OBSERVATIONAL STUDY

An Observational Study to Evaluate Single Deepest Vertical Pocket (SDP) and Color Doppler Indices (CDI) with Severity of Covid in Pregnant Women with COVID-19

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Abstract

Aim: The present study was done for the assessment of the single deepest vertical pocket (SDP) and color Doppler indices (CDI) among COVID positive pregnant women to decide upon further management.

Materials and method: A total of 102 patients were enrolled. The data collection was done by a single examiner following the protocol for the study. The study included confirmed COVID-19 positive pregnant patients. The inclusion standards were singleton pregnancy along with gestational age 28 weeks onward. Patients were divided on the basis of symptoms into asymptomatic and symptomatic subjects. Symptomatic subjects were further divided into mild, moderate, and severely symptomatic on the basis of established COVID guidelines. For the comparison of categorical variables, the analysis of Chi-square has been used.

Results: The computation of Chi-square exhibited that the distribution of single deepest vertical pocket (SDP) score did not differ between asymptomatic and symptomatic subjects. Abnormal Doppler findings in the umbilical artery were found to be significantly more among subjects with severe COVID-19 symptoms compared to women with mild to moderate symptoms. Among women with abnormal Doppler, there were 6.3% vaginal and 93.7% cesarean deliveries. Mean APGAR at 1 minute and 5 minutes after birth was found to be 5.05 ± 1.09 and 3.16 ± 0.92 in asymptomatic and 5.24 ± 1.24 and 3.40 ± 1.02 in symptomatic patients, respectively. In symptomatic subjects, NICU admission was significantly more (54.0%) compared to asymptomatic subjects (16.0%).

Conclusion: As the research has indicated that COVID-19-infected pregnant women may experience rapid and increasing placental insufficiency, it appears that a comprehensive assessment and management of the mother is required.

Keywords: COVID-19, Doppler findings, SDP.

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Introduction

The majority of women are found to be asymptomatic COVID-19 positive and in pregnant women, the prevalence is around 14–15%.[1–3] People are impelled to distance themselves from others and isolate themselves, as well as working from home online, this has drastically changed the way people live around the world. All of these major changes put a big psychological strain on everyone, especially pregnant women, who are experiencing more dread and uncertainty than ever before about their pregnancy.[1] Only a small fraction of women experience severe symptoms, which usually appear in the third trimester of pregnancy,[2] there is a heightened danger of crucial obstacles and mortality among all the women.[4] Despite this, the majority of pregnant studied women with SARS-CoV-2 were recognized to be asymptomatic and also possessed a poor risk of perinatal inconveniences.

The amniotic fluid (AF) is a vital component of the baby's survival system. It promotes the growth of muscle tissue, limbs, the lungs, and the digestive system. It is originally formed from effusion provided by the mother's circulation, and then, from

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the 20th week, fetal urine becomes the primary source.[3] The single deepest vertical pocket (SDP) is a standardized method for determining the quantity of amniotic fluid in a pregnant woman. The fluid index of the amniotic is utilized by the patients who are being diagnosed with a minimum 24 weeks of pregnancy period along with a singleton pregnancy.

Screening for poor placentation and associated sequelae of pre-eclampsia, intrauterine growth restriction, and infant death is made easier by Doppler examination of the placental circulation. The evaluation of fetal circulation is critical for a better understanding of the pathophysiology of a variety of problematic pregnancies as well as their therapeutic therapy.[5]

Due to the physiological alterations in the cardiovascular systems and immunological structure, pregnant women are extremely vulnerable to infections of the respiratory tract and intense pneumonia, which reduces the toleration of hypoxia. The influenza pandemic of 1918 resulted in a 2.6% of mortality rate among the prevailing population, with a very high rate among pregnant women (37%).[6]

Miscarriage, early birth, intrauterine growth restriction, hypertension, and maternal mortality are all possible outcomes of drastic acute respiratory syndrome coronavirus 2 afflictions at the time of pregnancy.[7] Despite the indication of the vertical virus, the consensus was that infection at the time of pregnancy period was being correlated with only minimal or mild fetal side effects.[8]

There is a paucity of literature regarding the use of single deepest vertical pockets (SDP) and color Doppler indices (CDI) among pregnant patients with COVID-19. The present study was done for the assessment of the single deepest vertical pocket (SDP) and color Doppler indices (CDI) among COVID positive pregnant women to decide upon further management.

