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‘Patterns’ of COVID-19 Coronavirus Infection in Pregnant Women in Physician Practice

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Abstract

Objectives: Evaluation of the Effectiveness of Developed Algorithms for Managing Pregnant Women and Assessing Severity Using the WHO ABCDE Approach During COVID-19 Among Practicing Physicians

Material and methods: To evaluate the effectiveness of the algorithm for managing pregnant women and assessing severity using the WHO ABCDE approach during COVID-19, we analyzed 102 medical records of pregnant patients with COVID-19 who received treatment in infectious disease hospitals and perinatal centers in the city of Shymkent from January to April 2022.

Results: Diagnostic errors were made in 22.5% of the sample before the training on the developed algorithms. Following the training sessions, the error rate decreased by 7.8%. Physicians identified errors in the following diagnoses: influenza – 10.8% (11 cases), acute intestinal infections – 4.9% (5 cases), acute cerebrovascular accident, measles, and atypical pneumonia – 1.9% (2 cases each), and Kawasaki disease – 0.9% (1 case). After the training, the incidence of the diagnosis of "Influenza" decreased by 4.9% and "Acute intestinal infections" by 3%.

Our findings revealed that the percentage of diagnostic errors (underdiagnosis) significantly dropped from 41.2±6.9% (n=51) to 11.6%±4.9 ($p<0.01$) (n=43), representing a reduction of more than 3.6 times. The analysis of diagnostic errors related to the underdiagnosis of COVID-19 and the implementation of the algorithm for the management and severity assessment based on the WHO ABCDE approach led to a more than 3.6-fold decrease in cases of delayed diagnosis.

Conclusions: The analysis of diagnostic errors related to the underdiagnosis of COVID-19 and the implementation of the management and severity assessment algorithm based on the WHO ABCDE approach led to a more than 3.6-fold reduction in the number of delayed diagnoses.

Keywords: COVID-19, pregnancy, mistakes, SARS-Cov-2.

Introduction

On March 11, 2020, the WHO declared the COVID-19 outbreak a pandemic, and two days later, it announced that Europe had become the epicenter [1]. The number of cases without epidemiological links to explain the source of virus transmission was increasing. In the second half of March, the infection rapidly spread across European countries, while the number of cases in the United States surged [2]. On March 24, the WHO warned that the US was becoming the new epicenter [1]. By early 2022, data collected by the NWSS were considered an important independent source of information on the spread of SARS-CoV-2 in the US. As of May 23, 2024, more than 775 million cases of the disease had been registered worldwide, with over 7 million confirmed deaths, making the COVID-19 pandemic one of the deadliest in history [1].

From 2019 to 2023, there were six waves of COVID-19 globally. The first wave was recorded in December 2019. The peak of the second wave occurred in the spring of 2020. The third wave happened in June-July 2020. It is important to note that the seasonality of COVID-19 and influenza are not identical. November 2021 marked the fourth wave. The fifth wave occurred in January-February 2022. The final sixth wave was registered in August 2022 [1].

As of 2022, according to the Committee on Sanitary and Epidemiological Control of Shymkent, Kazakhstan, 1,394,287 cases of the disease were confirmed. Across the country, 1,379,442 people

recovered, and there were 13,069 deaths [3].

The COVID-19 incidence rate in December 2023 was 57.89 cases per 100,000 population. In Shymkent, it was 34.88 cases per 100,000 population [3].

From 2020 to 2023, Shymkent registered a total of 38,149 cases, of which 1,646 were pregnant women: 537 cases in 2020, 892 cases in 2021, and 217 cases in 2022 [1].The progression of the disease caused by the SARS-CoV-2 virus is directly dependent on the entry of the virus into host cells after binding to angiotensin-converting enzyme 2 (ACE2). ACE2 replicates on cell membranes and tropen in the placenta throughout pregnancy. This phenomenon is a possible etiology of predisposition of pregnant women to COVID-19 [4]. Reduced immune reactivity and other physiological changes during gestation cause an increased susceptibility to respiratory diseases and severe pneumonia in pregnant women, which can lead to hospitalization in intensive care units and mechanical ventilation [5]. A lightning-fast development of a critical condition is possible against the background of a fairly stable course of the disease in pregnant women with coronavirus infection COVID-19 [5].

