REVIEW ARTICLE

REVISTA ENFERMAGEM ATUAL IN DERME

RELATIONSHIP BETWEEN THROMBOTIC EVENTS AND SARS-COV-2 INFECTION: A LITERATURE REVIEW

RELAÇÃO ENTRE EVENTOS TROMBÓTICOS E INFECÇÃO PELA SARS-COV-2: UMA REVISÃO DE LITERATURA

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ABSTRACT

Objective: to present the knowledge produced about thrombotic events and their relationship with SARS-CoV-2 infection. Method: an integrative literature review study, carried out in May and June 2020, in four databases/virtual libraries/portals and academic search engines, with the following keywords: coronavirus, SARS and thrombus (Pubmed, Cochrane and Science Direct) and SARS Virus and Blood Coagulation Disorders (Virtual Health Library). After the search, 263 studies were found and with the use of inclusion and exclusion criteria, 59 works remained. Results: the studies showed that the chances of occurrence of thrombotic events increase in older people with comorbidities. In addition, the most prevalent thrombotic events in patients affected by the disease were microvascular pulmonary thrombosis, lower limb venous thromboembolism, acute coronary syndrome and stroke. The assessment and follow-up of patients, especially those hospitalized in the Intensive Care Unit, regarding their inflammatory state and their hypercoagulability markers are important for early detection and decision-making for the administration of anticoagulant therapies. Nursing is essential for the follow-up and monitoring of these patients. Final considerations: although the incidence of thrombotic events in people with COVID-19 worldwide is already better described in the literature, it is still necessary to produce more clinical and epidemiological studies to better explain this relationship; it is also important to determine whether this disease can actually be classified as belonging to the group of vascular diseases.

Keywords: SARS-CoV-2; Coronavirus Infections; Thrombosis; Nursing; Critical Care Nursing.

RESUMO

Objetivo: apresentar o conhecimento produzido sobre eventos trombóticos e sua relação com a infecção pela SARS-CoV-2. Método: estudo do tipo revisão integrativa da literatura, realizado nos meses de maio e junho de 2020, em quatro bases de dados/bibliotecas virtuais/portais e buscadores acadêmicos, com as seguintes palavras-chave: coronavírus, SARS and thrombus (Pubmed, Cochrane and Science Direct) e Vírus da SARS and Transtornos da Coagulação Sanguínea (Biblioteca Virtual da Saúde). Após a busca, foram encontrados 263 estudos e com o emprego dos critérios de inclusão e exclusão restaram 59 trabalhos. Resultados: os trabalhos mostraram que as chances de ocorrência de eventos trombóticos aumentam em pessoas mais idosas e com comorbidades. Além disso, os eventos trombóticos mais prevalentes nos pacientes acometidos pela doença foram trombose pulmonar microvascular, tromboembolismo venoso de membros inferiores, síndrome coronariana aguda e acidente vascular cerebral. A avaliação e acompanhamento de pacientes, principalmente os internados em Unidade de Terapia Intensiva, no tocante ao seu estado inflamatório e os seus marcadores de hipercoagulabilidade são importantes para a detecção precoce e tomada de decisão para a administração de terapias anticoagulantes. A enfermagem é primordial para o acompanhamento e monitoramento desses pacientes. Considerações finais: embora a incidência dos eventos trombóticos em pessoas com COVID-19 em âmbito mundial já esteja melhor descrita na literatura, ainda é necessário que se produzam mais estudos clínicos e epidemiológicos para melhor explicar essa relação; é importante ainda para que se possa determinar se de fato essa doença pode ser classificada como pertencente ao grupo de doenças vasculares.

Palavras-chave: SARS-CoV-2; Infecções por Coronavirus; Trombo; Enfermagem; Enfermagem de Cuidados Críticos.

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INTRODUCTION

Organizations and researchers around the world are concerned about the spread of this new coronavirus called SARS-CoV-2, the virus responsible for the outbreak of the new coronavirus 2019 disease (COVID-19), detected on December 31, 2019 in Wuhan, China[1].