Materials and Method

The present study was an observational hospital-based cross-sectional study. The study was done for a period of 9 months from April 2020 to December 2020 after being approved by the Institute's Ethics committee. The research was being conducted at Teerthanker Mahaveer Medical College and Research Centre in Moradabad, in the Department of Obstetrics and Gynaecology. All COVID-19 women who are pregnant with gestational age more than 28 weeks were included in the study.

In order to carry out the compilation of clinical data, verbal consent was being given by the pregnant women, and written down mindful consent was relinquished because of the pressing necessity for information. Pregnant women provided written informed consent and pharyngeal swab samples were also collected for newborns.

Data Collection

The data collection was done by a single examiner following the protocol for the study. The study included 102 confirmed COVID-19 positive pregnant patients. The only criterion for inclusion was a singleton pregnancy with 28 weeks of period of gestation or more.

The data included demographic profile, clinical symptoms, general and systemic examination findings, radiographic and laboratory results, and ultrasound findings including SDP and color Doppler indices were all collected as per the predesigned proforma. The samples of the study comprised both patients with symptoms and without the symptoms. The infection of SARS-CoV-2 was diagnosed either by RNA-PCR or by rapid antigen examination of nasopharyngeal samples. Mild, moderate, and severe symptoms were assigned to symptomatic patients on the basis of mildly symptomatic- upper respiratory tract symptoms (and/or fever) without shortness of breath or hypoxia, moderately symptomatic- a respiratory rate more than 24/min, breathlessness or SpO_2: 90% to less than 93% on room air and severely symptomatic–a respiratory rate more than 30 minutes/min, breathlessness and SpO_2 less than 90% on room air.

Outcome Parameters

The single deepest vertical pocket (SDP) and color Doppler indices (CDI) were recorded as per the protocol. A Doppler study assessment was carried out for the umbilical artery (UA) in women having gestational age beyond 28 weeks.

Following ISUOG recommendations, Doppler velocimetry included umbilical artery-pulsatility index (UA-PI, RI, S/D).[9] The gestational age of the individuals with aberrant Doppler findings was determined. The symptomatic and asymptomatic patients who went into spontaneous labor or were terminated during their stay period were observed and the pregnancy outcome was noted in terms of mode of delivery, birth weight, APGAR score, NICU admission, and neonatal transmission.

Statistical Analysis

Both groups were given descriptive data based on their baseline clinical parameters. Using the Chi-square test, continuous data were analyzed. A significant *p* value of less than 0.05 was used. The data was permeated inside a Microsoft Excel spreadsheet, and then the data was evaluated with SPSS edition 26.0 statistical software. For quantitative data, mean standard deviations were recorded, while categorical types were conveyed as quantities and percentages.

Results

A total of 102 patients were included in the current study.

The distribution of chronic disease was significantly more among symptomatic patients compared to asymptomatic patients (Table 1).

There was no significant difference in the SDP scores within the asymptomatic and symptomatic patients, according to the Chi-square analysis (Table 2).

Asymptomatic and symptomatic sufferers had the same Doppler outcomes, according to the Chi-square estimation (Table 3).

