



Patient-Centered Approaches to Medical Intervention

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Importance of Fetal Echocardiography in Women with COVID-19 during Pregnancy

¹Sevara A. Palvanova, ²Ahmad X. Karimov

¹Researcher Perinatal Center of Khorezm region, Khorezm, Uzbekistan

²Tashkent Medical Academy, Tashkent, Uzbekistan

palvanovas6@gmail.com, dr.akhmad@mail.ru

Abstract

This study aimed to evaluate the impact of COVID-19 on fetal heart function in 60 pregnant women who contracted the virus during their second and third trimesters. Key parameters such as cardiothoracic index, aorta-to-pulmonary artery diameter ratio, left ventricular contraction fraction, and blood flow velocities in the pulmonary artery, aorta, tricuspid, and mitral valves were assessed using echocardiography and Doppler ultrasound. Comparisons with a control group of 40 healthy pregnant women revealed no significant changes in heart morphology but identified functional alterations, including increased fetal heart rates and arrhythmias. These findings suggest that COVID-19 may disrupt uterine-placental blood circulation, affecting fetal heart function. The study emphasizes the need for routine Doppler assessments during prenatal care to monitor for potential complications, particularly after 32 weeks of gestation. Future research should focus on understanding the long-term effects of these functional changes and developing preventive measures to minimize the cardiovascular impact of maternal COVID-19 on fetal health.

Keywords: Fetal Echocardiography, Pregnancy, COVID-19, Arrhythmia

Introduction

The Covid-19 pandemic has raised significant concerns about its impact on pregnancy, particularly in terms of fetal heart health in the 2nd and 3rd trimesters. Previous research has established that viral infections, such as SARS and MERS, can lead to complications in pregnancy, including placental dysfunction and fetal heart disease [1]. Studies have demonstrated that maternal infections can induce fetal myocarditis and disrupt uteroplacental circulation [2, 3]. Research on Covid-19's impact highlights the need for early detection of fetal heart complications through advanced imaging techniques like echocardiography and Doppler ultrasound [4, 5]. The proposed solution aims to develop diagnostic criteria for managing pregnant women with a history of Covid-19, which could be highly beneficial in preventing adverse outcomes through timely intervention in the field of maternal-fetal medicine.

Materials and Methodology

In this study, the authors aimed to investigate the impact of targeted therapies on sexual dysfunction among 129 female patients aged between 18 and 61. These patients were divided into two groups: 64 participants formed the control group, and 65 were part of the target group. The underlying conditions included stroke, multiple sclerosis (MS), or traumatic brain injury (TBI), all of which are known to significantly affect sexual well-being. The primary objective of the study was to assess how specific therapies could alleviate sexual dysfunction resulting from these neurological conditions. The inclusion criteria required female patients within the specified age range, diagnosed with one of the mentioned neurological conditions, and presenting with sexual dysfunction. Exclusion criteria ruled out patients with

significant psychiatric conditions, seizure disorders, unstable angina, autoimmune diseases, or other medical complexities that might interfere with the treatment.

The methodology involved the use of four comprehensive assessment tools: the Functional Independence Measure (FIM) for assessing personal care abilities, the Female Sexual Distress Scale-Revised (FSDS-R) for measuring distress related to sexual dysfunction, the Beck Depression Inventory (BDI-2) for assessing depressive symptoms, and the Female Sexual Function Index (FSFI) for evaluating sexual function across various dimensions. These tools were employed before and after therapy, with assessments taken four weeks prior to the intervention phase to establish baseline data.

The intervention protocol for the target group included disease-specific treatments, biofeedback therapy, and transcranial magnetic stimulation (TMS). TMS targeted both the dorsolateral prefrontal cortex (DLPFC) to address depressive symptoms and the sacral region to improve pelvic floor function. Patients underwent 15 TMS sessions lasting approximately 25 minutes each, applying electromagnetic pulses to stimulate nerve cells. The study likely spanned six months, covering patient recruitment, treatment, and follow-up assessments. Statistical analysis using t-tests and p-values under 0.0001 was conducted to measure significant changes and improvements post-intervention, providing valuable insights into the therapeutic effectiveness of the applied techniques.

Results and Discussions

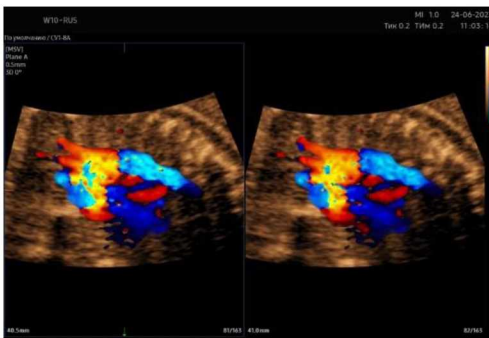
The study involved 60 pregnant women who had contracted COVID-19 during their second and third trimesters, and the aim was to evaluate the virus's impact on fetal heart function. Key cardiac parameters

were measured and compared to a control group of 40 healthy pregnant women. The study focused on assessing both morphological and functional parameters of the fetal heart.

