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LABORATORY BIOMARKERS IN COVID-19 AS GUIDELINES FOR A NURSING CARE PLAN: A REVIEW STUDY

BIOMARCADORES LABORATORIAIS NA COVID-19 COMO NORTEADORES PARA PLANO DE CUIDADOS DE ENFERMAGEM: ESTUDO DE REVISÃO

BIOMARCADORES DE LABORATORIO EN COVID-19 COMO PAUTAS PARA ELABORAR UN PLAN DE ATENCIÓN DE ENFERMERÍA: ESTUDIO DE REVISIÓN

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Objective: to research, in the literature, the laboratory profile of patients severely affected by COVID-19, as well as to organize a Nursing care plan according to the changes in biomarkers listed in this review. Method: an integrative review carried out in the MEDLINE and PubMed databases. Articles involving adult and hospitalized patients were included. Those that did not answer the guiding question were excluded, as well as genetic or immunological studies, repeated studies and opinion articles. Subsequently, Nursing diagnoses and interventions were listed for the laboratory alterations found. Results: a total of 25 articles were reviewed, which showed laboratory changes in inflammatory, coagulation, biochemical and hematological biomarkers capable of interfering with functionality of the body and which may lead to clinical complications such as bleeding, edema and thromboembolism, making it essential for Nurses to prepare a care plan. Final considerations: laboratory biomarkers are important for identifying patients at risk of severity and mortality, contributing to defining Nursing diagnoses and course of action in intensive care.

Descriptors: COVID-19. Biomarkers. Intensive Care Units. Nursing Care. Nursing Diagnosis.

Objetivo: pesquisar, na literatura, o perfil laboratorial dos pacientes acometidos gravemente pela COVID-19, bem como organizar um plano de cuidados de enfermagem de acordo com as alterações de biomarcadores elencados nessa revisão. Método: revisão integrativa realizada nas bases de dados MEDLINE e PubMed. Incluíram-se artigos envolvendo pacientes adultos e hospitalizados. Excluíram-se aqueles que não responderam à questão norteadora, estudos genéticos ou imunológicos, estudos repetidos e artigos de opinião. Posteriormente, foram elencados diagnósticos e intervenções de enfermagem para alterações laboratoriais encontradas. Resultados: revisados 25 artigos, que mostraram alterações laboratoriais em biomarcadores inflamatórios, de coagulação, bioquímicos

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e hematológicos capazes de interferir na funcionalidade do organismo, podendo acarretar complicações clínicas, como sangramentos, edemas e tromboembolismos, tornando fundamental a elaboração de plano de cuidados pelo Enfermeiro. Considerações finais: biomarcadores laboratoriais são importantes para identificação de pacientes com risco de gravidade e mortalidade, contribuindo para definição de diagnósticos e condutas de enfermagem em terapia intensiva.

Descritores: COVID-19. Biomarcadores. Unidade de Terapia Intensiva. Cuidados de Enfermagem. Diagnóstico de Enfermagem.

Objetivo: recurrir a la literatura para investigar el perfil de laboratorio de pacientes afectados gravemente por COVID-19, al igual que organizar un plan de atención de Enfermería de acuerdo con las alteraciones de biomarcadores indicadas en esta revisión. Método: revisión integradora realizada en las bases de datos MEDLINE y PubMed. Se incluyeron artículos cuyos participantes fueron pacientes adultos y hospitalizados. Se excluyeron aquellos materiales que no respondiesen a la pregunta guía, al igual que estudios genéticos o inmunológicos, estudios repetidos y artículos de opinión. Posteriormente, se generó una lista de diagnósticos e intervenciones de Enfermería para las alteraciones de los parámetros de laboratorios encontradas. Resultados: se revisó un total de 25 artículos que evidenciaron alteraciones en valores de laboratorio en términos de biomarcadores inflamatorios, de coagulación, bioquímicos y hematológicos capaces de interferir en la funcionalidad del organismo, con la posibilidad de derivar en complicaciones clínicas, como ser hemorragias, edemas y tromboembolias, volviendo así fundamental la elaboración de un plan de atención de Enfermería. Consideraciones finales: los biomarcadores de laboratorio son importantes para identificar pacientes con riesgo de cuadros de enfermedad graves u mortalidad, contribuyendo de esta manera a definir diagnósticos y acciones de Enfermería en cuidados intensivos.