Although the clinical manifestations caused by SARS-CoV-2 are similar to those caused by the common flu and a large percentage of people manifest mild symptoms, attention should be paid to the elderly and people with comorbidities (such as cardiovascular diseases, diabetes mellitus, asthma, and chronic obstructive pulmonary disease), pregnant women, and women up to 45 days postpartum, because these conditions increase the chances for the most serious forms of the disease. The main complications of SARS-CoV-2 infection are pneumonia, severe acute respiratory syndrome (SARS), renal failure, sepsis, cardiomyopathies, and increased clotting activity, which favors the occurrence of thrombotic events[2].

Patients hospitalized in the intensive care unit (ICU) are particularly in risk to develop pulmonary thromboembolism, so it is essential to take into account the associated factors, such as prolonged rest, the base illness, age, and comorbidities, in order to perform anticoagulant prophylaxis[3]. In addition, in February 2020, it was consistently demonstrated that SARS-CoV-2 causes a cytokines storm, which lead to the activation of the coagulation cascade that generate thrombotic complications[4-5].

Disseminated intravascular coagulation (DIC) is a secondary complication of serious infections, classically related to bacterial infections, malaria, hemorrhagic fevers associated with Dengue and Ebola viruses, and is now also related to SARS-CoV-2. One study detected ischemia (acro-ischemia) concomitant with the onset of dyspnea[6]. This observation led researchers to consider the hypothesis of respiratory failure, due to the extensive pulmonary capillary obstruction by thrombi, and that the DIC may be playing an important role in hypoxemia, as well as in the morbidity and mortality results of ICU patients with COVID-19[6].

Because the disease is currently a pandemic, several research questions are emerging as the disease progresses and manifests itself in different parts of the world. Research has been carried out and has already helped to clarify some themes such as the genome of the virus, the main forms of virus transmission and disease prevention, the search for effective and safe drugs to treat the infection, and the formulation and testing of vaccines.

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However, much research is still needed to deepen the issues listed above.

In this context, the following questions arose: a) What is the incidence of thrombotic events in patients with SARS-CoV-2 worldwide? b) What are the most common thrombotic events in patients with SARS-CoV-2? c) Is there a difference in the incidence of these thrombotic events with respect to sex, age group and previous presence of comorbidities? d) What are the most common clinical and laboratory manifestations of thrombotic events in patients with SARS-CoV-2? e) Is there a decrease in morbidity and mortality in patients with SARS-CoV-2 treated with anticoagulant and/or cardiovascular protector agents?

In view of the aforementioned facts, this study's main objective is to present the current knowledge about thrombotic events related with SARS-CoV-2 infection. The relevance of this study lies in the fact that SARS-CoV-2 is a novel virus that can be easily spread and cause a significant number of deaths in the world population, as well as important and serious complications such as thrombotic events. Thus, studies are needed to elucidate the issues related to thrombotic events in patients with COVID-19. Its relevance is also given because it presents a synthesis of many works that have been published on the topic COVID-19, providing relevant information to professional nurses and others that make up the interdisciplinary health teams.

METHODS

To accomplish this study, the literature review was chosen as the objective was to synthesize research results on a limited topic, in a systematic and organized manner, contributing to the deepening of knowledge[7]. The steps of the literature review were: identification of the research questions, literature search, data evaluation, data analysis, and presentation[8].

Identification of the research questions

The search was carried out on the topic of interest: coagulopathies and thrombotic events related to SARS-CoV-2 infection. To gather knowledge about this theme, an integrative literature review was conducted with the following purpose: To present the current knowledge about thrombotic events related with SARS-CoV-2 infection.

As already mentioned, the research questions were: a) What is the incidence of thrombotic events in patients with SARS-CoV-2 worldwide? b) What are the most common thrombotic events in patients with SARS-CoV-2? c) Is there a difference in the incidence of these

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thrombotic events with respect to sex, age group and previous presence of comorbidities? d) What are the most common clinical and laboratory manifestations of thrombotic events in patients with SARS-CoV-2? e) Is there a decrease in morbidity and mortality in patients with SARS-CoV-2 treated with anticoagulant and/or cardiovascular protector agents?

