

# Determinants for Mode of Delivery in COVID-19 Pregnancy: A Single-center Retrospective Observational Study

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## ABSTRACT

**Introduction:** With the rise in COVID-19 cases round the world, we have the problem of COVID-19 positive pregnancies at hand. Various case series and reports around the world have shown a high incidence of cesarean deliveries in these patients. We have attempted to study the factors predicting an increase in cesarean section (CS) rates in COVID-19 positive pregnancies admitted to our institution.

**Methods:** Retrospective analysis of all deliveries of COVID-19 affected pregnancies in a tertiary care center in north Kerala from 15 April 2020 to 31 October 2020. There were 253 deliveries during this period with 183 cases of cesarean and 70 vaginal deliveries. The data were entered in Microsoft Excel and analyzed with appropriate statistical software.

**Results:** There was 71.42% cesarean section rate in women below 35 years of age compared to 100% in those above 35 years. The rate was higher among nullipara (77.77%) compared to 67.32% among multipara. There was also a positive correlation between cesarean with obesity [prepregnancy body mass index (BMI) more than 30].

There were 70.22% term cesareans compared to 89.28% in preterm. Induction of labor also seemed to increase rate of cesarean. Fetal growth restriction (88.88%) contributed more to cesarean rates unlike those without (71.06%) preterm rupture of membranes (PROM) and meconium staining of amniotic fluid (MSAF) was also seen to increase the possibility of cesarean.

Cardiotocogram abnormalities (13.83%) were another important contributing factor. A total of 100% of patients with abnormal cardiotocogram (CTG) underwent cesarean section when compared to only 67.88% in those with normal CTG.

In patients delivered while still positive, the incidence of cesarean section was 77.63%, while this reduced to 63.04% in those whom delivery was delayed till seronegativity achieved.

A total of 75.95% cases were done in the morning. There were 19.67% cases of fetal distress which added to the cesarean numbers.

**Conclusions:** We found increased maternal age, obesity, nulliparity, fetal growth restriction, PROM, MSAF as factors which contributed to increased cesarean section rates in COVID-19 positive pregnancies. Hence these pregnancies need careful monitoring.

**Keywords:** Cesarean section, COVID-19, Growth restriction, Meconium, Obesity.

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## INTRODUCTION

The COVID-19 was first reported from Wuhan, China and then there was rapid increase in case numbers worldwide prompting the World Health Organization to declare a pandemic on 11 March 2020. The initial reports were that pregnancy does not alter the course of the disease, but most of the deliveries were by cesarean.<sup>1</sup> There was fear about health workers getting infection while monitoring during labor and at the time of pushing during second stage. The practical difficulty of fetal heart monitoring was another issue. There were reports of fetal heart rate alteration even in asymptomatic COVID-19 infected patients in labor. The cesarean section was also thought to protect the babies from getting infection. Another reason for increasing cesarean when urgent delivery needed for maternal or fetal compromise. There is need for a proper study to determine the appropriate mode of delivery in COVID-19 affected pregnancies.

## METHODS

This is a retrospective analysis of all deliveries of COVID-19 affected pregnancies in a tertiary care center in north Kerala from 15 April 2020 to 31 October 2020. Ethical clearance for the study was taken from the institutional ethical committee. The hospital is referral center for all COVID-19 positive pregnancies of northern two districts of Kerala. The state policy is to screen for COVID-19 all

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pregnant ladies admitted for delivery or elective cesarean section if they are symptomatic or history of contact or travel abroad or other states. The initial test done is rapid antigen test and if the test is found negative, reverse transcription polymerase chain reaction (RT-PCR) of nasopharyngeal swab. The data is collected from all patients as part of an ongoing multicentric study. The relevant data is extracted to know the effect of following variables on mode of delivery – age, parity, severity of disease, the previous obstetric history (previous cesarean, previous myomectomy), BMI, gestational age, PROM, onset of labor (spontaneous or induced), fetal growth restriction (FGR), CTG abnormalities, meconium staining of liquor,

COVID-19 status at time of delivery, time of delivery (day/night) and cases seen till 31 August 2022 or cases from 1 September 2022. The data was entered in Microsoft Excel sheet and analyzed using appropriate statistical software.

**RESULTS**

Among the women less than 35 years of age, 71.42% underwent cesarean section; however, in the 8 women above 35 years, 100% underwent cesarean (Table 1). Among the nullipara the incidence of cesarean was 80% whereas the incidence was 67.32% among multipara (which also included the cases with previous cesarean. (Table 2). There were 12 patients among the cesarean group and there was a positive correlation of cesarean section with obesity (BMI >30) (correlation: +1) (Table 3).

There was an incidence of 70.22% cesarean sections in term pregnancies compared to 89.28% in preterm cases (Table 4). Among the patients in whom labor was induced, 7% underwent cesarean whereas among those who went into labor spontaneously 100% delivered vaginally (Table 5). A total of 100% of patients with history of previous cesarean underwent repeat cesarean (Table 6).