Descriptores: COVID-19. Biomarcadores. Unidades de Cuidados Intensivos. Atención de Enfermería. Diagnóstico de Enfermería.

Introduction

SARS-CoV-2 is a type of β-coronavirus with higher affinity for Angiotensin-Converting Enzyme II (ACE-II). Transmission is primarily through droplets and aerosols. The most common symptoms are runny nose, cough, fever, diarrhea and, in more advanced cases, pneumonia[1].

The clinical spectrum ranges from asymptomatic infections to severe disease with respiratory failure and exacerbated inflammatory response, which require specialized treatment in Intensive Care Units (ICUs), where care is provided continuously to patients with severe clinical conditions. These units have health professionals capable of providing high-complexity care in a safe manner, in addition to having a technological arsenal designed for this purpose. With the advent of the pandemic and the development of severe infectious conditions by patients affected by the new coronavirus, these care units had their importance highlighted[1-2].

In the care context there are several resource apparatuses and laboratory tests among the most requested and of greater importance and impact on clinical decisions. This is because, in addition to the etiological diagnosis, aspects such as definition of the prognosis, treatment guidance, therapeutic monitoring of the patients and definition of the care planning that will be demanded by the multidisciplinary team, with emphasis on Nursing, are important in understanding signs and symptoms[3-4].

According to the literature, it is estimated that nearly 70% of the clinical decisions are made based on laboratory test results, which constitute approximately 5% of the Public Health expenses, which renders the cost-effectiveness ratio feasible. As members of the multidisciplinary team, effectively active in the assistance provided to patients at all care levels, Nurses must collect and interpret the data from the patients' health history, physical examination and also complementary exams to compose their clinical reasoning and, thus, systematize the care to be offered, elaborating the Nursing diagnoses and prescriptions[4-5].

According to recent studies, a variety of laboratory parameters have shown common changes in patients severely affected by SARS-CoV-2, such as hepatic, cardiac, renal, pro-inflammatory and other biomarkers. Results like those ones help understand the viral mechanism, its clinical manifestations and even predict possible complications that may lead to unfavorable clinical outcomes[6-7].

Whenever possible, the Ministry of Health recommends investigating these markers and also emphasizes the importance of early recognition of hypoxemia, sepsis and thrombosis, as well as of measures to prevent them, as they are associated with greater disease severity[8].

Thus, the objective of this study is to research, in the literature, the laboratory profile of patients severely affected by COVID-19, as well as to organize a Nursing care plan according to the changes in biomarkers listed in this review.

Method

This is an integrative review carried out in six stages:

1) Identification of the topic and choice of the research question;

2) Definition of the inclusion and exclusion criteria for the studies;

3) Selection of the articles;

4) Definition of the diverse information to be extracted from the studies selected;

5) Organization of the material in table format;

6) Analysis and discussion of the data and presentation of the results in the form of a scientific article[9].

In the first stage, the research question was delimited: "Which is the clinical and laboratory profile of patients seriously affected by COVID-19?" Subsequently, the following descriptors were defined in the Descriptors in Health Sciences (*Descritores em Ciências da Saúde*, DeCS) platform: "COVID-19", "*Biomarcadores*" ("Biomarkers") and "*Unidades de Terapia Intensiva*" ("Intensive Care Units").

In the second stage, the eligibility criteria for the articles were established. As this is a new theme, with no publications prior to 2020, no time frame was established, thus including all articles published to that date, within the theme proposed and involving adult and hospitalized patients. Articles that did not answer the guiding question were excluded, as well as genetic or immunological studies, full-texts not available, repeated and review studies, manuals/guides/clinical protocols, opinion articles and monographs/dissertations/theses.

Also in the second stage, the search was initiated in indexed databases by associating the descriptors with the "*and*" Boolean operator, thus generating the following search strategy: ("COVID-19") *and* (*biomarcadores*) *and* ("*unidades de terapia intensiva*"). The MEDLINE databases were accessed via *Biblioteca Virtual em Saúde* (BVS) and PubMed. Data collection was performed in October 2021.

In the third stage, the titles and abstracts were read and the exclusion criteria were applied. The articles selected proceeded to the fourth stage, in which the eligible studies were read in full and the data were categorized.

