

# COVID-19 in Pregnancy: Case-based Analysis of Maternal Mortality

Sumitra Bachani<sup>1</sup>, Renu Arora<sup>2</sup>, Anjali Dabral<sup>3</sup>, Neha Mohit Bhagwati<sup>4</sup>

Received on: 08 December 2022; Accepted on: 30 December 2023; Published on: 31 October 2023

## ABSTRACT

**Background:** Coronavirus infectious disease-2019 (COVID-19) is a respiratory system disease caused by the novel coronavirus severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), which started in Wuhan province of China and soon became a pandemic involving almost all the countries of the world. COVID-19-infected people with all age-groups, from neonates to pregnant women, were also infected with varying presentations. Pregnancy is a high-risk condition for developing severe COVID-19, and these patients need to be monitored closely.

**Objectives:** We are reviewing a case series of all pregnant women who succumbed to COVID-19 pneumonia in a tertiary care teaching hospital in the capital city of New Delhi in India to understand the clinical profile of pregnant patients dying of COVID.

**Study design:** It is a retrospective case series review, where case records of all pregnant women who were admitted to a teaching tertiary care hospital for a period of 1 year from the start of the pandemic were reviewed.

**Results:** In this retrospective review, case records of all 282 pregnant women admitted to our hospital were reviewed. Eight pregnant women suffering from COVID-19 died in our hospital. Detailed analysis of all 8 mortalities among pregnant women infected with COVID-19 was done. Clinical profile and laboratory values of all these cases were analyzed and discussed in the review.

**Conclusion:** COVID-19-related maternal deaths are not uncommon. Fever is almost the universal symptom of presentation and all fevers in the pandemic should be evaluated for COVID-19 owing to the ongoing pandemic. Severe acute respiratory syndrome coronavirus-2 causes respiratory tract infection and widespread inflammation, which culminates in multiorgan failure in some pregnant women. The course of illness in patients who die because of COVID is very aggressive, and these patients develop septic shock early in the course, possibly owing to the immunosuppressed state of pregnancy.

**Keywords:** COVID-19 in pregnancy, Maternal mortality, Severe acute respiratory syndrome coronavirus-2.

*Journal of South Asian Federation of Obstetrics and Gynaecology* (2023); 10.5005/jp-journals-10006-2313

## INTRODUCTION

The coronavirus infectious disease (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) had spread from Wuhan, China, to 223 countries worldwide over a span of 14 months and has affected over 10% of the global population.<sup>1</sup> It has been one of the deadliest pandemic encountered, with over 4,724,876 mortalities worldwide at the time of writing this article, despite implementations of numerous measures to combat the spread of the infection, such as travel restrictions, facility closures, and nationwide lockdowns.<sup>2</sup>

Severe acute respiratory syndrome-associated coronavirus was first identified in 2003 when it was first reported in China and eventually became an epidemic causing around 774 deaths, it has always shown clear capacity to spread across countries via International air travel.<sup>3</sup> The Middle East respiratory syndrome (MERS), which was identified in Saudi Arabia in 2012, was another coronavirus infection with a high mortality rate of around 35%.<sup>4</sup> Severe acute respiratory syndrome coronavirus-2 is a novel virus and we are still learning about its behavior.

The virus not only spreads from exposure to respiratory droplets from an infected person in close vicinity but also by airborne transmission in enclosed or poorly ventilated spaces.<sup>5</sup> The presentations range from common cold to diarrhea to highly fatal acute respiratory distress necessitating intensive care.

Coronavirus infectious disease-2019 deaths have been reported in not only the high-risk elderly population but also in otherwise

<sup>1-3</sup>Department of Obstetrics and Gynaecology, VMMC and Safdarjung Hospital, Delhi, India

<sup>4</sup>Department of Obstetrics and Gynaecology, Holy Family Hospital, Delhi, India

**Corresponding Author:** Neha Mohit Bhagwati, Department of Obstetrics and Gynaecology, Holy Family Hospital, Delhi, India, Phone: +91 8447091411, e-mail: nehakwatra6188@gmail.com

**How to cite this article:** Bachani S, Arora R, Dabral A, *et al.* COVID-19 in Pregnancy: Case-based Analysis of Maternal Mortality. *J South Asian Feder Obst Gynae* 2023;15(5):618–623.