Literature search

The following databases were searched: Virtual Health Library (which contains the LILACS, BDENF, WHO-IRIS, PAHO-IRIS, and SCIELO databases), Pubmed (wich contains the Medical Literature Analysis and Retrieval System Online database), Cochrane and Science Direct (one of the largest sources of health research databases accessed through the Elsevier portal).

The decision to use these diverse databases, portals, and libraries, was intended to expand the scope of the research and thus minimize possible bias. The search strategy employed a combination of specific descriptors of each database.

The MeSH terms "coronavirus", "SARS", and "thrombus" were used in Pubmed, Science Direct, and Cochrane databases. The DeCS structured and trilingual vocabulary descriptors in the health sciences "SARS Virus" and "Blood Coagulation Disorders" in Portuguese and their respective synonyms in English and Spanish were used in the Virtual Health Library.

We highlight that initially the search was performed using controlled descriptors in each database. However, due to the small number of studies, the descriptors were used as keywords, expanding the scope of the research. The inclusion criteria established for the studies were: a) full-text articles investigating the theme of coagulopathies and thrombotic events related to SARS-CoV-2 infection; and b) studies that answer at least one of the research questions.

The literature search was conducted in May 2020 and updated in June 28, 2020. Each database was accessed in a single day, with a recording of the search pages. The selection of studies was carried out in the following days, through reading of the titles and abstracts. When necessary, the full text was read to check whether it met the inclusion and exclusion criteria.

Figure 1 displays a flowchart describing the selection process of the evaluated studies.

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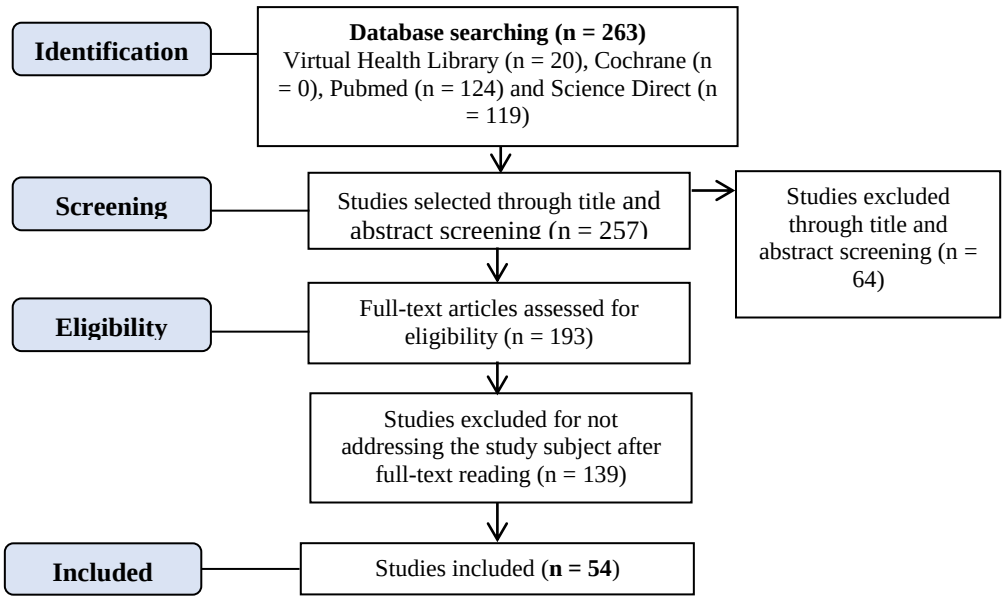
Figure 1 - Flowchart of selection of works selected from the databases selected for this integrative review.



Source: The authors (2020).

Data evaluation - methodological quality

The methodological quality of the studies was evaluated in June 2020 based on their levels of evidence[9].

Data analysis – data reduction, display, comparison, and presentation

The last steps of the literarure review are similar, they are presented in a single section. All selected studies were synthesized according to the following characteristics: identification, methodological description, results, and level of evidence. Data were presented in a qualitative way using major themes for categorization, as follows: relationship between thrombotic events and sociodemographic and clinical factors in patients with SARS-CoV-2; most common thrombotic events in patients with SARS-CoV-2 with some clinical and laboratory findings; and results of treatments for this clinical situation.

