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ORIGINAL ARTICLE

Biomarkers hematological in detection of inflammation with illness renal chronicle in hemodialysis: one analysis evaluation

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Abstract

Introduction: it is known that the proportions of different blood cell components are new inflammatory markers that have good predictive value in the outcome of chronic kidney disease, cardiovascular diseases, rheumatic diseases, among others, including the neutrophil/lymphocyte ratio, monocyte/lymphocyte ratio, and platelet/lymphocyte ratio.

Objective: to evaluate the inflammatory profile, through the neutrophil/lymphocyte, platelet/lymphocyte, and monocyte/lymphocyte parameters in patients with chronic kidney disease on hemodialysis.

Methods: analytical cross-sectional study. The analyses were conducted using R software (version 4.2.2). A total of 112 hemodialysis patients were evaluated, excluding cases with missing data per variable. Biomarkers such as neutrophil/lymphocyte, platelet/lymphocyte, and monocyte/lymphocyte ratios were analyzed by boxplot to verify symmetrical and outliers and compared between patients with and without inflammation. Student's t-tests, preceded by assessments of normality (Shapiro-Wilk) and homogeneity of variance (Levene), compared the groups and the reference values of the biomarkers.

Results: the comparison between groups without inflammation and with inflammation, identified by the neutrophil/lymphocyte, platelet/lymphocyte and monocyte/lymphocyte ratio, showed a significant difference between the three parameters ($p<0.05$). To verify the consistency of the inflamed and non-inflamed groups, the parameters were compared to the reference values, in the three biomarkers, two groups differed statistically ($p<0.05$) from the reference value, with the exception of patients with inflammation, who in the platelet/lymphocyte ratio marker did not differ from the reference value, suggesting that this biomarker, alone, may not be sufficient to detect inflammation in this group.

Conclusion: the study highlights the relevance of hematological biomarkers in identifying inflammation in hemodialysis patients. Although isolated platelets/lymphocytes were not sufficient for this diagnosis, other markers stood out, indicating the need for an integrated analysis for greater diagnostic accuracy.

Keywords: chronic kidney disease; inflammation; hemodialysis; biomarkers.

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Authors summary

Why was this study done?
This study was carried out to identify the effectiveness of neutrophil-lymphocyte, platelet-lymphocyte and monocyte-lymphocyte ratios as biomarkers in detecting inflammation in patients with chronic kidney disease on hemodialysis, aiming to improve the diagnosis and improve the clinical management of these patients.

What did the researchers do and find?
The researchers of this study used hematologic data such as neutrophil/lymphocyte, platelet/lymphocyte, and monocyte/lymphocyte ratios. The results of this study together provide important elements on the usefulness of hematologic biomarkers in identifying inflammatory processes in patients undergoing hemodialysis.

What do these findings mean?
The study shows that the neutrophil-lymphocyte, platelet-lymphocyte and monocyte-lymphocyte ratio biomarkers are a strong indicator of the inflammatory state of patients and can be used in clinical practice.

Highlights
This study highlights the importance of hematologic biomarkers in detecting inflammation in hemodialysis patients, specifically neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR) and monocyte/lymphocyte ratio (MLR). The novelty of the study is the finding that, although MLR alone may not be sufficient to detect inflammation, the other markers (NLR and MLR) showed a significant association with inflammation. This reinforces the need for an integrated and multifactorial approach for a more accurate diagnosis of inflammation in hemodialysis patients .

INTRODUCTION

Chronic kidney disease (CKD) is a global public health condition that affects millions of people and has a significant impact on patients' quality of life. It is characterized by a progressive and irreversible loss of kidney function and is closely associated with serious complications such as cardiovascular disease, metabolic disorders and a substantial increase in the risk of mortality[1].

Globally, hemodialysis is still the most important renal replacement therapy. With the continued development and optimization from the technology of dialysis, the time of survival of patients on maintenance hemodialysis (MHD) is gradually prolonged. However, even in developed countries, the mortality rate of patients with MHD remains high[2].

The function renal and evaluated for the filtration glomerular (FG) and the your decrease and observed in CKD, associated with the loss of regulatory, excretory and endocrine functions of the kidney. When GFR reaches very low values, less than 15mL/min/1.73m^2, what we call functional renal failure (FFR) is established, that is, the most advanced stage of the continuum of progressive functional loss observed in CKD[3].