The Chi-square computation showed that SDP scores of less than 2 was found to be more among subjects with

Table 1: Distribution of sociodemographic parameters between asymptomatic and symptomatic subjects

		Asymptomatic	*Symptomatic*	*p-value*
Age		37.90 ± 4.40 years	38.47 ± 5.12 years	0.381
BMI		23.17 ± 2.36 years	24.18 ± 3.03 years	0.194
Socio-economic status	Lower lower	8 (12.5%)	5 (13.2%)	0.309
	Lower middle	44 (68.8%)	25 (65.8%)	
	Middle	12 (18.8%)	8 (21.1%)	
Chronic disease		4 (6.3%)	5 (13.2%)	0.001*

Table 2: Comparison of SDP score between asymptomatic and symptomatic subjects

SDP score	*Asymptomatic*	*Symptomatic*
> 8	20 (31.2%)	11 (28.9%)
2–8	36 (56.3%)	21 (55.3%)
< 2	8 (12.5%)	6 (15.8%)

Chi-square value = 3.126, *p*-value = 0.211

Table 3: Comparison of Doppler findings between asymptomatic and symptomatic subjects

Doppler findings	*Asymptomatic*	*Symptomatic*
Normal S/D <3 RI <0.75 PI <1.5	57 (89.1%)	13 (34.2%)
Abnormal S/D >3 RI >0.75 PI >1.5	7 (10.9%)	25 (65.8%)

Chi-square value = 38.478, *p*-value <0.001*

Severe COVID-19 symptoms but the results did not show any statistical significance (Table 4).

Abnormal Doppler findings of umbilical artery (S/D > 3, RI > 0.75 and PI > 1.5) were found to be significantly ($p < 0.05$) more among subjects with symptoms of the severe COVID-19 correlated to women with mild to moderate indications (Table 5).

Out of 102 patients 64 patients were delivered during the stay period. There existed 21 vaginal and 43 cesarean deliveries. Among women with SDP <8, there were 14 (28.0%) Vaginal and 36 (72.0%) cesarean deliveries. Among women with abnormal Doppler, there were two (6.3%) Vaginal and 30 (93.7%) cesarean deliveries (Table 6).

The association of gestational age with the mode of delivery was assessed using the Chi-square test which showed no significant association (Table 7).

Birth weight was found to be ≥2.5 among 26 (52.0%), 1.5–2.5 kgs among 23 (46.0%) and <1.5 kgs among 1 (2.0%) subject. APGAR score <7 at 1 minute was found among 35 (70.0%) and 37 (74.0%) subjects ,respectively. NICU admission was significantly more among symptomatic subjects (54.0%) compared to asymptomatic subjects (16.0%). The mean APGAR scores at 1 minute and at 5 minutes and Mean Birth Weight did not differ significantly between asymptomatic and symptomatic patients (Table 8).

In our research, we found no evidence of vertical transmission.

Discussion

The aberrant single deepest vertical pocket did not differ significantly among those pregnant women who were having drastic acute respiratory syndrome coronavirus-2 infection positive and had mild, moderate, or severe clinical symptoms. Statistical difference in color Doppler was there in severely symptomatic COVID.

However, data from single-center reports, systematic reviews, and/or meta-analysis suggests that SARS-CoV-2 infection can cause prenatal problems.[10,11] It's unclear if this is because of the altering maternal circumstances, vertical virus transmission, or interactions with the maternal comorbidities.

The existence of SARS-CoV-2 in maternal and newborn specimens has implied vertical transmission, nevertheless, this appears to be a once-in-a-lifetime occurrence rather than a regular one.[6,12]

SARS-CoV-2 differs from other viruses in that it uses the transmembrane serine protease 2 receptors and angiotensin-converting enzyme 2 to infest the cells.[13] An interaction of additional proteins with SARS-CoV-2 may contaminate cells through several mechanisms, according to the researchers. Pregnant women who tested positive had no greater prevalence of aberrant ultrasound but a significant difference in color Doppler was there in severely symptomatic COVID.

IgM antibodies for COVID-19 virus have been found in neonatal serum at the time of birth, according to some research.[2,14] Since crossing the placenta is not dime by the IgM antibodies and these studies used extremely small sample sizes, it's likely that this is due to the neonatal immunological response to infection in pregnancy.