Materials and methods

We have implemented the "Severity Assessment of COVID-19 in Pregnant Women Using the WHO ABCDE Approach" at the Municipal Infectious Diseases Hospital and the City Maternity Hospital in Shymkent as of October 15, 2021 (Appendix A). The management algorithms for pregnant women with COVID-19 and the severity assessment using the WHO ABCDE approach were integrated into the mandatory training program "Management and Early Diagnosis of Pregnant Women with COVID-19" for infectious disease specialists and obstetricians-gynecologists in Shymkent and the Turkestan region. This included institutions such as the Municipal Infectious Diseases Hospital, Regional Perinatal Center No. 2, and the City Maternity Hospital, with training conducted both in-person and online (Appendix A). Furthermore, these algorithms were incorporated into the infectious disease curriculum for 4th and 5th-year students and residents in "Infectious Diseases," "Obstetrics and Gynecology," and "General Practice" at the South Kazakhstan Medical Academy starting from November 2022.

Over seven months, 57 physicians from Shymkent and the Turkestan region, 15 residents specializing in "Infectious Diseases" and "Obstetrics and Gynecology," and 89 students from the South Kazakhstan Medical Academy underwent training.

To evaluate the effectiveness of the management algorithms and severity assessment using the WHO ABCDE approach for COVID-19 in pregnant women, we analyzed 102 medical histories of pregnant patients with COVID-19 treated in infectious disease hospitals and perinatal centers in Shymkent from January to April 2022.

Statistical Analysis

The normality of the distribution was checked using the Kolmogorov-Smirnov test with the Lilliefors correction. Since all data showed a normal distribution, the mean and standard deviation were subsequently used. Categorical variables are presented as absolute numbers, percentages, and frequencies. A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS Statistics 26.0.

Ethics

The study was approved by the Local Bioethical Committee of JSC "SKMA" (date: 03/16/2021). Written informed consent for publication was obtained from the patients or their legal representatives.

Results

To reduce the incidence of COVID-19 among pregnant women and prevent fatalities, we developed a step-by-step management algorithm for pregnant women with COVID-19 (Appendix A). This algorithm is based on the Clinical Protocol for the Diagnosis and Treatment of "COVID-19 in Pregnant Women, Women in Labor, and Postpartum Women" from March 4, 2022. The algorithm outlines management strategies for pregnant women with asymptomatic, mild, moderate, severe, and extremely severe COVID-19. Patients with symptoms such as fever, general weakness, malaise, loss of appetite, and cough (dry or with small amounts of difficult-to-expectorate sputum) receive outpatient treatment.

According to the algorithm, outpatient observation is provided for the following categories: pregnant women with asymptomatic COVID-19, pregnant women, and postpartum women with mild COVID-19, and pregnant women discharged from the hospital after recovering from COVID-19.

We recommend hospitalization for pregnant women with severe and extremely severe COVID-19. Physicians adhering to the algorithm can timely adjust the management sequence for pregnant women with COVID-19 during gestation.

Our next development was the severity assessment of COVID-19 using the WHO ABCDE approach (Appendix G). The ABCDE algorithm is an effective method for assessing the condition of critically ill patients. The steps of the ABCDE algorithm aim to identify and immediately correct life-threatening conditions. Progression to the next step in the ABCDE algorithm is possible only after correcting life-threatening conditions at the current step. This method is used for a systematic approach to each patient, enabling early recognition of life-threatening conditions.

According to our development, the initial assessment (A-airway) of the patient's condition is based on consciousness, positioning, and resting SpO2. The next parameter assessed for severity was breathing (B-breathing). Severe and extremely severe cases are identified by the presence of shortness of breath with minimal exertion or at rest, a respiratory rate of 30 breaths per minute or more, SpO2 <90%, and CT signs of pneumonia with typically >50% lung involvement.

The third step in severity assessment is circulation (C-circulation). Circulation is assessed using heart rate (60-80 beats/min for mild, 90-120 for moderate, over 120 beats/min for severe and extremely severe cases), skin color (pale pink for mild, pale pink, pale, hyperemic, cyanotic for moderate, pale, hyperemic, cyanotic for severe and extremely severe cases), and peripheral perfusion (less than 3 seconds for mild, 3-5 seconds for moderate, more than 5 seconds for severe and extremely severe cases). Neurological status (D-Disability) is assessed using consciousness and AVPU/GCS scores. External factors (E-Exposure) are determined by the presence of temperature, symptoms, and Doppler metrics.

