% compared to the minimum value of the biological reference range) and the values were inhomogeneous (minimum value of 1.4 mmol / L).

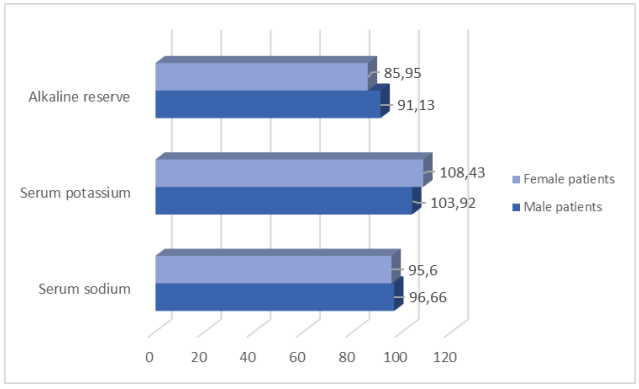

Figure 3. Percentage representation of the average values of the alkaline reserve, potassium and serum sodium in dialysis patients

Mean serum potassium levels were elevated in all patients (hyperkalaemia). In men the mean serum potassium was 5.30 ± 0.78 mmol / L (103.92% compared to the maximum value of the reference biological range) and in females the mean serum potassium was 5.53 ± 0. 95 mmol / L (108.43% compared to the maximum value of the biological reference range) (Fig. 3). This can be explained by decreased potassium excretion in the kidneys, which is extremely depressing for heart function, as potassium along with calcium and magnesium ions controls contraction and cardiac output and cardiovascular complications are the leading cause of death for the dialyzed patient. This is commonly seen in metabolic acidosis coupled with decreased alkaline reserves in the body.

The mean serum sodium values in the analyzed patients undergoing dialysis are within the biological limits (in men the mean value was 140.17 ± 10.01 mmol / L and in women, 138.62 ± 1.89 mmol / L) even if this condition it is characterized by hyponatremia due to impaired renal function, when water appears in excess relative to the sodium concentration, due to reduced renal excretion while the intake continues (ARROYO, 2008 & WEIR, 2008).

The investigation of hemoglobin levels was consistent with other studies linking anemia to the type of dialysis (more severe in hemodialysis compared to peritoneal dialysis), gender (more severe in women compared to men) or various associated pathologies such as diabetes (more severe in those diagnosed with diabetes) (CANA-ROIU DANIELA ET AL., 2012; CANA-ROIU DANIELA ET AL., 2013).

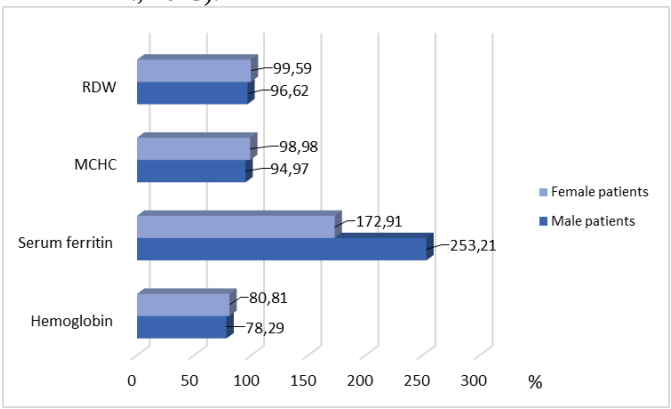

Figure 4. Percentage representation of mean hemoglobin, ferritin, MCHC and RDW in dialysis patients

Thus, in men, the mean value of hemoglobin was 10.57±1.43 g/dL and in women 10.91±0.88 g/dL (which represent 78.29% and 80.81% respectively, of the biological minimum normal value) (Fig. 4). In this case, anemia involves erythropoietin deficiency, inefficient erythropoiesis and inadequate red blood cell count (CASESA ET AL., 2018). It is of utmost importance to know the factors and mechanisms that contribute to the development of anemia in chronic kidney disease, as their correction can improve the degree of anemia and thus can slow the progression of the disease. The conclusion is also supported by the increase in serum ferritin which indicates the inefficiency of erythropoiesis and altered mobilization of iron stores. (KALTWASSER, 1998). Serum ferritin had a mean value of 1012.85 ± 1104.22 in men (253.21% compared to the maximum biological reference range 30-400 ng / mL) and in women 691.66 ± 1064.27 (172.91% compared to the maximum value of the biological reference range) (Fig. 4). All these values were correlated with hypochromia in women and marked anisocytosis (erythrocyte populations of different sizes) (Table 1 and 2).