Data categorization, carried out in the fourth stage, was through a Microsoft Excel 2010 spreadsheet that included the following information: title of the article, country, month and year of publication, type of study, study objectives, main results and level of evidence. The evaluation of the studies regarding the level of evidence followed the *Oxford Centre Evidence-Based Medicine* guideline[10].

In the fifth stage, the data were organized into charts.

The sixth and final stage consisted of the knowledge synthesis and presentation of the review.

For the knowledge synthesis, the material was read, the changes caused by the modified biomarkers were compiled, and a care plan was developed containing, the patient's laboratory context in the Nursing diagnoses and the care measures adopted in the Nursing interventions, in order to contribute to preventing health

problems optimizing recovery of critical patients. Thus, for each altered biomarker, its dysfunction in the body was researched. For such purpose, the necessary Nursing diagnoses and interventions were carried out. All laboratory biomarkers that appeared altered in the studies of this review were related to Nursing diagnoses and interventions based on NANDA [2018-2020][11] and on NANDA-NOC-NIC Links[12], to contemplate the objectives of this study and present them as a Nursing care plan.

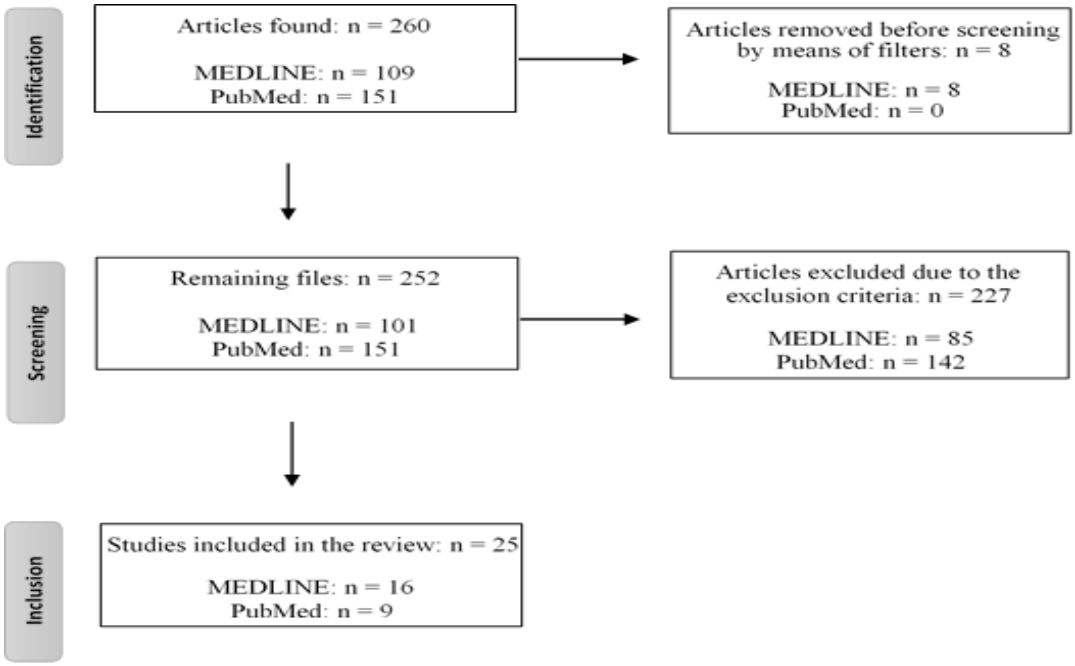
In the review presentation context, the results were discussed and optimized through a literature review, which strengthened the Nursing care plan for patients with COVID-19 and changes in laboratory biomarkers.

Finally, this type of study waives approval by a Research Ethics Committee for not involving the direct participation of human beings, as indicated by Resolution No. 510/2016 of the National Health Council, in the sole paragraph of its Article 1.

Results

The search in the databases yielded 260 articles, of which 8 were removed after applying the search filters. Thus, 252 articles proceeded to reading their titles and abstracts. After applying the exclusion criteria, 25 studies were eligible for this review (Figure 1).

Figure 1 – Flowchart corresponding to selection of the studies



Source: The authors.