To evaluate the effectiveness of the management algorithm and severity assessment using the WHO ABCDE approach for COVID-19 in pregnant women, we analyzed 51 medical histories of pregnant patients with COVID-19 treated in

infectious disease hospitals and perinatal centers in Shymkent from January to April 2022. We found that the percentage of diagnostic errors (underdiagnosis) significantly decreased from 41.2±6.9% (n=51) to 11.6±4.9% (p<0.01) (n=43), a reduction of more than 3.6 times. Physicians made diagnostic errors in 5 cases: 2 cases of incorrect diagnosis of respiratory failure (4.7%) and 1 case each (2.3%) of incorrect anticoagulant therapy, hemorrhagic complications, and ARDS (Figure 1).

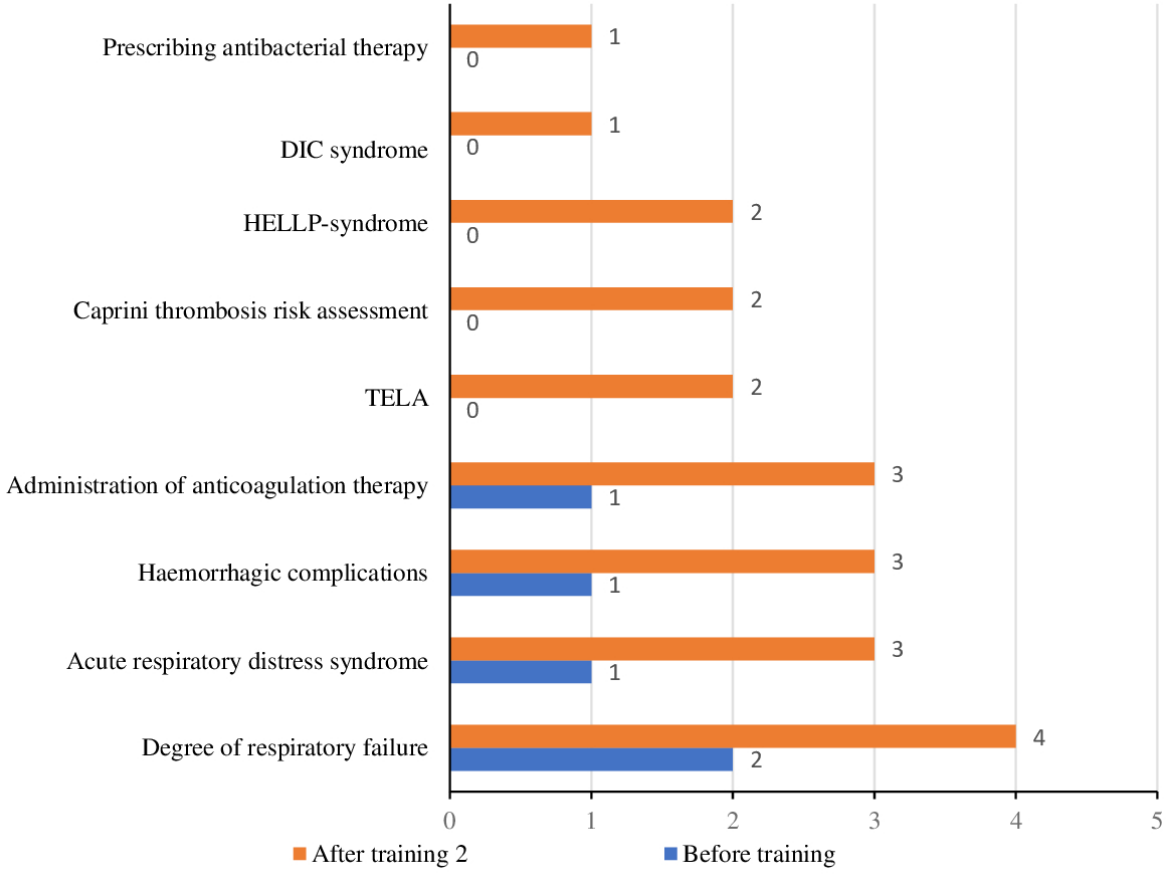

Figure 1 – Effectiveness of the Implementation of the WHO ABCDE Approach for the Management and Severity Assessment of COVID-19