This loss of kidney function is slow, progressive and irreversible, causing the body to no longer be able to maintain metabolic and hydroelectrolytic balance[4,5].

Despite recent advances in dialysis technology, solutes, and membranes[6], patients in dialysis run one risk significantly increased of death premature due to the high risk of cardiovascular and infectious complications, often related to wasting[7]. This increased risk is closely linked to the underlying inflammatory processes that also play a crucial role in the progression of chronic kidney disease[8].

The inverse relationship between glomerular filtration rate (GFR) and inflammation levels has recently been established. In the Chronic Renal Insufficiency study Cohort (CRIC), it was observed that inflammatory biomarkers, such as IL-1β , IL-1 receptor antagonist, IL-6, TNF-α, CRP and fibrinogen, showed inverse associations with measures of renal function and positive associations with albuminuria[9]. Different biomarkers of inflammation appear to have different predictive value in CKD[10].

It is known what to the proportions of different components of the cells blood they are new inflammatory markers, which have good predictive value in the outcome of CKD, cardiovascular diseases, rheumatic diseases, among others, including the neutrophil/lymphocyte ratio (NLR)[11-14], monocyte/lymphocyte ratio (MLR)[15-18] and platelet/lymphocyte ratio (PLR)[19-23].

Given the current socioeconomic scenario, it is crucial to seek biological markers that offer an advantageous cost-effectiveness ratio. As we explore the utility of markers extrapolated from other areas, the platelet-to-lymphocyte ratio (PLR) and the neutrophil-to-lymphocyte ratio (NLR) have been increasingly used in renal patients. Specifically, they are employees as indicators of inflammation, damage endothelial and, more recently, as predictors of mortality[24-26].

These markers are promising due to their ease of measurement, low cost and potential predictive value in renal patients. By analyzing the relationship between these parameters and clinical outcomes, healthcare professionals can obtain important information to guide patient management and follow-up, even in challenging socioeconomic contexts[24-26].

In view of the above, the objective of this study was to evaluate the profile inflammatory, through the parameters neutrophil/lymphocyte, platelet/lymphocyte and monocyte/lymphocyte in patients with CKD on hemodialysis.

METHODS

Design of study

Analytical cross-sectional study , with a quantitative approach with hemodialysis patients.

Study location and period

The search he was developed node Hospital of the Kidneys from the city of River White, Acre, northern region of Brazil. The hospital come on consolidating its assistance to its patients in quality and safety with cutting-

edge technology, including one of the most modern hemodynamic services on the market. With a complete structure, it serves a dozen specialties, as cardiology, oncology, neurosurgery, between others. The hospital account still with a highly modern ICU.

All the data collected were of month September of 2023.

Population of study and criteria of eligibility

The sample consisted of chronic renal patients on HD at the Hospital who were over 18 years old, of both sexes, who had not undergone transplants, who had been on hemodialysis for more than 6 months and who agreed to have access to their medical records containing biochemical tests. There are a total of 112 patients, divided into two daily shifts, Monday, fourth and Friday and other in the third, fifth and Saturday. THE first turn of each day starts at 7a.m. and ends to the 12:30 p.m. The second turn start to the 12hours and ends to the 6pm each turn with 30 patients.

Collect of data

To the collect of data, they were made collected laboratory monthly for the hospital and the data obtained by the machine of hemodialysis Fresenius Medical Care 4008S V10, always in the first week of each month and on the same days.

All data were collected in the month of September 2023. Sociodemographic data included: age, sex, income monthly, marital status and education. Clinical and hematologic data included neutrophil count (mm/^{3}), lymphocytes (mm/^{3}), monocytes (mm/^{3}), platelets (mm/^{3}). RNL, RML and RPL they were calculated dividing you neutrophil, monocyte and platelet per lymphocyte ratios, respectively.

For the inflammation score, NLR, RPL and RML values were used. According to the study of Liao *et al.*[2], where determined you values of court of RNL, RPL and RML through of receiver operating characteristic (ROC) analyses, found that a NLR cutoff value of 4.56 had a sensitivity of 0.695 and a specificity of 0.602; a cutoff value of RML of 0.38 had sensitivity of 0.780 and specificity of 0.634; one value of RPL cutoff of 202 had a sensitivity of 0.559 and specificity of 0.509 to differentiate mortality put all to the causes, put quite of analysis ROC. From agreement with you values of ideal cutoffs, RNL, RML, and RPL were given 0 or 1 points, respectively. Then, the inflammation score was obtained by adding the scores of RNL, RPL, and RML.