Of the 25 studies included, 14 were published in 2021, whereas 11 were published in 2020. Regarding the countries of origin, 24 studies are international, with 8 conducted in China, 4 in the United States, 3 in Turkey, 3 in Italy, 2 in Spain, 1 in France, 1 in Sweden, 1 in Denmark and 1 in Canada; only 1 study was conducted in Brazil. All studies were published in English. In relation to the type of study, 21 are retrospective cohort, 3 are prospective cohort and 1 is cross-sectional cohort. All presented level of evidence 2B according to the Oxford classification, which refers to cohort studies with poor quality of randomization, control or without extended monitoring periods, as well as cross-sectional cohort studies. The main results of the articles are shown in Chart 1

Chart 1 – Main results of the articles selected (continued)

Authors Year	Country	Design/ Number of patients	Results	Level of Evidence
Velazquez S, et al 2021[13]	Spain	Retrospective cohort/ n=2,254	High levels of LDH, CRP, TTPA, D-dimer; leukocytes and neutrophils. Reduced levels of lymphocytes, monocytes, eosinophils and platelets.	2B
Ducastel M, et al 2021[14]	France	Retrospective cohort/ n=160	High levels of CRP, fibrinogen, leukocytes, neutrophils, and IL-6. Reduced hemoglobin and albumin levels.	2B
Gürsoy B, et al 2021[15]	Turkey	Retrospective cohort/ n=150	High fibrinogen, LDH, CRP, D-dimer and procalcitonin levels. Reduced lymphocyte levels.	2B
Mellhammar L, et al 2021[16]	Sweden	Prospective cohort/ n=35	High Neutrophil-derived Heparin (HBP) levels.	2B
Dheir H, et al 2021[17]	Turkey	Cross-sectional/ n=87	High D-dimer, troponin, ferritin, and lactate dehydrogenase (LDH) levels.	2B
Short S, et al 2021[18]	United States	Retrospective cohort/ n=3,418	High D-dimer levels.	2B
Zhang W, et al 2021[19]	China	Retrospective cohort/ n=158	High D-dimer and lactate dehydrogenase (LDH) levels.	2B
Pitre T, et al 2021[20]	Canada	Retrospective cohort/ n=336	High C-reactive protein levels.	2B
Deng F, et al 2021[21]	China	Retrospective cohort/ n=100	High levels of neutrophils, inflammatory cytokines (IL-6, IL-8, IL-10 and TNF-□) and ferritin.	2B
Gayam V, et al 2020[22]	United States	Retrospective cohort/ n=408	High serum ferritin, CRP and D-dimer levels.	2B
Uyar E, et al 2021[23]	Turkey	Retrospective cohort/ n=63	Reduced lymphocyte and albumin levels.	2B
Hodges G, et al 2020[24]	Denmark	Retrospective cohort/ n=1,310	High levels of CRP, leukocytes, procalcitonin, urea, troponins and D-dimer.	2B
Cattelan A, et al 2020[25]	Italy	Retrospective cohort/ n=303	High levels of neutrophils, aspartate transaminase and CRP.	2B
Guirao J, et al 2020[26]	Spain	Retrospective cohort/ n=50	High levels of IL-6 and leukocytes. Reduced lymphocyte levels.	2B
Zuo P, et al 2020[27]	China	Retrospective cohort/ n=446	High prealbumin level.	2B
Ayanian S, et al 2020[28]	United States	Retrospective cohort/ n=299	High IL-6, CRP, ferritin, LDH and D-dimer levels were predictors of mortality.	2B
Panigada M, et al 2020[29]	Italy	Prospective cohort/ n=24	High fibrinogen, CRP and D-dimer levels. There was no significant change in the level of platelets, PT and aPTT.	2B
Li Q, et al 2020[30]	China	Retrospective cohort/ n=1,449	High levels of neutrophils, fibrinogen; D-dimer, CRP, procalcitonin and LDH; maximum PT and aPTT values. Reduced lymphocyte and albumin levels.	2B

Chart 1 – Main results of the articles selected (conclusion)