**Source of support:** Nil

**Conflict of interest:** None

healthy adults and children. Like any other population, pregnant and postpartum women have also been affected by the deadly virus and it has been a significant cause of maternal and perinatal mortality.

In such highly infectious diseases where limiting the spread of infection is an overwhelming task, controlling morbidity and mortality after infection is indispensable. An efficient in-depth and precise understanding of the tragic events, including the patient's profile and disease progression, is of utmost importance to take preventive measures in current as well as future similar virulent infections. Hence, we attempt a comprehensive review of the maternal deaths due to COVID-19 among the affected obstetric population.

## MATERIALS AND METHODS

This is a retrospective review where all maternal case records of the antenatal women admitted in COVID block of a 1500-bedded tertiary care hospital attached to a medical college in the capital city of India have been reviewed. The hospital records up to 22,000 deliveries every year. It has a separate facility with an obstetric ward with level-III intensive care units (ICUs) for pregnant women with COVID-19. About 282 women with SARS-CoV-2 infection have delivered in the facility during the first wave of the pandemic in 2020. All mortality cases carrying the ICD code of maternal mortality were thoroughly reviewed by the maternal mortality review committee of the hospital, and all the direct as well as contributing factors were taken into account during the assessment of the cases. Maternal mortality is defined by the World Health Organization (WHO) as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause aggravated by the pregnancy or its management but not from accidental or incidental causes”.<sup>6</sup> A total of 8 maternal deaths have been reviewed briefly in this paper.

Advisory on the strategy for COVID-19 testing in India, as recommended by the National Task Force on COVID-19 initially at the beginning of the pandemic, was limited to symptomatic patients and residents of containment zones to more liberal testing.<sup>7</sup>

Containment zone is defined as the area of radius 3 km around the epicenter, i.e., the residence of a positive case or where they have been isolated.<sup>8</sup>

## CASE DESCRIPTION

### Case 1

A 35-year-old G4P3L3 with term pregnancy was received in the second stage of labor with breech presentation with severe preeclampsia with pulmonary edema. She was breathless since 3 days prior to admission. On examination, she was conscious with a pulse rate of 92 beats/min, blood pressure of 98/68 mm Hg, albuminuria on urine dipstick analysis, tachypnea with a respiratory rate of 44/bpm, and oxygen saturation of 67% on room air. Chest auscultation revealed bilateral coarse crepitations. After initial stabilization and hematological investigations, she underwent emergency cesarean section for obstructed labor and delivered a macerated male baby of 3.85 kg. She was taken to the ICU in intubated state on inotropic support (noradrenaline and vasopressin). She was transfused two units of fresh frozen plasma (FFP), 2 units of platelet-rich plasma (PRP), and 1 unit of packed red blood cells (PRBC). In the immediate postoperative period, while the reverse transcriptase polymerase chain reaction (RT-PCR) test for COVID-19 was awaited, she developed ventricular fibrillation and was revived after a brief cardiopulmonary resuscitation (CPR). She then developed anuria and progressed to septic shock with multiorgan dysfunction syndrome (MODS). She had a second cardiac arrest and expired within 24 hours of her surgery. Her investigations revealed severe anemia, leukocytosis, deranged renal function, and mixed metabolic respiratory acidosis. Chest X-ray depicted bilateral pulmonary edema with “white out lung” sparing the apices only. She was diagnosed as COVID-19 positive on qRT-PCR, which was confirmed post-mortem.

### Case 2

A 32-year-old G3P2L2 at 29 weeks and 5-day period of gestation reported fever since 4 days, difficulty in breathing, and decreased

fetal movements since 1 day. On examination, the patient was anxious, tachypneic, febrile, and hemodynamically stable, with oxygen saturation on room air of 80% and bilateral crepitations on chest auscultation. Fetal heart sounds were not detected on auscultation, and point-of-care ultrasound confirmed intrauterine fetal demise. She was diagnosed COVID-positive by the rapid antigen test, which was reported within an hour. Chest imaging (X-ray) revealed diffuse infiltrates in both lung fields. She was admitted in the ICU and received oxygen through high-flow nasal cannula (HFNC), corticosteroids, doxycycline, azithromycin, remdesivir, and low-molecular-weight heparin (LMWH). Her oxygen requirement kept increasing despite maximal HFNC support, and she had to be intubated. Within the next 24 hours, she developed MODS and septic shock and required high-dose inotropes and 100% FiO<sub>2</sub>. On the second day of admission, she developed severe bradycardia followed by cardiac arrest. She could not be revived despite prolonged CPR.