Analysis of the data

All to the analysis they were carried out using the software R, version 4.2.2 (R Core Team, 2023).

The analysis sociodemographic of the patients hemodialysis with and without inflammation, were performed as to the aspects descriptive (frequency absolute and relative), the comparison between groups was performed using the chi-square test. 112 patients were analyzed, however, in function from the lack of information of some patients us aspects sociodemographic (variable), the size sample put variable he was changed, then the patient without information to the respective variable analyzed was excluded from the analysis.

Biomarker data: Neutrophil/Lymphocyte Ratio (NLR), Platelet/Lymphocyte Ratio (PLR) and Monocyte/Lymphocyte Ratio (RML) were analyzed put using boxplot , to check for symmetry and extreme values (outlier). In this analysis, a boxplot was first performed with all the data for each biomarker and then with the data from patients without inflammation and with inflammation separately, for the three biomarkers.

Student ‘s t-test was performed to verify whether patients without and with inflammation differed. For this purpose, for each marker, patients without and with inflammation were separated into independent samples. The data from patients without and with inflammation detected by each biomarker were compared separately using the Student ‘s t-test to the reference value of the biomarker (NLR = 4.56; RPL = 202; RML = 0.38). In this analysis, the sample mean is compared to the reference mean to verify whether there is a statistical difference between them . Before performing the Student ‘s t-test, the data underwent normality analyses using the Shapiro-Wilk test and equality of variances using the Levene test, with the aid of the byf.shapiro () and eveneTest () functions , respectively.

Aspects ethical and legal from the search

The study was approved with opinion number: 6,085,783 by the Research Ethics Committee. of Hospital of the Clinics of ACRE – HCA/FUNDACRE and followed all the recommendations of resolution no. 466/2012 of the National Health Council, which deals with research and testing on human beings. All participants signed the Free and Informed Consent Form.

RESULTS

It was observed what the gender no influence node process inflammatory us 3 biomarkers evaluated, no having difference statistically significant ($p>0.05$) between you patients with inflammation and without inflammation according to sex (table 1).

He was observed what the range age no influenced node process inflammatory of the patients (table 2). Thus, age was not shown to be a determining factor for the inflammatory process of hemodialysis patients ($p>0.05$).

In table 3, according to the data, the inflammatory process is independent of purchasing power and was not a fundamental factor for the onset of the clinical condition. When statistical analysis was performed, no difference was observed in this variable ($p>0.05$).

You patients with inflammation and without inflammation they were analyzed and separated put shifts, morning and afternoon. Regardless of the circadian cycle and hormonal production, both the morning and afternoon shifts did not influence ($p>0.05$) the inflammatory process of hemodialysis patients (table 4).

Table 5 illustrates the relationship between marital status and inflammation. It was observed that regardless of whether the patient had a stable emotional relationship, marital status did not statistically influence the inflammatory process ($p>0.05$).

Table 1: Description of sex of patients without inflammation and with inflammation of hospital of the Kidneys of the city of Rio Branco-Acre, for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Sex	Without inflammation		With inflammation		total	p-value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
Feminine	29	42.65	7	28.00	36	0.29
Masculine	39	57.35	18	72.00	57	
Relationship platelet/lymphocyte						
Feminine	27	40.30	9	34.62	36	0.79
Masculine	40	59.70	17	65.38	57	
Relationship monocyte/lymphocyte						
Feminine	18	46.15	18	33.33	36	0.30
Masculine	21	53.84	36	66.67	57	

Source: authors

Table 2: Description from the range age of patients without inflammation and with inflammation, Hospital dos Rins in the city of Rio Branco-Acre, for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Age range (years)	Without inflammation		With inflammation		Total	p-value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
Until 60 years	37	59.68	11	50	48	0.59
Over 60 years	25	40.32	11	50	36	
Relationship platelet/lymphocyte						
Until 60 years	14	56	34	57.63	48	0.99
Over 60 years	11	44	25	42.37	36	
Relationship monocyte/lymphocyte						
Until 60 years	24	51.06	24	64.86	48	0.29
Over 60 years	23	48.94	13	35.14	36	