Despite the fact that several of the neonates experienced prenatal difficulties, one study discovered that 38 of the neonates delivered by COVID-19 positive women did not have coronavirus infection. Surprisingly, inside the placentas of those infants who had perinatal difficulties, SARS-CoV-2 was noticed.[15]

Table 4: Comparison of SDP score between mild–moderate and severe symptoms

SDP score	*Mild to moderate symptoms*	*Severe symptoms*
> 8	10 (32.3%)	1 (14.3%)
2–8	18 (58.1%)	3 (42.9%)
< 2	3 (9.7%)	3 (42.9%)

Chi-square value = 4.857, *p*-value = 0.088

Table 5: Comparison of Doppler findings between mild–moderate and severe symptoms

	Mild to moderate symptoms	*Severe symptoms*
Normal S/D <3 RI <0.75 PI <1.5	13 (41.9%)	0 (0.0%)
Abnormal S/D >3 RI >0.75 PI >1.5	18 (58.1%)	7 (100.0%)

Chi-square value = 4.462, *p*-value = 0.035*

Table 6: Pregnancy outcome among study population

	Vaginal (n = 21)	*LSCS (n = 43)*	*p-value*
SDP <8 (n = 50)	14 (28.0%)	36 (72.0%)	0.121
Abnormal Doppler (n = 32)	2 (6.3%)	30 (93.7%)	<0.001*

Table 7: Association of gestational age with mode of delivery

Gestational age	*Vaginal (n = 21)*	*LSCS (n = 43)*
28–32	0	6
32–36	5	17
>36	16	20

Chi-square value = 3.929, *p*-value = 0.140

Table 8: Distribution of study population according to birth weight

	Asymptomatic	*Symptomatic*	*p-value*
Mean days of NICU admission	4.89 ± 1.20 days	7.53 ± 2.87 days	0.039*
Mean APGAR score at 1 minute	5.05 ± 1.09	5.24 ± 1.24	0.206
Mean APGAR score at 5 minutes	3.16 ± 0.92	3.40 ± 1.02	0.169
Mean birth weight	2.89 ± 1.13 kgs	2.95 ± 1.27 kgs	0.692

Amniotic Fluid

During the initial phase of the pandemic, none of the studies reported any vertical transmission;[16] however, recently, some cases with a probability of vertical transmission have been noted.[17] These studies had their focus mainly upon the women in late pregnancy.[2,14]

The SDP values did not differ significantly between symptomatic and asymptomatic pregnant women suffering from COVID-19 and even no discrepancy was set up with the severity of COVID-19. The likelihood for the sheer transmission of SARS-COV-2 cannot be decreed.[18] Yu et al. did a retrospective investigation of those laboratory findings and clinical records among two pregnant women in 1st trimester of pregnancy possessing COVID-19 and was unable to detect SARS-CoV-2 in the amniotic fluid.[19]

The reduction in the volume of amniotic fluid is correlated along with elevated chances for perinatal rates of both morbidity and mortality. Estimating the volume of amniotic fluid is a significant element of the antenatal fetal surveillance.[20]

Doppler Parameters

During the time of the third trimester of pregnancy, fetal Doppler ultrasound is commonly indicated to assess the umbilical artery and other fetal arteries for fetal well-being.[10] By evaluating the variations between the velocity of end-diastolic and peak systolic within the blood vessels throughout every cardiac cycle, the downstream vascular resistance is described by the pulsatility and resistance indices.[11]

In the current research, abnormal Doppler findings were found to be significantly ($p < 0.05$) more among subjects with severe COVID-19 symptoms compared to asymptomatic and women with mild to moderate symptoms. The sample size was very small in our study to justify these findings. There is only a little amount of research on these findings.

Shanes et al. surveyed the placentas of 16 study subjects who were women who had significant COVID-19 affliction and according to the study, pregnant women who have been tainted through COVID-19 and gave birth in their third trimester had placentas with evidence of intervillous thrombi and maternal vascular malperfusion.[21] However, no pathognomonic aspects had been discovered. Their findings indicate that the circulation of maternal was abnormal, indicating a hypercoagulable state or a systemic inflammatory which impacted placental physiology and led to poor perinatal outcomes.