Ethical aspects

Regarding ethical aspects, there was no need to send the project to the Research Ethics Committee of the University of International Integration of Lusofonia Afro-Brazilian, in accordance with Resolution 466/2012[10], as it is an integrative review study.

RESULTS

The results from the methodological quality assessment of the

studies based on their levels of evidence[9] is shown in Table 1.

Table 1 – Description of the methodological quality assessment of the articles included in this integrative review.

Levels of Evidence	Absolute frequency of studies	Relative frequency of studies
1	1[41]	2.0%
2	0	0.0%
3	0	0,0%
4	6[19,28,32,36,37,62]	11.1%
5	20[11,13,22,23,25,27,29,30,33-35,43-46,49,52,55,68,70]	37.0%
6	17[15,20,21,24,26,40,42,47,48,53,54,56-58,61,63]	31.4%
7	10[14,16,17,31,38,51,60,64,65,69]	18.5%

Source: The authors (2020).

Table 1 shows that most studies included in this review are literature reviews, descriptive studies, and case reports. However, it is opportune to consider that the COVID-19 pandemic is a major health emergency in global public health, therefore, health information is relevant even from studies with a low level of evidence. The exchange of information between health workers and the constant update of knowledge about the novel coronavirus raise research questions and stimulate the development of case reports, descriptive studies, and literature reviews. Such studies can serve as a basis for the development of research with more robust methods and can enhance the clinical practice through evidence-based decision making.

The results are presented according to the following thematic categories: relationship between thrombotic events and sociodemographic and clinical factors in patients with SARS-CoV-2; most common thrombotic events in patients with SARS-CoV-2 with some clinical and laboratory findings; and results of treatments for this clinical situation.

Relationship between thrombotic events and sociodemographic and clinical factors in patients with SARS-CoV-2

Evidence of abnormal coagulation parameters associated with COVID-19 appeared at the beginning of reports from China[11]. A study developed with the first 99 hospitalized patients in Wuhan[12] found that in 36% of the patients had high D-dimer, increased inflammatory biomarkers such as inteleukin-6, high erythrocyte sedimentation volume, and high C-reactive protein. Thrombocytopenia was present in

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only 12% of patients and four died of septic shock[12].

A number of authors[13-17] referenced the study by Tang et al.[18] on coagulopathies and COVID-19. Such research[18] evaluated 183 patients with SARS-CoV-2, among which 21 patients (11.5%) died. From the 21 patients who died 71% met the criteria of the International Society for Thrombosis and Homeostasis for disseminated intravascular coagulation compared with 0.6% of the surviving patients.

Worldwide, there are no population-based or multicenter studies on the prevalence of thrombotic events in people with SARS-CoV-2.

Several studies[13,19-35] point out that most of the thrombotic events related to SARS-CoV-2 occur in elderly people, male, and patients with pre-existing chronic diseases such as cardiovascular, cerebrovascular, lung, cancer, liver diseases, nephropathies, obesity, and diabetes mellitus.

A study[36] about venous thromboembolism in patients with COVID-19 based on autopsy findings found that the presence of neurodegenerative diseases is a risk factor for thrombotic complications in patients with SARS-CoV-2. An Italian cohort study[37] observed that fibrinogen values appeared to be higher in women affected by COVID-19 compared to the control group. A nonsignificant trend towards increased fibrinogen levels has been demonstrated in male patients. Patients with SARS and COVID-19 tend to have significant levels of fibrinogen compared to those without SARS, and D-dimer levels showed an insignificant upward trend.

Guidelines on the prevention and treatment of thromboembolism[38] recommend the assessment of the risk for venous thromboembolism based on different clinical conditions, such as: age over 40, three days in bed, laboratory confirmation of COVID-19 combined with one of following risk factors: presence of sepsis, presence of severe acute respiratory disease, heart failure, obesity, history of venous thromboembolism, acute exacerbation of obstructive pulmonary disease, acute stroke, acute coronary syndrome, varicose veins in the lower limbs, cancer, inflammatory bowel disease, and chronic kidney failure.