Source: authors

Table 3: Description from the income of patients without inflammation and with inflammation, hospital of the Kidneys of the city of Rio Branco-Acre, for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Income	Without inflammation		With inflammation		Total	p-value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
Until 3 wages	55	79,71	18	78,26	73	0,99
Above 3 wages	14	20,29	5	21,74	19	
Relationship platelets/lymphocytes						
Until 3 wages	53	77,94	20	83,33	73	0,99
Above of 3 wages	15	22,06	4	16,67	19	
Relationship monocyte/lymphocyte						
Until 3 wages	31	79,49	42	79,25	73	0,08
Above of 3 wages	8	20,51	11	20,76	19	

Source: authors

Table 4: Description of turn of service of patients without inflammation and with inflammation at the Kidney Hospital in the city of Rio Branco-Acre for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Shift of day	Without inflammation		With inflammation		total	p-value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
First	31	58.49	10	52.63	41	0.86
Second	22	41.51	9	47.37	31	
Relationship platelet/lymphocyte						
First	28	54.90	13	61.90	41	0.78
Second	23	45.10	8	38.10	31	
Relationship monocyte/lymphocyte						
First	20	55.56	21	58.33	41	0.99
Second	16	44.44	15	41.67	31	

Source: authors

Table 5: Description of state civil of patients without inflammation and with inflammation, at the Kidney Hospital in the city of Rio Branco-Acre, for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Marital status	Without inflammation		With inflammation		total	p-value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
Married	44	62.86	18	72.00	62	0.56
Single	26	37.14	7	28.00	33	
Relationship platelet/lymphocyte						
Married	48	69.57	14	53.85	62	0.23
Single	21	30.43	12	46.15	33	
Relationship monocyte/lymphocyte						
Married	28	70.00	34	61.82	62	0.54
Single	12	30.00	21	38.18	33	

Source: authors

Regarding education (table 6), it was evident that regardless of whether the patient had higher education or not, this was not statistically significant for the inflammatory process (p>0.05).

There was a statistical difference between the groups without inflammation and with inflammation in the biomarkers RNL (p = 2.632-9), RPL (p = 5.855-5) and RML (2.2-16) (Figures 1a, 1b and 1c). The results from RNL and RPL showed that there were, respectively, 1 and 3 patients with a very high degree of inflammation, compared to other patients with inflammation (figures 1a and 1b).

Table 6: Description from the education of patients without inflammation and with inflammation, at the Kidney Hospital in the city of Rio Branco-Acre, for the biomarkers neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and monocyte/lymphocyte ratio

Education	Without inflammation		With inflammation		Total	p- value
	N	%	N	%		
Relationship neutrophil/lymphocyte						
With superior	58	82.86	24	96.00	82	0.19
Without superior	12	17.14	1	4.00	13	
Relationship platelet/lymphocyte						
With superior	59	85.51	23	88.46	82	0.97
Without superior	10	14.49	3	11.54	13	
Relationship monocyte/lymphocyte						
With superior	35	87.50	47	85.45	82	0.99
Without superior	5	12.50	8	14.55	13	

Source: authors.

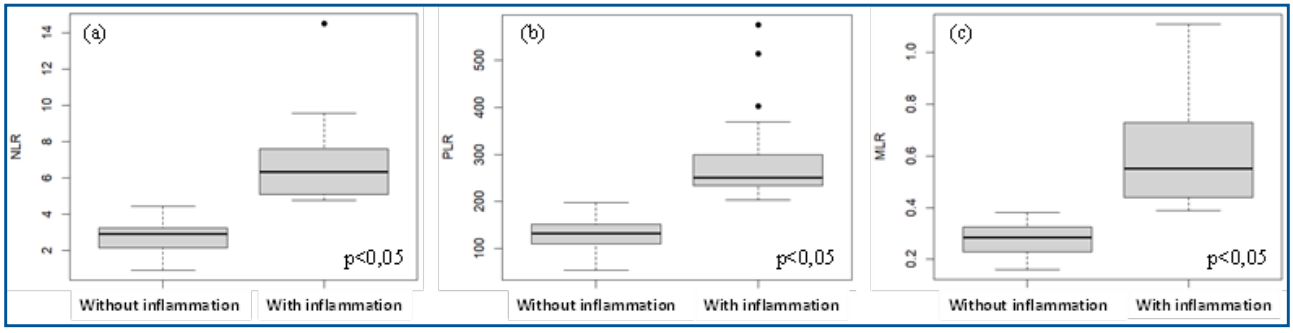

Figure 1: Comparison between groups without inflammation and with inflammation, identified regarding Neutrophil/Lymphocyte Ratio (NLR) (a), Platelet/Lymphocyte Ratio (PLR) (b) and Monocyte/Lymphocyte Ratio (MLR) (c) of patients at the Kidney Hospital in the city of Rio Branco- Acre

Source: authors.