Table 1 Effectiveness of misdiagnoses before and after the development training

Mistaken diagnoses	Before training n=102		After training n=102	
	Abs	%	Abs	%
Influenza	11	10,8	6	5,9
Acute gastrointestinal infections	5	4,9	2	1,9
Acute cerebrovascular disorder	1	0,9	0	0
Kawasaki disease	1	0,9	0	0
Measles	2	1,9	1	0,9
Atypical pneumonia	2	1,9	1	0,9

Note: The number of cases is shown in parentheses.

To examine the effectiveness of misdiagnoses before and after the development training, 102 case histories of pregnant women with coronavirus infection were studied. Table 1 shows the spectrum of misdiagnoses made by physicians before and after the trainings. Misdiagnosis errors were made in 22, 5% of the sample before the developmental trainings. Further, there was a decrease of 7, 8% after the trainings. Physicians made errors in the following diagnoses: influenza-10.8% (11), acute intestinal infections-4.9% (5), acute cerebral circulatory disorder, measles and SARS-1.9% (2), acute cerebral circulatory disorder and Kawasaki disease-0.9% (1). After development trainings among doctors, there is a decrease in the diagnosis of 'Influenza' by 4.9%, 'Acute intestinal infections' by 3%.

Discussion

The defects in the diagnosis of COVID-19 coronavirus infection and erroneous diagnoses described by us are consistent with the data of other authors. Thus, Khateeb J et al with co-authors in their work note that special difficulties in the diagnosis of viral diseases are noted in the initial period of the disease, flowing fever, myalgia, catarrhal syndrome [6,7]. The authors emphasise that in all cases of differential diagnosis first of all it is necessary to exclude acute neurological diseases and intestinal infections, respiratory diseases.

In our study, physicians before development training made a 10.8% error in the diagnosis of 'Influenza'. According to the protocol 'Coronavirus infection COVID-19 in pregnant, labouring and delivery women' the exclusion criteria for this diagnosis are marked catarrhal syndrome, scleritis, rhinorrhoea, tracheitis, relative lymphocytosis, negative PCR assay for SARS-Cov-2 [8-11]. The catarrhal period of measles is characterised by acute onset and fever, which is similar to coronavirus infection. At the same time, the criteria for excluding measles are a pronounced catarrhal syndrome, scleritis, conjunctivitis followed by a staged rash, Belsky-Filatov-Koplik spots and a

negative ELISA result. The picture of 'acute abdomen' may resemble nausea, vomiting, abdominal pain.

The authors of the article stress the importance of a properly collected epidemiological history in the differential diagnosis of COVID-19 coronavirus infection with other diseases [12,13].

Van den Berg P et al. in their work also emphasises that the use of standard case definition during the admission of patients with catarrhal syndrome allows to identify a patient with coronavirus infection in the first days of the disease, to isolate him in time and to start the necessary treatment [14].

The described clinical cases clearly demonstrate that health care providers need to be wary of patients with comorbidities during pregnancy [15,16]. This leads to hypodiagnosis of coronavirus infection, treatment at home or not infrequent hospitalisation of patients initially in somatic wards. This significantly increases the risks of transmission in family foci and non-core hospitalisations [17-21]. Worldwide, it is essential that physicians and medical staff from various specialities are vigilant, have up-to-date knowledge and apply modern diagnostic methods, algorithm of management tactics to reduce the likelihood of diagnostic errors when COVID-19 coronavirus infection is detected [21-24].

Recruitment of pregnant women with COVID-19 during the pandemic has been rapid, which is one of the strengths of the study. However, the study was conducted in only one city, which was the limitation. In the future, we plan to conduct research in other cities. Another limitation was that this study is single centre, which does not provide extended results. It should be noted that the sample size was relatively small.

Conclusion

Thus, the analysis of diagnostic errors associated with hypodiagnosis of COVID-19 coronavirus infection and the introduction of the algorithm of management tactics and severity assessment based on the WHO ABCDE approach resulted in a 3.6-fold decrease in the number of delayed diagnoses and helped to avoid delays in initiating the necessary pathogenetic and etiotropic therapy.

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The author has read and agreed to the published version of the manuscript.

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