Authors Year	Country	Design/ Number of patients	Results	Level of Evidence
Sun J, et al 2020[31]	China	Retrospective cohort/ n=241	High CRP, ALT and D-dimer levels. Reduced levels of serum calcium and lymphocytes.	2B
Chen L, et al 2020[32]	China	Retrospective cohort/ n=1,859	High levels of neutrophils, ALT and AST.	2B
Garrido P, et al 2020[33]	China	Retrospective cohort/ n=56	High Procalcitonin levels were predictors of mortality.	2B
Ten-Caten F, et al 2021[34]	Brazil	Retrospective cohort/ n=30,000	High CRP, ferritin, fibrinogen and LDH levels. Reduced levels of platelets, lymphocytes, basophils and eosinophils.	2B
Marchetti M, et al 2021[35]	Italy	Prospective cohort/ n=63	High D-dimer, fibrinogen, CRP and procalcitonin levels.	2B
Kheir M, et al 2021[36]	United States	Retrospective cohort/ n=181	Reduced albumin levels.	2B
Jin M, et al 2021[37]	China	Retrospective cohort/ n=281	High levels of inflammatory cytokines, ferritin, CRP, procalcitonin, PT, TTPA, D-dimer. Reduced lymphocyte and albumin levels.	2B

Source: The authors.

Chart 2 presents a Nursing care plan based on the results found in the studies reviewed, correlating with the changes in biomarkers capable of interfering with the biochemical and physiological processes of the body, which may lead to changes in the patient's general condition and lead to clinical complications.

Chart 2 – Nursing Care Plan (continued)

Altered biomarkers	**Nursing diagnoses**	**Nursing interventions** (1)
High CRP High IL-6 High LDH High procalcitonin Hyperferritinemia	Impaired Spontaneous Ventilation, associated with altered metabolism, evidenced by increased partial pressure of carbon dioxide (PCO_2) and decreased arterial oxygen saturation (SaO_2).	Perform acid-base monitoring Aspirate airways Promote precautions against Bronchoaspiration Monitor vital signs
High D-dimer High fibrinogen	Risk of Venous Thromboembolism, associated with significant medical comorbidity	Perform physical examinations, checking for pain on palpation, swelling, erythema
Leukocytosis Neutrophilia Lymphopenia	Risk of Shock, associated with sepsis.	Control hypovolemia Control infection Perform Respiratory monitoring Monitor vital signs

Chart 2 – Nursing Care Plan (conclusion)

Altered biomarkers	**Nursing diagnoses**	**Nursing interventions** (1)
Low hemoglobin Hypoalbuminemia	Excessive Fluid Volume associated with compromised regulatory mechanisms evidenced by decreased edema, hematocrit and hemoglobin	Control infection Control hypervolemia Perform acid-base monitoring Monitor skin Prevent pressure injuries
Hypocalcemia High urea	Risk of Electrolyte Imbalance, associated with compromised regulation mechanism	Monitor electrolyte serum level Monitor occurrence of associated acid-base imbalance Monitor renal function (urea and creatinine serum levels) Monitor relationship between fluid losses and gains through water balance Monitor ventilation adequacy Administer prescribed supplemental electrolytes

Source: The authors.

(1) All Nursing interventions should be established according to the Nurses' clinical evaluation for each specific case and routine of the institution in the care of critically-ill patients.

Discussion

Among the inflammatory markers, 14 studies indicate increased CRP as a predictor of severity. CRP is a protein produced by the liver that is increased in the face of an inflammatory or infectious process, being one of the first parameters altered. In other words, it is an acute phase biomarker with Interleukin-6 (IL-6) as its main inducer[7,13-14].

Interleukins are a family of cytokines involved in differentiation and activation of the immune cells, and are also responsible for trafficking such cells to the infection site. Among the interleukins, IL-6 has the role of regulating the response in the acute phase. It is produced by almost all stromal cells, lymphocytes and other defense cells, in addition to tumor cells. The literature shows that IL-6 is the cytokine with greater involvement in the cytokine storm induced by the Novel Coronavirus. In this sense, five of the studies presented in this review revealed that their high levels are in fact associated with greater severity[7,21,28].

Other inflammatory markers identified in the most severe COVID-19 cases are LDH, ferritin and procalcitonin, whose high levels were found in patients that required ICU admission. LDH is an enzyme found in the intracellular environment, fundamental in the anaerobic energy production mechanism. Leaks of this enzyme into the bloodstream reveal tissue damage. In the COVID-19 context, the increased LDH serum levels mentioned in seven studies suggest lung injury and failure of other organs affected by the infection, also due to the cytokine storm triggered by the disease[7,30,34].

Found in six studies, hyperferritinemia is a compensatory mechanism for the release of iron into circulation, due to direct damage to hemoglobin caused by the virus. Ferritin is a protein that stores iron and its increase predicts disease severity, as it also contributes to immune dysfunction, inflammation and hypercoagulation[21].