To verify the consistency of the diagnosis, patients in the inflamed and non-inflamed groups had their parameters compared to the biomarker reference values (table 7). It was observed that the 2 groups differed statistically in the 3 biomarkers ($p<0.05$). of value of reference, the exception of the patients with inflammation, what node marker RPL did not differ from the reference value.

Table 7: Averages of patients without and with inflammation compared the values of reference of the biomarkers neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR) and monocyte/lymphocyte ratio (MLR)

Group	Biomarkers					
	RNL	p-value	RPL	p-value	RML	p-value
No inflammation	2.76	2.2 -16*	181.02	1.215 -9*	0.28	8,277 -13*
With inflammation	6.76	4.776 -5*	189.22	0.272	0.61	2.52 -11*
Reference value	4.56	-	202	-	0.38	-

* Indicates difference significant between each group (without inflammation and with inflammation) with the value of reference at 5% probability by Student's t-test. The lack of asterisk indicates absence of statistical difference between each group (without inflammation and with inflammation) with the value reference, considering an alpha of 5% probability by the Student's t-test.

Source: authors.

DISCUSSION

The results of this study together provide important elements regarding the usefulness of hematologic biomarkers in identifying inflammatory processes in patients undergoing hemodialysis. Although the sociodemographic analysis did not reveal statistically significant differences in the distribution of the biomarkers analyzed, the comparison between patients with and without inflammation, using reference values, highlighted significant nuances. In particular, the platelet/lymphocyte ratio (PLR) in patients with inflammation did not differ from reference values, suggesting that this biomarker, in isolation, he can no to be enough to detect inflammation in that group. Nonetheless, When the biomarkers were evaluated individually, a statistically significant relationship was observed between inflammation and the other markers, reinforcing the need for an integrated and multifactorial approach for a more accurate diagnosis of inflammation in hemodialysis patients.

THE age advanced and one factor of risk to the DRC, the Society Brazilian of Nephrology developed the Census Brazilian of Dialysis in 2012, performing one stratification of those who undergo renal replacement therapy and it was found that the vast majority of patients (63.6%) they were in the range age of 19 the 64 years. In our study, 57.15% of the patients were aged up to 60 years and 42.85% were aged higher than 60 years[27]. In study by Da Cunha et al., 54.89% of patients were over 60 years old and 45.12% were under 60 years old[28].

The realization that no there was statistically significant difference between age groups in relation to the inflammatory process suggests that the impact of age may not be an aggravating factor in this specific pathological process for the population studied.

The socioeconomic situation of hemodialysis patients, as well as their families, is a factor to be considered as it can be decisive in the quality and continuity of treatment. failure renal chronic. There is of if consider what such fact he can come the influence on access to medicines not provided by the Unified Health System, which favors the appearance of complications that aggravate the progression of kidney disease[29].

A study carried out with people undergoing hemodialysis found that most of them no work then no present conditions physical to carry out activity labor[30,31]. In our study, 79.35% of patients receive up to 3 minimum wages per month, and only 20.65% receive more than 3 minimum wages per month. Corroborating our studies, NR de Vargas *et al.*, reported that in their research, hemodialysis patients who received up to 3 minimum

wages represented 80.8% of patients, while 15.4% received up to 3 minimum wages and 3.8% did not report their monthly income[32].

Those results highlight the complexity of the interactions between factors socioeconomic factors and health. While financial status may influence access to health care resources, it is important to recognize that other factors, such as lifestyle, genetics, and quality of medical treatment, also play significant roles in regulating the inflammatory profile.

So while financial status is a crucial consideration, it is equally important to assess and address these other factors that may impact patients' inflammatory status. This more comprehensive approach may provide more accurate insights. on to the influences multiple and interconnected in the health and to help the guide more effective intervention and treatment strategies.