**Table 1:** Percentage of cesarian based on age

Age	N = 183	Women underwent cesarean section (%)
<35 years	175	71.42
>35 years	8	100

**Table 2:** Parity affecting cesarian rates

Parity	N	Women underwent cesarean section (%)
Nullipara	80/100	80
Multipara	103/153	67.32

**Table 3:** Prepregnancy BMI

BMI	Obese	Non-obese
CS	12	171
Vaginal	5	65
Correlation = 1		

**Table 4:** Period of gestation (preterm/term)

Gestational age at CS	Term (N)	%
≥37 weeks	158/225	70.22
<37 weeks	25/28	89.28

**Table 5:** Pregnancies where labor was induced

Onset of labor	Spontaneous (N)	Induced (N)
CS (emergency)	0	1
Vaginal delivery	57	13
Delivery (%)	100 (vaginal delivery)	7 (CS)

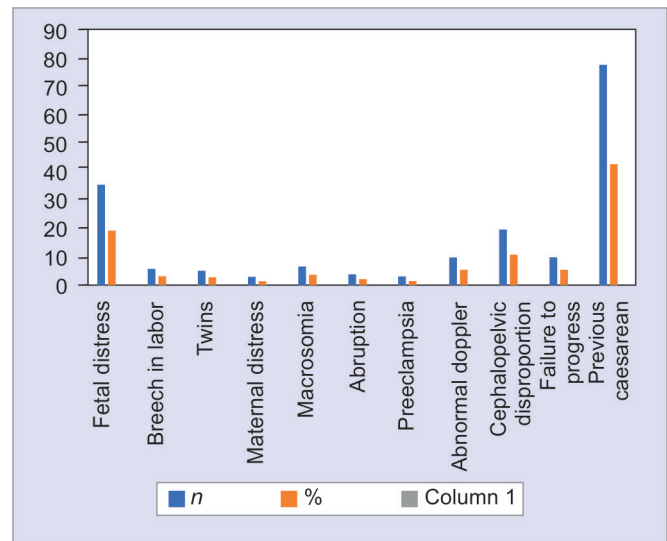
**Table 6:** Women with history of previous cesarian section

Previous CS	Yes	%
CS	79/79	100

A total of 88.88% of patients with fetal growth restriction (Fig. 1) (Table 7) underwent emergency cesarean section, whereas the incidence of cesarean was only 71.06% in those without growth restriction. There was a positive correlation of patients with PROM with cesarean section (Table 8). There was also a positive correlation of patients with meconium-stained amniotic fluid and cesarean section.

There were 35 patients (13.83%) who developed abnormalities of fetal heart rate on CTG (Fig. 1) (Table 9). A total of 100% of patients with abnormal CTG underwent cesarean section, when compared to only 67.88% in those with normal CTG.

In this study, although we have considered only COVID-19 positive cases, as per hospital protocol, we waited till patients turned negative before planning delivery. However, some of them delivered while still positive either vaginally or emergency cesarean. It was found that in patients who had to be delivered while still



**Fig. 1:** Indications for emergency CS. Number of cases (n); percentage contribution to total CS rate.

**Table 7:** Cases where FGR was diagnosed on ultrasonogram

FGR	Yes (N)	No (N)
CS	16	167
Vaginal delivery	2	68
Women undergoing CS (%)	88.88	71.06

**Table 8:** Cases with PROM

PROM	Yes (N)	No (N)
CS	19	167
Vaginal delivery	1	68
Correlation = 1		

**Table 9:** Cases where abnormal patterns were seen on CTG

CTG abnormalities	Yes (N)	No (N)
CS	35	148
Vaginal delivery	0	70
Women undergoing CS (%)	100	67.88

**Table 10:** The COVID-19 status at the time of delivery

COVID-19 status at the time of delivery	Positive (N)	Negative (N)
CS	125	58
Vaginal delivery	36	34
Women undergoing CS (%)	77.63	63.04

**Table 11:** Cases where there was MSAF found

Meconium-stained liquor at delivery or intrapartum	Yes (N)	No (N)
CS	10	173
Vaginal delivery	1	69
Women undergoing CS (%)	90.9	71.48

**Table 12:** Time of day when cesarian section is done

Delivery time	Day (N)	Night (N)
CS	139	44
Women undergoing CS (%)	75.95	24.04

positive, the incidence of cesarean section was 77.63%, while this reduced to 63.04% in those whom delivery was delayed till seronegativity achieved (Tables 10 to 12).

While considering time of day when cesareans happened, 75.95% cases were done in the morning. Among indications for cesarean section there were 19.67% cases of fetal distress. Some of these babies had intrauterine growth restriction and abnormal doppler parameters.

## DISCUSSION

There is a concern worldwide regarding the management of rising COVID-19 cases. The addition of COVID-19 positive pregnancies has only compounded the data. However, unlike other viral infections, the progress, outcome, symptomatology of COVID-19 is quite hazy. There is also a dearth of adequate randomized studies adequate enough to provide us with guidelines for management. There seems to be a disproportionate increase in the rate of cesarean sections in most centers caring for COVID-19 patients.