In relation to the progressive increase in procalcitonin, reported in six studies, this change reflects a worse prognosis, as serum procalcitonin levels are usually normal in patients with viral infections or viral sepsis, whereas its gradual increase probably indicates a bacterial superinfection, which may then contribute to an unfavorable progression[15,30].

The results found corroborate the data in the literature, according to which the increase in biomarkers related to inflammation occurs as the clinical condition deteriorates. This exacerbated inflammatory response induces Acute Respiratory Distress Syndrome (ARDS) and multiple organ dysfunction[7].

Such clinical manifestations justify the "Ineffective Respiratory Pattern" and "Impaired Spontaneous Ventilation" Nursing diagnoses, which require the following from Nurses in intensive care: management of advanced airways, monitoring of acid-base imbalances and attention to the vital signs of critically-ill patient[11].

As for the coagulation markers, high D-dimer and fibrinogen were mentioned by 13 and 6 studies, respectively, as factors associated with greater severity and mortality due to COVID-19. D-dimer is generated by the degradation of cross-linked fibrin monomers. A high plasma concentration is indicative of repeated coagulation and fibrinolysis. Clinically, high D-dimer is generally considered a coagulation activation marker. Although it has low specificity, it is highly sensitive and its high serum concentration is associated with death in critically-ill patients[18].

The literature has shown that thrombotic changes and coagulopathies are frequent in severe cases of the disease. Changes in hemostatic biomarkers, represented by the increase in D-dimer and fibrin/fibrinogen degradation products, indicate coagulopathy whose essence is massive fibrin formation, which is why thrombolytic events are more frequent than hemorrhagic manifestations[38].

No divergence was found regarding high D-dimer and fibrinogen levels in more severe cases, although it is not possible to assert the same in relation to platelets, Prothrombin Time (PT) and activated Partial Thromboplastin Time (aPTT). A study[29] concluded that there was no significant change in platelet level, prothrombin time and activated partial thromboplastin time. Other studies[30,37] asserted that maximum prothrombin time and activated partial thromboplastin time values and reduced platelet levels were predictors of mortality.

In the researched literature, some authors argued that prolongation of the prothrombin and activated partial thromboplastin times, as well as thrombocytopenia, are infrequent in COVID-19, when compared to bacterial sepsis cases[38].

The laboratory data found in the studies serve as a physiological basis for understanding such thrombolytic events, which can progress to ischemic stroke, pulmonary thromboembolism and heart diseases, secondary to COVID-19. In this sense, the "Risk of Venous Thromboembolism" and "Risk of Shock" Nursing diagnoses guide courses of action aimed at precautions against embolism, and it is up to Nurses to perform a thorough physical examination in search of signs of thrombosis, such as edema, erythema and pain on palpation, as well as to work with the multiprofessional team in the therapeutic measures for thrombosis and in the prevention of complications[11-12].

Regarding the manifestations in the blood count, the studies pointed out that severe COVID-19 cases shared common abnormalities, including increased leukocyte and neutrophil counts, as well as low lymphocyte counts, called lymphopenia, with prognostic value[1,15,30].

Reported in eight studies, lymphopenia can be explained by the virus ability to directly affect lymphocytes, as they are cells that express the ECAII receptor. By affecting the lymphocytes, the virus can inhibit the cellular immune function, in addition to disrupting these defense cells. In addition to that, the sustained response of cytokines, in particular interleukins, contributes to promoting lymphocyte apoptosis[37].

Reported in seven studies, neutrophilia is also a result of the cytokine storm and hyperinflammatory state, also suggesting secondary bacterial infection. A higher number of neutrophils and a lower number of lymphocytes, that is, an increase in the Neutrophil/Lymphocyte Ratio (NLR), have been observed in patients with more severe evolutions when compared to those with milder clinical manifestations. A research study[1] corroborates other surveys, arguing that NLR can be considered a reliable marker in systemic inflammation and infection cases

and a predictor of bacterial infection, including respiratory syndromes and pneumonia, being associated with worse clinical outcomes[32,39].