Regarding the shift in which hemodialysis is carried out, there appears to be a divergence in the literature regarding the benefits and challenges associated with different hemodialysis shifts. While some studies suggest that hemodialysis in the morning shift is associated with better sleep quality, increased survival and lower prevalence of insomnia, others studies point to one bad quality of sleep subjective and high prevalence of depression between you patients submitted the hemodialysis node turn from the morning, with one potentially better sleep quality in night shift patients[33-35].

These discrepancies may be attributed to a variety of factors, including differences in study methodology, patient demographic and clinical characteristics, and of variations us protocols of treatment of hemodialysis in different centers physicians. For example, age, comorbidities, duration of hemodialysis, quality of treatment and individual adaptation to the schedule may influence the results[33-35].

Despite the discrepancies found in the literature regarding the different hemodialysis shifts and their potential effects on patients' quality of life and sleep, it is important to highlight that in relation to the inflammatory process, we did not find statistically significant differences between the different shifts.

When analyzing marital status, positive marital quality is generally associated with lower low-grade chronic inflammation, but not everyone benefits equally from spousal support[36].

Factors such as perceived quality of relationship, the effectiveness of the support received and the individual characteristics of the partners can influence the magnitude of the impact of the support conjugal in the health. Put example, in some cases, same in relationships positive, can exist stressors external or internal what mitigate you benefits of support conjugal in reducing chronic inflammation[36].

Additionally, individuals in negative or conflictual relationships may experience an increase in chronic inflammation due to stress and lack of emotional support. Therefore, while the quality conjugal positive he can be a factor protector against chronic inflammation for many, it is important to recognize that the effects may vary according to a number of contextual and individual factors[36].

Spousal support plays a crucial role in couples' relationships, but its implications to the health they can to be varied. Second Wilson SJ and al., influenced by prejudice of assignment and by the theories of aging, conclude what both the age as for satisfaction conjugal play papers important in the relations between the support conjugal and biomarkers of healthy aging[37].

This suggests that the quality of relationship and the age of partners may interact in complex ways to influence how spousal support affects aging processes. He can be one association more strong between the support conjugal and biomarkers of healthy aging in older couples or in couples with higher levels of marital satisfaction[37]. However, in our study, it was found that there was no difference in the process inflammatory in relationship to the state civil, those results suggest what, although the marital support may have positive health implications with regard to the inflammatory process evaluated by the biomarkers in our study, the state civil of the patients does not appear to be a determining factor.

Node level of education, Boylan JM *et al*., examined multiple aspects from the experience and expression from the anger (frequency, expression external, suppression, control) as moderators of the association of social inequality measured by educational status with markers of inflammation, interleukin 6 and protein W reactive (IL-6 and PCR) and coagulation, where found that relationships inverse between education and markers of inflammation they were more strong between individuals with high anger and were attenuated among those with high anger control[38].

Results distinct they were found in this study, indicating what others factors beyond the level educational they can perform one paper more significant in the regulation from the inflammatory response. Those factors they can include questions genetics, environmental, of style of life and even the quality of medical treatment received.

Inflammation is one of the central pathophysiological factors in kidney disease. In a review systematic, he was verified that you biomarkers inflammatory more used were TNF- α and IL-6, which they are biomarkers what no do part of blood count and exams of routines and need to be requested[39], showing what you parameters evaluated in that work they can be useful in clinical practice and low cost.

Albarrán -Sánchez A, *et al*., report what you patients who passed away had diagnosed with hypertension for more years and presented significant differences in the blood count and acute phase reactants and an increase in NLR[40].

Lu *et al.,* evaluated 86 patients undergoing peritoneal dialysis (PD) for follow-up of 36 months to investigate the association between the RNL and markers of arterial stiffness. The results suggest that elevated NLR is independently associated with arterial stiffness and predicts cardiovascular and all-cause mortality in patients with PD[41].

Kato A, *et al.*, evaluated Glasgow Prognostic Score (standard and modified), NLR, PLR, Prognostic Index and

Prognostic Nutritional Index, in long-term hemodialysis patients term and reported what all the markers (including RNL and RPL) were associated with higher total mortality rates[42].

In a study published by Catabay *et al.*, elevated NLR in incident hemodialysis patients predicted mortality, especially in the short term. NLR, but not PLR, added a modest benefit in predicting mortality along with demographics, comorbidities, and serum albumin, and should be included in prognostic approaches[43]. In our work, when verifying the diagnostic consistency of the 3 biomarkers, the RPL no differed of value of reference, or it is, with basis in that biomarker, patients might not be diagnosed as inflamed.