Regarding the age of dialyzed patients, it was extremely inhomogeneous in both sexes. For men, the age was between 34 and 68 and for women, between 21 and 80. As a percentage, by age groups, in men most patients belonged to the age group 50-59 years (35.71% of the total cases) followed by the age group 40-49 years (28.57% of the total cases) and the age group 60-69 (21.42% of total cases). In women, most patients were in the 40-49 age group (35.29%), followed by patients in the 50-59 age group (29.41%), and 60-69 ani (11.76%), respectively (Fig. 5).

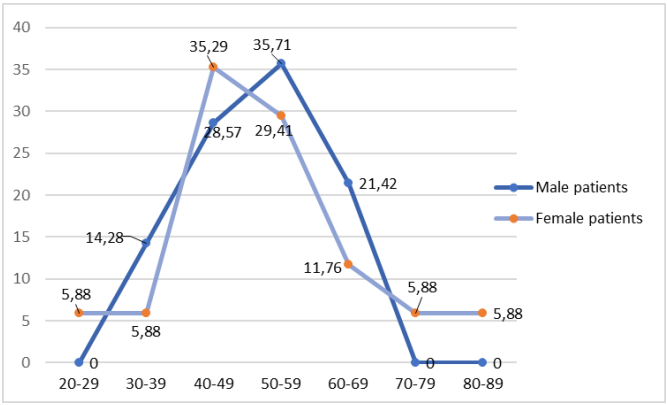

Figure 5. Distribution of dialysis patients by age categories

CONCLUSIONS

Serum creatinine in the investigated patients revealed an average of approximately eight times higher in men (9.96 mg / dL ± 2.54) and six times in women (8.23 mg / dL ± 2.16, respectively) compared to the maximum value of the biological reference range (1.2 mg / dL). Serum urea showed abnormal values of 131.97 mg / dL ± 21.02 (306.90% compared to the maximum biological reference range) in men and 139.01 mg / dL ± 33.56 in women (323.27% compared to the maximum value of the biological reference range). The two parameters suggest a strong disturbance of renal function with a drastic decrease in glomerular filtration.

Monitoring of dialysis patients revealed normocalcemia, serum calcium values within the normal biological limits (in men 8.89 ± 0.53 mg / dL, in women 8.63 ± 0.53 mg / dL) but serum potassium values were higher than the maximum biological reference range (in men, 5.12 ± 1.67 mg / dL and in women 6.33 ± 1.61 mg / dL), indicating chronic kidney disease.

The decrease in alkaline reserve suggests the installation of metabolic acidosis, associated with chronic kidney disease; the average value was 20.05 ± 2.48 mmol / L in men (91.13% compared to the minimum value of the biological reference range) and in women, the average value of alkaline reserve was 18.91 ± 5.48 mmol / L (85.95% compared to the minimum value of the biological reference range). Mean serum potassium levels were elevated in all patients (hyperkalaemia). (5.30 ± 0.78 mmol / L, and 5.53 ± 0.95 mmol / L respectively) compared to the biological reference range (3.5-5.1 mmol / L). The condition is extremely depressing for heart function, as potassium along with calcium and magnesium ions control heart contraction and flow and cardiovascular complications are the leading cause of death for the dialysis patient.

The hemoglobin level was on average 10.57 ± 1.43 g / dL in men and in women 10.91 ± 0.88 g / dL (which represents in men 78.29% and in women 80.81% of the minimum normal biological value) and which suggests the onset of anemia in all patients, probably due to erythropoietin deficiency.

The distribution of patients by age groups in the examined group was as follows: most of the male patients belonged to the age group 50-59 years (35.71% of all cases) followed by the age group 40-49 years (28.57% of total cases) and the age group 60-69 years (21.42% of total cases). In the case of women, most patients were in the 40-49 age group (35.29%), followed by the 50-59 age group (29.41%) and the 60-69 age group, respectively (11.76 %).

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