Proposal of Isolated Ultrasonography Room Model for the Examination of Pregnant Women With Confirmed Coronavirus Disease 2019

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Since the first case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in China in December 2019, coronavirus disease 2019 (COVID-19) has resulted in a pandemic situation. According to data from The Centers for Disease Control and Prevention, the proportion of pregnant women among reproductive-aged women infected with COVID-19 is ~9%, which is higher than the corresponding proportion of mothers who generally account for ~5% of women ages 15 to 44 years. Several studies have demonstrated that most immunological and physical changes associated with pregnancy render pregnant women vulnerable to disease such as COVID-19.

In general, pregnancy is considered a high-risk group for COVID-19. According to previous studies, the rate of intensive care unit hospitalization is 3 times higher, and the mortality rate is 1.7 times higher in pregnant women with COVID-19 than in their nonpregnant counterparts. This is owing to the physiological changes associated with pregnancy such as immunological changes, increased thrombotic tendencies, and decreased in lung volume due to uterine enlargement. The lower inoculation rate of the COVID-19 vaccine in pregnant women than in non-pregnant women may also be a factor.

COVID-19 during pregnancy also increases the prevalence of pregnancy-related complications, including pre-eclampsia, preterm birth, stillbirth, gestational diabetes, and fetal growth restriction, which are associated with the severity of the culprit infections. COVID-19 related anxiety and stress caused by isolation from
activities of daily life can also cause maternal metal health problems.

Therefore, mothers confirmed with COVID-19 are considered high-risk individuals and are often admitted to the hospital for conservative treatment and close monitoring. Pregnant women with COVID-19 undergo several tests simultaneously to verify the well-being of the fetus owing to the peculiarity of pregnancy along with the monitoring of parameters, such as respiratory rate, oxygen saturation, presence of fever, and presence of upper respiratory tract infection symptoms that are routinely performed in patients with COVID-19. Not only subjective parameters, such as the intensity of fetal movements perceived by the mother, but also objective parameters, such as uterine contractions and the fetal variability through nonstress test, fetal growth, Doppler index, and amniotic fluid index, are measured using ultrasonography to verify maternal and fetal wellness.

In our province, confirmed pregnant women are recommended to be admitted to the isolation ward, and medical staff should wear special protective gear before any contact with patients. Next, ultrasonography should also be performed for each patient, and even if they connect oxygen containers, have difficulty breathing, wear multiple layers of protective gear, so they are hot, sweaty, wear face shields and have a lot of trouble talking to the patient. Additionally, because it takes a long time to wear and remove the special protective gear, the ensuing mental and physical fatigue of the medical staff was also significant because they had to repeatedly wear and remove the gears every time they met a new patient. So, we designed an ultrasonography room model that is more comfortable and facilities ultrasonographic

Figure 1. Schematic view of the isolated ultrasonography room models for the examination of pregnant women with confirmed coronavirus disease 2019. This room is connected to the end of the quarantine ward, however, because it is not an actual quarantine space, medical staff can enter without separate protective equipment. The wall between this room and the isolation ward is made of glass, and the mothers with confirmed COVID-19 and medical staff wear masks when they come in contact with each other, however, they can talk face to face. ** indicates the ultrasonography room where the medical staff can enter without protective gear. * indicates the room for pregnant women with COVID-19 infection. Blue arrow indicated the way to the ultrasonography room for medical staff after new ultrasonography room model. Orange arrow indicated the way to the isolation room for medical staff to examine the ultrasound before this ultrasound room model.
examinations for mothers with confirmed COVID-19. We are currently using this room and the results so far have been satisfactory. This study was approved by the Institutional Review Board of Kyungpook National University Chilgok Hospital (IRB No: KNUCH 2022-01-010).

**Design of Ultrasonography Room**

This room is connected to the end of the quarantine ward; however, because it is not an actual quarantine space, medical staff can enter without separate protective equipment. The wall between this room and the isolation ward is made of glass, and the mothers with confirmed COVID-19 and medical staff wear masks when they come in contact with each other, however, they can talk face to face. As each room is equipped with a microphone, there is no problem in communication. On the wall next to the isolation room, there is a bed on which the mother lies during the ultrasound examination. There are gloves and ultrasonicographic probes on the wall next to the bed, and the medical staff put their gloved hands outside the isolation room to hold the ultrasonic probe on the side of the isolation room and put the probe on the mother’s abdomen to perform the ultrasound. There are also vaginal probes to be used for early pregnancy ultrasonography to perform regardless of gestational age. The ultrasound machine itself is located in the space of the medical staff outside the isolation room where the medical staff operates the machine. The monitor that shows the ultrasound image is located in the isolation room so the mother can observe the movements of her fetus on the monitor in real time (Figures 1 and 2).

**Advantage of Isolated Ultrasonography Room**

First, this entire setup has the advantage of allowing medical staff to perform ultrasounds more comfortably than they do when wearing protective gear. This drastically reduced the necessary time required for ultrasound. Until the end of 2021, 150 gravidas infected with COVID-19 were examined using portable ultrasound, and it took an average of more than 30 minutes. Since these facilities were installed in January 2022, an average of 10 minutes was enough.
to examine 30 infected gravidas. Second, these facilities ensure that there is little risk of infection for medical staff even without wearing any protective equipment. Third, the mother was satisfied that she could see the condition of her fetus via ultrasonography and communicate with the medical staff through glass wall and therefore she could trust and confide in the medical staff. Finally, through this setup, it was possible to respond quickly even in obstetric emergencies such as decreased fetal movement or vaginal bleeding.

In conclusion, in the COVID-19 pandemic, confirmed cases of COVID-19 among pregnant women will be encountered. Therefore, it is necessary to find more ways to effectively monitor mothers and their fetuses. The model wherein the ultrasonography room is next to the isolation room we proposed is considered a relatively low-cost and highly effective setup, and we think it can satisfy both medical staff and mothers during the COVID-19 pandemic that may last for a long time.

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