Researchers[13,38-39] claim that pregnant women and those in the postpartum period with COVID-19 are more likely to develop venous thromboembolism. This risk is heightened by age over 35 years, history of venous thromboembolism, preeclampsia, delayed intrauterine growth, genetic thrombophilia, blood transfusion, postpartum infections, systemic lupus, heart disease, obesity,

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multiple pregnancies, and postpartum hemorrhages[38-39].

A point of interest in the COVID-19 pandemic has been differences in the pattern of mortality in young people. Some of these patients have a worse prognosis, but without predisposing risk factors. In Italy, high mortality rates have been observed in young patients[40]. One explanation for this finding may be mutations in the coagulation cascade or complement inhibitory factors, such as complement factor H, which appears to exist in 1% of the Italian population[40].

However, a systematic review study[41] with meta-analysis of the impact of cerebrovascular and cardiovascular diseases on the severity and mortality of COVID-19 found that such diseases were associated with increased mortality, but gender, age, arterial hypertension, diabetes mellitus, and respiratory conditions did not influenced this association.

Most common thrombotic events in patients with SARS-CoV-2 with some clinical and laboratory findings

Thromboembolism related to the SARS-CoV-2 virus can be seen in the pulmonary vessels in addition to cases of acute fibrinous and organizing pneumonia. Pulmonary lesion of small blood vessels is a common manifestation in patients dying from COVID 19, with microvascular thrombosis in the lungs and thromboembolism with hemorrhagic infarction in larger vessels. In COVID-19, microvascular thrombosis is largely observed[21,24,25,28,30-34,36,42-46].

Several researchers[11,12,17,25-28,33,34,37,45,47-53] described the occurrence of manifestations of thrombotic events in patients with SARS-CoV -2 in addition to pulmonary thromboembolism, stroke, venous thromboembolism, acute myocardial infarction, cerebral venous sinus thrombosis, disseminated intravascular coagulation, and sepsis-induced coagulopathies.

Other studies[19,28,54] reported that small vessel thrombosis led to intestinal ischemia, cholestasis and distention of the gallbladder and acute infarction of organs such as spleen, liver and kidneys in people with COVID-19. A research[36] also described, based on autopsy results, that pulmonary emboli are due to deep venous thrombosis of the lower limbs and that complications such as thrombosis in the prostate venous plexus are also present in people with SARS-CoV-2 infection.

Regarding cardiovascular complications related to COVID-19, these involve heart failure, myocarditis, pericarditis, vasculitis, and cardiac arrhythmias. The presence of microangiopathy and microthrombi can also predispose the patient to

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microinfarctions in multiple organs, such as liver, heart or kidney, further exacerbating the state of injury and multiple organ failure[29,50-51,55].

Two studies described thrombotic events in the skin capillaries, which generate the necrotizing capillary lesion, manifesting through slightly purplish reticulated eruptions on the chest, legs and arms, consistent with livedo reticularis[56-57]. The explanation for this manifestation is that as endothelial cells also express the ACE2 gene, SARS-CoV-2 may cause direct endothelial dysfunction after binding to ACE2, leading to subsequent thrombosis[15].

Other research[40] developed on the analysis of the deposition of the SARS-CoV-2 virus in five placentas reported that there was thrombosis in larger vessels of the fetal circulation, frank thrombosis in three cases, while in the other two cases, vascular thrombosis confined to the villi of the trunk was confirmed, generating poor fetal perfusion due to thrombosis in placental vessels.

The clinical and laboratory manifestations of thrombotic events in people with SARS-CoV-2 are correlated with the specific signs and symptoms of central venous thrombosis[26,48], stroke[41,47,49,53], acute myocardial infarction[13,21,29,41], pulmonary thrombosis[28,31,33,45,58], deep peripheral venous thrombosis[20], disseminated intravascular coagulation[14,45,58], and acute renal failure[53,59-60].

Research on intestinal abnormalities[19] found abnormalities in the intestinal wall of ICU patients affected by SARS-CoV-2 using CT scans. The researchers found gastrointestinal symptoms such as nausea, vomiting, diarrhea, abdominal pain, and thickening of the intestinal wall, associated with pneumatosis and portal venous gas due to mesenteric ischemia.