In the study by Erhan Tártaro, *et al*., where they investigated the association of the neutrophil/lymphocyte ratio and of the platelet/lymphocyte ratio with clinical outcomes in geriatric patients with chronic kidney disease (CKD), concluded that the neutrophil/lymphocyte ratio predicts all-cause mortality in geriatric patients with chronic kidney disease, however, the relationship platelets/lymphocytes no he was associated the death and the need of therapy renal replacement therapy independently[44].

Liao *et al.,* established an inflammation scoring system including NLR, MLR, and PLR and found that a higher inflammation score was independently associated with all-cause mortality in HD patients[2].

Study limitations

Some patients did not provide complete information on sociodemographic variables, which may affect the analysis. Future studies could expand the sample size and explore other inflammatory biomarkers to validate the findings presented. In addition, longitudinal approaches could clarify the progression of inflammation in hemodialysis patients.

CONCLUSION

This study highlights the importance of hematologic biomarkers in detecting inflammation in hemodialysis patients. Although sociodemographic analysis did not show differences significant us biomarkers, the comparison between patients with and without inflammation revealed important points. The relationship platelet/lymphocyte ratio (PLR) in patients with inflammation was similar to reference values, suggesting that this biomarker alone may not be sufficient to detect inflammation. However, other markers showed a significant association with inflammation, reinforcing the importance of an integrated approach for a more accurate diagnosis.

Contribution of the authors:

All authors contributed to the manuscript. Fabiano Santana of Oliveira: Participated from the guidance general from the search, definition of design of study, statistical analysis, discussion of results and final version of the text. Mauro José de Deus Morais: Participated in the study design, statistical analysis, discussion of results and final version of the text. Clemeson Silva de Souza: Participated in the statistical analysis. Luiz Carlos de Abreu: Participated in the general orientation of research, definition of study design, analysis statistics, discussion of results and final version of the text. Andrés Ricardo Pérez-Riera: Participated in the orientation general from the search, definition of design of study, analysis statistic, discussion of the results and final version of the text.

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Conflict of interests

All authors no report no conflict of interests.

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Resumo

Introdução: sabe-se que as proporções de diferentes componentes das células sanguíneas são novos marcadores inflamatórios, que têm bom valor preditivo no resultado da doença renal crônica, doenças cardiovasculares, doenças reumáticas, dentre outras, incluindo a relação neutrófilo/linfócito, relação monócito/linfócito e relação plaqueta/linfócito.

Objetivo: avaliar o perfil inflamatório, através dos parâmetros neutrófilo/linfócito, plaqueta/linfócito e monócito/linfócito em pacientes com doença renal crônica em hemodiálise.

Método: estudo transversal analítico. As análises foram conduzidas no software R (versão 4.2.2). Foram avaliados 112 pacientes hemodialíticos, com exclusão de casos com dados ausentes por variável. Biomarcadores como relação neutrófilo/linfócito, plaqueta/linfócito e monócito/linfócito foram analisados por boxplot para verificar simetria e outliers, e comparados entre pacientes com e sem inflamação. Testes de t de Student, precedidos por avaliações de normalidade (Shapiro-Wilk) e homogeneidade de variância (Levene), compararam os grupos e os valores de referência dos biomarcadores.

Resultados: a comparação entre grupos sem inflamação e com inflamação, identificados quanto a relação neutrófilo/linfócito, plaqueta/linfócito e monócito/linfócito, os três parâmetros tiveram diferença significativa entre os grupos ($p<0,05$). Para verificação de consistência dos grupos inflamados e não inflamados, os parâmetros foram comparados aos valores de referência, nos 3 biomarcadores, 2 grupos diferiram estatisticamente ($p<0,05$) do valor de referência, a exceção dos pacientes com inflamação, que no marcador relação plaqueta/linfócito não diferiram do valor de referência, sugerindo que esse biomarcador, isoladamente, pode não ser suficiente para detectar inflamação nesse grupo.

Conclusão: o estudo evidencia a relevância dos biomarcadores hematológicos na identificação de inflamação em pacientes em hemodiálise. Apesar da plaqueta/linfócito isolada não se mostrar suficiente para esse diagnóstico, outros marcadores destacaram-se, apontando a necessidade de uma análise integrada para maior precisão diagnóstica.

Palavras-chave: doença renal crônica; inflamação; hemodiálise; biomarcadores