### Case 3

A 26-year-old primigravida underwent emergency cesarean section delivery for fetal distress in early labor at term gestation. She received two units of PRBC and four units of PRP transfusion in view of preoperative anemia (Hb 8.5 gm%) and thrombocytopenia (31,000/cumm). She had high-grade fever (104–106°F) on the first postoperative day and was diagnosed to be COVID-19-positive on subsequent qRT-PCR. Chest X-ray revealed bilateral pneumonia. She gradually deteriorated and developed hypoxemia within the next 24 hours. She was shifted to the ICU and attached to noninvasive ventilation with a FiO<sub>2</sub> of 0.5. She was administered corticosteroids, antibiotics, antiviral and prophylactic LMWH, and other supportive treatment as per the hospital COVID-19 treatment protocol. However, her hypoxemia worsened on the third postoperative day, and she developed MODS. She continued to deteriorate despite maximal ventilatory support and succumbed to her illness the next day.

### Case 4

A 32-year-old third G3P2L2 with previous two cesarean deliveries, a known case of dialysis-dependent chronic kidney disease stage V, presented with severe fetal growth restriction at 32 weeks of gestation. She was tested for COVID-19 as she resided in a containment zone and incidentally detected positive for the same. However, due to deteriorating renal function, the multidisciplinary committee decided to expedite delivery. She underwent cesarean section under subarachnoid block and delivered a low-birth-weight baby of 1 kg subsequently admitted to the NICU. She received antibiotics, steroids, and other supportive treatment. However, she developed pneumonia and eventually sepsis, which progressed to septic shock postoperatively. On POD 2, she further deteriorated and developed intractable septic shock, metabolic acidosis, and multiorgan dysfunction. On day 12 of testing positive for COVID-19 and postoperative day 2, she had a cardiac arrest and expired. It was declared a COVID-related death by the authorities.

### Case 5

A 25-year-old P3L3 had severe uncontrollable intraoperative bleeding during an abdominal hysterectomy done for severe hemorrhage with incomplete abortion in a peripheral district hospital. Intraoperative abdominal packing was done, and she was referred to the study center for intensive care and management.

**Table 1:** Demographic and clinical data

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Symptomatic on	Antenatal at 36 weeks	Antenatal at 29 + 5 weeks	POD 1	Antenatal at 32 weeks	Post-abortion	POD 5	PND 5	Antenatal at 34 + 3 weeks
Age	35	32	26	32	25	30	30	27
Parity	G4P3L3	G3P2L2	G1	G3P2L2	P3L3	G4P3L3	G2P1L0	G1
Comorbid condition	No	No	No	CKD		No	No	Hypothyroidism
Symptomatic	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Presenting symptom	SOB	Fever	Fever	None	None	Fever	Fever	Fever
Pregnancy complications	PE					APE		APE
Mode of delivery	NVD	Undelivered	LSCS	LSCS		LSCS	NVD	LSCS
Baby status	IUD		Alive	Alive		IUD	IUD	Alive
Baby's birth weight			2.54	1.1				2

The abdominal pack was removed, and surgery was completed after uterine artery embolization at our hospital. She was diagnosed as COVID-19-positive and tested after admission as she was a resident of the designated containment zone. She remained on ventilatory support and vasopressors in the postoperative period. She had persistent tachycardia and could not be weaned off from the ventilator. Her chest X-ray revealed bilateral basal infiltrates. She was administered antibiotics, antivirals, steroids, and prophylactic LMWH. She continued to worsen and developed sepsis and septic shock. Despite all efforts, she could not be revived and died on day 9 of her illness.