Figure 1: Heart contractions and rhythm



Figure 2: Aortic arch and its branches



Morphological Parameters

The analysis of the morphological parameters of the fetal heart showed no significant structural changes between the COVID-19 group and the control group. The cardiothoracic ratio (CTI) was similar in both groups: 0.50 ± 0.03 for the control group and 0.49 ± 0.04 for the COVID-19 group. The heart apex angle and interventricular septum thickness also showed no significant deviations, as outlined in Table 1. The ratio of the aorta to pulmonary artery trunk diameter in the COVID-19 group was slightly lower (1.11-1.24) compared to the control group (1.16-1.27), but still within a normal range.

Table 1: Comparison of values between Control groups and Covid-19 groups

Parameter	Control Group	COVID-19 Group
Cardiothoracic ratio	$\geq 0.50 \pm 0.03$	$\geq 0.49 \pm 0.04$
Heart apex angle (degrees)	47.3 ± 5.9	45.6 ± 8.3
Aorta-to-pulmonary artery diameter	1.16-1.27	1.11-1.24

Interventricular septum thickness (mm)	4.1 (3.3-4.5)	3.6 (3.2-4.5)
Posterior wall thickness (mm)	4.1 (3.5-4.5)	3.9 (3.4-4.6)

Functional Parameters

Although no morphological changes were observed, functional changes were evident. The peak velocities in the aorta and pulmonary artery were slightly higher in the COVID-19 group. Aortic velocity was 79.4 cm/s compared to 77.1 cm/s in the control group, while pulmonary artery velocity was 67.4 cm/s versus 64 cm/s. Additionally, the E/A ratio in the mitral and tricuspid valves was reduced in the COVID-19 group, indicating altered diastolic function. These findings suggest the virus impacted fetal heart function, as detailed in Table 2.

Table 2: Comparison of functional parameter values between Control groups and Covid-19 groups

Functional Parameter	Control Group	COVID-19 Group
Aortic velocity (cm/s)	77.1 (56.7-94)	79.4 (56.9-101.2)
Pulmonary artery velocity (cm/s)	64 (42.1-81)	67.4 (59.2-81.4)
E/A ratio (Mitral valve)	0.74 (0.66-0.81)	0.67 (0.61-0.76)
E/A ratio (Tricuspid valve)	0.72 ± 0.09	0.71 ± 0.09

Analysis and Discussion

The study revealed that while COVID-19 did not significantly affect the morphology of the fetal heart, it did cause functional alterations, particularly in the blood flow dynamics and heart rhythm. The findings align with existing research suggesting that COVID-19 disrupts the blood coagulation system, leading to complications in the uterine-placental-fetal blood circulation system. This, in turn, can lead to fetal tachycardia and arrhythmias.

The increased velocities in the aorta and pulmonary artery, coupled with altered E/A ratios, point to potential diastolic dysfunction. This could be due to the compromised maternal respiratory system, which affects oxygen exchange and, consequently, fetal heart function.

The use of Doppler ultrasound to measure blood flow velocities in the umbilical artery, middle cerebral artery, and uterine artery was critical in assessing the hemodynamic state of the fetus. The Doppler findings indicated that while morphology remained intact, the functional response of the fetal heart to maternal COVID-19 infection was significant and should not be overlooked.

Conclusion

The study examined the effect of COVID-19 on the fetal heart among 60 pregnant women infected with the virus during their second and third trimesters. Key fetal cardiac parameters were measured, including the cardiothoracic index, the ratio of the aortic to pulmonary artery diameters, left ventricular contraction fraction, and thickness of the posterior wall and interventricular septum. Blood flow velocities in the pulmonary artery, aorta, tricuspid, and mitral valves were also assessed. In addition, Doppler indices of resistance in the umbilical artery, middle cerebral artery, and uterine artery were measured and compared to a control group of 40 healthy pregnant women. While no significant morphological changes were detected, functional changes, such as increased fetal heart rates and arrhythmias, were observed. These findings suggest that COVID-19 affects the uterine-placental blood circulation, potentially leading to fetal tachycardia and other functional heart changes. The study recommends integrating fetal Doppler assessments of blood flow velocities into prenatal care, especially after 32 weeks of gestation, to detect possible complications early. Future research could explore the long-term effects of these functional changes and develop preventive strategies to mitigate the cardiovascular impact of maternal COVID-19 on fetal development.

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Note: All the figures and tables in this chapter were made by the author.