Mulvey et al. found out that there was fetal vascular malperfusion with many thrombi among placentas obtained from COVID-19 patients that had term delivery.[12] Nonetheless, there have been ongoing debates concerning COVID-19's vertical transmission, and this issue has yet to be resolved.

Pregnancy Outcome

There were 21 vaginal and 43 cesarean deliveries in our study. The first data we have on birth method comes from China, in the region where the preferred option was

noticed to be cesarean section for preventing perinatal transmission.[13,22] Due to the high frequency of fetal distress documented in research from China, the current RCOG guidelines recommend using electronic fetal monitoring continuously intrapartum.[23]

Association of SDP with Mode of Delivery

In our study, among women with SDP <8, there were 14 (28.0%) vaginal and 36 (72.0%) cesarean deliveries. Some of the researchers have given the hypothesis that respiratory failure and hypoxia among mothers might lead to a temporary reduction in the uterine blood flow to the placenta.[24] Some of the researchers have given the hypothesis that respiratory failure and hypoxia among mothers might lead to a temporary reduction in the uterine blood flow to the placenta.[24]

Association of Doppler with Mode of Delivery

The current study demonstrated that among women with abnormal Doppler, there were two (6.3%) vaginal and 30 (93.7%) cesarean deliveries. Doppler ultrasonography examination may be beneficial in predicting IUGR and preeclampsia when there is high resistance to blood flow.[25]

Association of Gestational Age with Mode of Delivery

In the current study, the alliance of gestational duration with the procedure of delivery was assessed using the Chi-square test showed no significant association. Preterm birth was found to be 19% in the study where 37 pregnant women suffered from COVID-19 infection.[26]

Neonatal Outcome

Birth weight was found to be ≥2.5 among 26 (52.0%), 1.5–2.5 kgs among 23 (46.0%), and <1.5 kgs among 1 (2.0%) subjects. Two of four preterm newborns with a birth weight less than 2500 gms were detected by Chen et al. at 36 gestational weeks plus 2 days, one at 1880 gms, and one at 2460 gms.[22]

A group of neonates with an APGAR score of 7 at 1 minute was discovered among 35 (70.0%) and 37 (74.0%) subjects, respectively. All the nine live births possessed an Apgar record of 8–9 after 1 minute and a record of 9–10 after 5 minutes, according to Chen et al.[22] According to Juan et al., APGAR counts at 1 and 5 moments varied from 7–10.[27]

NICU admission was significantly more among symptomatic subjects (54.0%) compared to symptomatic subjects (16.0%).

Maternal Mortality

There is presently no proof correlating COVID-19 to a heightened threat of miscarriage or early pregnancy loss. However, no maternal and fetal death was reported by Chen et al.[22]

Vertical Transmission

In our research, we found no evidence of vertical transmission. It's important to highlight that anytime vaginal secretions were being assessed for COVID-19 in the history and in relation to vaginal birth, the results have been negative.[28] Chen et al.[22] reported no fetal intrauterine transmission. However, Fenizia et al.[29] found in utero vertical transmission among 6% enrolled women infected with COVID-19.

Coronavirus is an illness that causes inflammation. Pregnancy includes proinflammatory stages in the first and third trimesters, which may help the condition develop more quickly. Because of the placenta's more sophisticated protective mechanisms, intrauterine vertical transmission of the SARS-CoV-2 did not get specified with detailed pathophysiology.[30]

The major limitation of our study was the cross-sectional study design rather than a prospective follow-up. The other limitation was the small sample size of the study which limits the generalizability of the results.

Conclusion

No significant difference in SDP values was seen. Statistical difference in color Doppler was there in severely symptomatic COVID. Given the potential of rapid and progressive placental insufficiency in pregnant women possessing COVID-19 infection, it appears that as an extension to the mother's inspection and care, we should keep the likelihood of acute placental shortage and fetal hypoxia in mind. Additionally, the chance for vertical transmission to the fetus has to be considered.

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