### Case 6

A 30-year-old P4L3 was referred to our institute on postoperative day 15 of an emergency cesarean section done under general anesthesia for antepartum eclampsia in poor general condition. She had delivered a stillborn baby and had been extubated on day 4 of surgery. She had several febrile episodes from the fifth postoperative day and subsequently had burst abdomen. On admission to our institute, she was unconscious and intubated in view of the poor score on Glasgow Coma Scale (GCS)-E1VTM1. She was pale with reduced bilateral air entry on chest auscultation. The patient was diagnosed COVID-19-positive (qRT-PCR) on being tested after admission. She was shifted to the ICU and put on mechanical ventilator in PAC mode. Her chest X-ray revealed bilateral pneumonia. She was administered broad-spectrum antibiotics, steroids, and antivirals. Lumbar puncture was done to evaluate encephalopathy, which was suggestive of infective etiology. Abdominal ultrasonography (USG) detected evidence of mild, clear free fluid in the peritoneal cavity. Surgical closure of the abdominal wound was done on day 18. Her total blood count was 22,200/mm<sup>3</sup>, serum ferritin -481 ng/mL, interleukin 6 (IL-6) -196 pg/mL, serum fibrinogen -242 mg/dL, and D-dimer -2090 ng/mL. On postoperative day 24, she developed ventricular tachycardia and underwent CPR as per the ACLS protocol, but she expired on day 5 of relaparotomy.

### Case 7

A 30-year-old P2L0 was referred on postnatal day 10 in view of the development of shortness of breath and fever 7 days post-delivery, which was gradually deteriorating. At the time of admission, she had tachycardia (pulse 112/minute), blood pressure of 140/90 mm Hg, tachypnea (32 bpm), decreased oxygen saturation (82%), and decreased urine output (350 mL in 24 hours). She tested positive

for COVID-19 by rapid antigen test at the time of admission. On evaluation, she had deranged renal function tests and bilateral pneumonia. She was admitted to the ICU and was administered a tertiary group of antibiotics, meropenem, azithromycin, and teicoplanin in view of clinical sepsis and leukocytosis (Table 1). She developed anuria and underwent multiple sessions of hemodialysis. She continued to worsen and developed septic shock and MODS. Her oxygen requirement gradually increased, and she had to be put on ventilatory support. However, she succumbed to her illness on day 19 of admission.

### Case 8

A 27-year-old primigravida known case of hypothyroidism on 100 µg thyroxine at 34 weeks and 3 days of gestation was referred to our institute with antepartum eclampsia. She had intractable seizures, not responding to antiepileptics and magnesium sulfate, with deteriorating neurological status since the first day of the disease. She also had a history of fever and cough since 15 days. On admission to the institute hospital, she was disoriented with a blood pressure of 134/106 mm Hg and other vital parameters within normal range. She underwent surgery under general anesthesia in view of worsening GCS and delivered a live male baby of 2 kg. She was shifted to the ICU and received antiepileptics, magnesium sulfate, antibiotics, and LMWH in the postoperative period. Contrast-enhanced computed tomography of the brain revealed leptomeningeal enhancement suggestive of meningoencephalitis. She subsequently tested positive for COVID-19 by qRT-PCR on day 2 of admission. Her condition deteriorated, and inotropes were administered for hemodynamic support. Despite all supportive treatment, she had bradycardia followed by asystole on postoperative day 3 and could not be revived.

## DISCUSSION

As a tertiary care referral center, our institute caters to a wide group of high-risk populations. Despite ample efforts to save all lives, there have been some unfortunate events of maternal mortalities.

In our institute, a total of 585 COVID-19 suspects and 282 COVID-19-positive women underwent deliveries in the first wave of COVID-19 in 2020. Most of the patients had mild disease and recovered well. Thirteen COVID-19-infected women had moderate-to-severe disease and required intensive care. Eight cases of maternal mortalities have been recorded in our institute in accordance with the ICD coding. Seven of these mortalities