Regarding laboratory tests, several studies[11,16,17,24,30,46,49,61] cited high D-dimer values as a predisposing factor for the occurrence of thrombotic events in patients with COVID-19.

Results of treatments for this clinical situation

Current reports demonstrate benefits of heparins in the prophylaxis of thrombotic events in patients with COVID-19. Treatments with low molecular weight heparin (enoxaparin) or unfractionated heparin have been adopted and the success of the treatment depends on age and D-dimer values. When the value of this marker exceeds six times the normal upper limit, mortality becomes lower with the treatment[22,55].

ICU patients with COVID-19 should use higher doses of low molecular

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weight heparin, as it has been shown that they develop pulmonary thromboembolism even with prophylactic treatment. Thus, both ICU and regular ward patients, even receiving low molecular weight heparin, are developing deep venous thrombosis or pulmonary embolism, which reinforces that heparin doses must be doubled in this clinical context[11,16,18,20,22-23,25,27,30,33,38,43,45,62-63].

Another study on pulmonary embolism in patients with COVID-19 added that there was an improvement in the antithrombotic effect when there was a change from enoxaparin to rivaroxaban[24]. Researchers[25] add that for patients with stroke and COVID-19 it seems reasonable to treat with tPA. In addition, AT1 receptor blockers, such as losartan, may have a protective effect in stroke patients.

Researchers[16,18,34,64] report the results on the use of intravenous immunoglobulin (IVIG) and anticoagulant therapy with low molecular weight heparin as early as possible, especially when the number of circulating T and B lymphocytes decreases and inflammatory cytokines and D-Dimer increases drastically. Although intravenous immunoglobulin has been shown to be effective in treating patients with influenza and SARS, more clinical data is needed to determine immunoglobulin efficacy in patients with COVID-19.

It should be noted that preclinical studies[66-67] document the anti-thrombotic effects of vitamin D supplementation. Researchers also point out that most intervention studies do not clearly show the protective effects of vitamin D supplementation in preventing cardiovascular events. However, most studies have not evaluated people with severe vitamin D deficiency[67-68]. Vitamin D deficiency is a prevalent problem worldwide – 7% of the world population has severe deficiency and about 40% have borderline levels of vitamin D in the body[66].

Regarding cardiovascular protection, two studies[29,51] describe that patients with COVID-19 and cardiac injury must be closely monitored for the increase in cardiac enzymes – the markers of cardiac stress, and that the administration of cardioprotective agents is necessary.

DISCUSSION

Among the explanations about the formation of microthrombi with lesions in several target organs, we find that the SARS-CoV-2 virus has an extensive tissue distribution causing the release of a high number of pro-inflammatory cytokines (cytokine storm), promoting a systemic inflammatory response syndrome with an important impact on the hematopoietic system and hemostasis, leading to

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infarction of organs such as lungs, heart, liver, and kidneys[14,50,68].

It is worth mentioning that specific changes in hemostasis are already present in the initial stage of the SARS-CoV-2 infection[11,18,37]. COVID-19-associated coagulopathy due to acute systemic inflammatory response is characterized by an elevation of several coagulation markers, such as D-dimer (a fibrin or fibrinogen degradation product), concomitant increase in inflammatory markers (including C-reactive protein), and mild thrombocytopenia[49,61].

Some hypotheses that justify the increased incidence of thrombotic events in older people and with pre-existing chronic diseases are: a) the tendency of these people to have a higher D-dimer value[16,18,34]; b) the use of antihypertensive drugs, such as ACE inhibitors and angiotensin II receptor blockers, which increase the expression of the ECA2 gene, and favor the replication of the SARS-CoV-2 virus[30]; and c) alteration of the renin-angiotensin-aldosterone system that is intrinsically linked to the coagulation cascade and can aggravate the immunothrombosis process, further stimulating the formation of microthrombi in COVID-19[69].