The blood count is a tool accessible to all hospitals, including those that lack the technical and material means to carry out complex immunological studies, which oftentimes produce late results. The analysis of the hematological parameters and proportions derived from blood counts, such as NLR, provides valuable information on the prognosis of patients admitted to ICUs, thus supporting Nursing diagnoses, such as: Risk of Shock, associated with sepsis; Excessive Fluid Volume associated with compromised regulatory mechanisms, evidenced by decreased edema, hematocrit and hemoglobin; and Risk of Electrolyte Imbalance, associated with compromised regulatory mechanism[1,11].

The biochemical imbalances were poorly documented in this review. Only three studies mention hypoalbuminemia as a predictor of severity, although there are no divergences in the findings. It is agreed that low albumin levels were found in patients who required ICU admission and that they are associated with a higher chance of mortality[14,23]. In the same sense, a study[36] revealed that high albumin levels at admission were associated with a 72% reduced risk of developing venous thromboembolism and with a lower risk of developing ARDS.

Albumin is a protein synthesized in the liver, responsible for nearly 80% of plasma oncotic pressure. In addition to that, it has the function of transporting endogenous substances and medications and maintaining the acid-base balance, among others. One explanation for the hypoalbuminemia reported in the studies is that, during critical illness, inflammatory mediators decrease albumin synthesis to prioritize synthesis of other acute phase reagents. In addition, these mediators increase vascular permeability, allowing albumin to escape into the extravascular space[7,36].

As for hypocalcemia, only one article points to this change as a predictor of mortality. Reduced calcium serum levels, especially ≤2.0 mmol/L, were associated with worse clinical parameters, higher incidence of organ damage and septic shock, and higher mortality within 28 days[31]. Patients with hypocalcemia had higher incidence of ARDS, as well as those with ARDS also had lower calcium serum values. These phenomena are indicative that hypocalcemia can be related to developing ARDS. Early diagnosis and treatment of hypocalcemia might alleviate lung injury in the COVID-19 acute phase[31]. Hypocalcemia was significantly correlated with decreased lymphocyte counts and with high CRP, Alanine-transferase (ALT) and D-dimer levels[28].

Renal and hepatic markers, such as Urea and ALT/AST, respectively, appear in the studies as signs of dysfunctions in the respective systems, which can be due to direct involvement of the virus, but mainly as a consequence of the sustained inflammatory response[24,31-32]. The "Risk of Electrolyte Imbalance" diagnosis allows Nurses to list measures for monitoring liver and kidney function, hydroelectrolyte and acid-base balance and treatment adequacy, contributing to better management of critically-ill patients[11].

A limitation to be mentioned was the lack of articles regarding Nurses' role in understanding biomarkers and the correlation with the care of critically-ill patients with COVID-19, who require continuous and good quality care due to the constant hemodynamic changes to which they are susceptible. There was scarcity of studies in the current literature to subsidize the practice of caring for patients with the new coronavirus.

The study contributes to defining Nursing diagnoses and courses of action in intensive care, considering that prognostic laboratory data may be even more important for the timely identification of patients at higher risks of severity and mortality.

Final considerations

Given the results presented in the literature analyzed regarding the laboratory profile of patients severely affected by COVID-19, it was possible to organize a Nursing care plan according to the changes in biomarkers found in the review.

There is lack of studies carried out within the theme addressed. Thus, the importance of conducting new research within the theme chosen by the authors of this review study stands out.

As this is a pandemic currently experienced with a little-known etiological agent, constant research is required to learn more and more about the behavior of the virus that causes COVID-19, mainly due to its constant mutations, with the development of more resistant strains having greater contamination power.

The construction of evidence-based knowledge aims at the chain of care measures to be provided by nurses, together with the multidisciplinary team, as well as at building the clinical reasoning required to promote care in an integral and safe way, aiming at reducing morbidity and mortality in the environment intended for intensive care development and with particular importance, especially nowadays.

Collaborations:

1 – Conception and planning of the project: Sara Maria dos Santos Costa;

2 – Data analysis and interpretation: Sara Maria dos Santos Costa; Vanessa Farias de Oliveira Bianchi and Anna Priscilla Barros de Oliveira;

3 – Writing and/or critical review: Sara Maria dos Santos Costa; Vanessa Farias de Oliveira Bianchi and Anna Priscilla Barros de Oliveira;

4 – Approval of the final version: Sara Maria dos Santos Costa; Vanessa Farias de Oliveira Bianchi and Anna Priscilla Barros de Oliveira.

Conflicts of interests

There are no conflicts of interest.

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