We have attempted to determine whether factors such as age, parity, BMI, and obstetric complications such as PROM, MSAF, and COVID-19 positive status at time of delivery have some role in the increase in cesarean section rates.

In a study by Zhang et al., the rate of cesarean sections were around 37.3%. Apart from maternal age and pregestational BMI, excess weight gain during pregnancy was associated with a higher cesarean rate.<sup>2</sup> In a study by Bisht et al., the rates of cesarean section was found to be 31.59%.<sup>3</sup> A study by Parpillewar et al. showed a cesarean section rate of 52.49%, and also found higher adverse outcomes with increased age and associated medical conditions.<sup>4</sup>

In this study, the cesarean rates were much higher; however, we too did find a positive correlation with increasing BMI. In this study, there were only 8 patients older than 35 years, however, all of them delivered by cesarean section; 2 being previous cesarean sections and the others developed complications such as macrosomia, abnormal CTG, and fetal distress. A study by Akhtar et al. shows a 14% incidence of fetal distress in COVID-19 positive pregnancies.<sup>5</sup> This compared to our findings of about 19.67% cases of fetal distress in our set of patients. The same study showed 8% incidence

of PROM in COVID-19 positive pregnancies. In our patients the incidence of PROM was 7.9%. Also, 95% of those with PROM ended up undergoing cesarean section, showing a positive correlation between increased PROM rates in COVID-19 positive pregnancies with increased cesarean section rates. However, in the study by Agarwal et al. showed no increase in PROM rates but showed an increase in cesarean section rates.<sup>6</sup>

In a meta-analysis by Capobianco et al. and in a study by Zhu et al., there were mentions that they found a 7.7% incidence of MSAF in COVID-19 positive pregnancies, necessitating intervention.<sup>7,8</sup> In these studies, 4.34% patients had MSAF; 90.9% of whom resulted in cesarean section, again showing a positive correlation with increased cesarean section rates.

Angiotensin converting enzyme 2 (ACE2), an enzyme belonging to renin angiotensin system (RAS) system, is a functional receptor in SARS-CoV-2-infected cells, chiefly expressed in the respiratory, urinary, cardiovascular, and digestive systems. A carboxypeptidase, ACE2, degrades angiotensin II into angiotensin 1-7, ensuring proper blood perfusion of important organs. When ACE2 expressing cells get infected with SARS-CoV-2, there is viral replication resulting in an immune response. It also destroys ACE2-positive cells, reducing ACE2 levels, resulting in hypoperfusion of organs having high ACE2 expression. The ACE2 reduction in pregnant women causes poor placental perfusion affecting fetal growth and development. The ACE inhibitors are known to cause maternal weight loss and to reduce blood pressure (BP), uterine perfusion, and resultant oligohydramnios leading to fetal mishaps. The ACE inhibitors are also implicated in intrauterine growth retardation, pulmonary hypoplasia, patent ductus arteriosus, neonatal hypotension, renal failure, and oligohydramnios.<sup>9</sup>

Studies have also implicated ACE2 gene polymorphism in pregnant women in causing recurrent abortion and fetal growth restriction.<sup>10,11</sup>

Hence, COVID-19 can possibly mimic ACE2 inhibitors or ACE2 gene polymorphism in pregnant women and fetuses.

In this study, there was an incidence of fetal growth retardation in 7.11% patients. A total of 88.88% of pregnancies with growth retardation underwent delivery by cesarean compared to 71.06% in those without growth restriction.

A study by Anna Gracia-perez-bonfils found that fetuses in COVID-19 positive pregnancies present with changes in CTG-like baseline FHR (>10%), loss of accelerations, late decelerations, zig-zag pattern and absence of cycling likely due to maternal pyrexia, maternal inflammatory response and the "cytokine storm."<sup>12</sup> In this study, 13.83% babies showed abnormal CTG findings such as late decelerations, baseline tachycardia, and atypical variable decelerations and all these babies had to be delivered by cesarean section.

## CONCLUSIONS

This study showed an increasing incidence of cesarean section in COVID-19 positive pregnancies especially when associated with advancing maternal age, pre pregnancy BMI, prematurity and cases where labor had to be induced due to COVID-19 related problems. There was also found an increased occurrence of fetal growth restriction, PROM, meconium-stained amniotic fluid, and abnormal CTG findings in pregnancies complicated by COVID-19, eventually necessitating cesarean section. There are lots of unanswered questions as far as this virus and pregnancies are concerned. However, in the present dark scenario where adequate

evidence is lacking, we have made a humble attempt to compile a few of our findings. We hope that this may provide some data which could help further research in our fight against the global nightmare, COVID-19.

## LIMITATIONS

The study was done retrospectively and there was no randomization. Larger randomized studies may be required to throw the further light on these factors.

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