There is strong evidence that occlusion and formation of microthrombi in small pulmonary vessels exists in critically ill patients with COVID-19 and that, therefore, the early application of anticoagulant therapy in these patients is important to improve the prognosis[18]. Every patient at risk of deep venous thrombosis admitted to the ICU should receive some preventive treatment (pharmacological, mechanical, or both), as prevention is essential, as long as it is safe and effective. The nursing team is essential in this process, from the administration of prescribed drugs to the performance of non-pharmacological measures that contribute as part of this preventive treatment described.

Nurses and other professionals should also be aware of the signs and symptoms of thrombotic events manifested by patients with COVID-19, because it is proven to be a disease that can generate such complications, which require timely effective clinical decision-making. Such complications affect the morbidity and mortality profile, as described. This responsibility applies even more to the nursing team, as they are the professionals who most provide direct care to clients.

The recommendation for nurses and other health professionals who provide nursing care to critical or semi-critical patients in referral hospitals for COVID-19 is to closely monitor sick patients. It is noteworthy to pay attention to the signs and symptoms of thrombotic events, the

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inflammatory markers and the hypercoagulable state they present. In addition, they can early recognize the high risk of thrombosis in these patients, especially in the elderly with comorbidities, especially cardiovascular, pulmonary, endocrine - diabetes mellitus - and metabolic - obesity, for the early and effective implementation of anticoagulant therapy.

Some research questions were not answered, such as the incidence of thrombotic events in people with SARS-CoV-2 worldwide and the effects of cardiovascular protective drugs on the reduction of morbidity and mortality. It is important that researchers from the most diverse areas of health can seek to answer them over time so that their findings are promptly published.

This literature review has the following implications: a) it brings an in-depth and updated synthesis of the knowledge produced by researchers from different countries about serious complications arising from the SARS-CoV-2 virus, such as thrombotic events; b) it can assist decision-making by doctors and nurses to monitor and treat COVID-19 patients; c) it describes knowledge gaps and research questions that need to be investigated further to contribute to the advancement of knowledge in the field; and d) in the context of this pandemic, studies involving the topic of infection by SARS-CoV-2 and COVID 19 are very important, regardless of the approaches, as this is a new disease and the knowledge that has been produced and disseminated has contributed to reducing the severe impacts caused by the SARS-CoV-2 virus.

Many issues highlighted in this integrative review need to be further investigated for further clarification, such as problems of thrombotic events related to SARS-CoV-2 virus infection in different continents; and whether there are proven effective protective factors (clinical, laboratory, pharmacological) that would decrease the chances of developing thrombotic events in people infected with SARS-CoV-2; and what are the effective tools used by the nursing team to reduce the incidence of this problem in this population.

Other issues also raised, which also need to be investigated, were whether vitamin D supplementation is effective in preventing thrombotic events in people with COVID-19; the comparison between non-pharmacological and pharmacological methods of preventing venous thrombosis in people with COVID 19; and follow-up studies of people who have had COVID-19 to determine the incidence of thrombotic events at a later stage or to investigate the recurrence of new events among those who

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manifested some thrombotic disease at an early stage of SARS infection. CoV-2.

FINAL CONSIDERATIONS

The studies included in this review indicate that there is a relationship between the pathophysiology of SARS-CoV-2 infection and thrombotic events, through cytokine storm and disseminated intravascular coagulation. The literature also showed that the chances of occurrence of thrombotic events in COVID-19 increase in the elderly and associated comorbidities. It also suggested that the most appropriate thrombotic events in this clinical setting were microvascular pulmonary thrombosis, lower limb venous thromboembolism, acute coronary syndrome, and stroke.

The assessment and follow-up of patients, especially those admitted to the ICU, regarding their inflammatory status and their hypercoagulability markers, such as D-dimer, were considered important for early detection and decision-making regarding the administration of anticoagulants. Nursing is essential for the follow-up and monitoring of these patients, as well as for quick and effective decision-making for the stability of the clinical picture of patients in critical care until the arrival of other professionals who make up the intensive care team.

Discrimination of thrombotic events in people with COVID-19 worldwide is already available in the literature, but further clinical and epidemiological studies are still needed to better explain this relationship. It is also important to determine whether this disease can really be classified as belonging to the group of vascular diseases. The results of this study can support research in this thematic line.

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