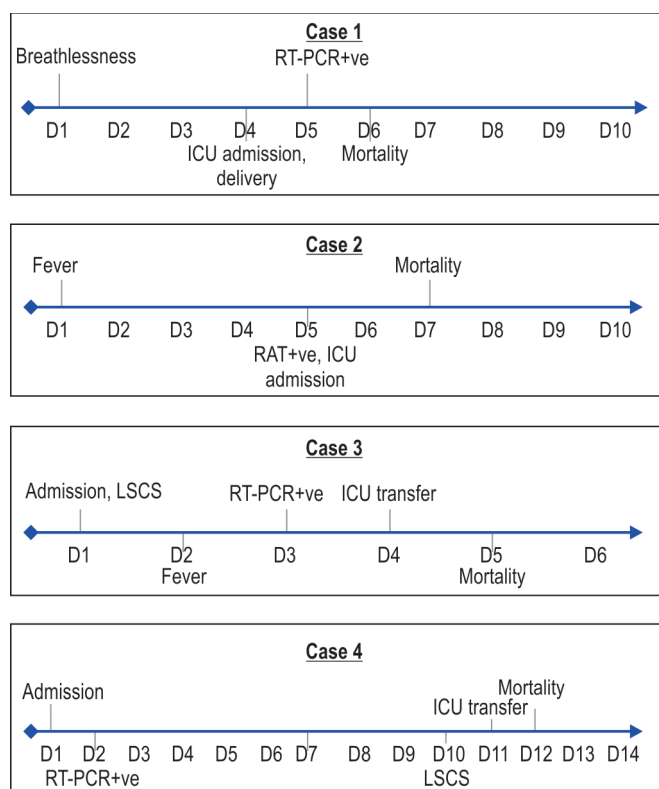


Fig. 1: Timeline of cases 1–4

have been implicated in SARS-CoV-2 coronavirus, whereas one of the unfortunate events was attributed to COVID-related death (Figs 1 and 2).

In a systematic review, the authors reviewed 160 COVID-19 maternal deaths, which were recorded worldwide till 1st July 2020.<sup>9</sup> Ellington S et al. reported an increased rate of hospitalization of 31.5% among pregnant women in contrast to 5.8% among similar nonpregnant women.<sup>10</sup> The need for admission could be due to obstetric indication, but they also reported an increased rate of admission of COVID-positive mothers to the ICU and higher requirement of mechanical ventilation in these women. Similar increased rates of ICU admission and requirement of invasive ventilation among the obstetric population were reported by Collin J et al. in Sweden.<sup>11</sup> These studies were contradictory to the initial reports of mild infection and favorable outcomes in pregnant women affected by the virus.<sup>12,13</sup>

Most of our women were between the age-group 25 and 30 years, which is similar to other studies (Table 1).<sup>14,15</sup>

Seven of the current study group women presented in the third trimester of pregnancy or postpartum.

Apart from one patient who was a diagnosed case of chronic renal disease, no other patients had any predisposing high-risk conditions such as diabetes, chronic hypertension, heart disease, or obesity. Mild gestational hypothyroidism and gestational hypertension were present in a few.

Hantoushzadeh S et al. described nine critically ill patients infected with COVID-19 in Iran over a period of 30 days at various designated centers across the country.<sup>16</sup> None of these patients had previous comorbidities and were normotensive on admission.

In three of the current studies, women had features of severe preeclampsia in the form of antepartum eclampsia in two, and

preeclampsia with pulmonary edema in the other. Both of these women did not have any preceding obstetric history of raised blood pressure during their antenatal period. This raises a suspicion of the possibility of COVID-related preeclampsia-like syndrome in these patients rather than preeclampsia itself, as reported by various other case reports across the globe. Mendoza M et al. report an incidence of 11.9% preeclampsia-like syndrome in severe COVID-19 cases, which is much higher than the worldwide incidence of preeclampsia in pregnancy.<sup>17</sup> In their study, cases were also distinguished from preeclampsia by normal uterine artery resistance studies and angiogenic factors in these patients, which are otherwise affected in preeclamptic pregnancies.

Among the study group, six women presented with some form of symptoms that warranted testing for COVID-19 virus. The most common symptom being fever accompanied by shortness of breath. Three of these women (cases 1, 2, and 8) were antenatal at the time of onset of symptoms, and one was immediate postoperative (case 3). All these four women had rapid progression of symptoms and clinical deterioration followed by multiorgan involvement. Despite vigorous supportive management in the ICU, they died within 2 days of symptom onset. This severe deterioration is thought to be due to immunological mechanisms responsible for virus-induced cytokine storm, as is seen in many COVID cases.<sup>18,19</sup> The disease progression is rapid, and the mortality is high in these cases.

The other two women (cases 6 and 7) were referred to our hospital from peripheral centers in view of progressive respiratory symptoms in the postpartum period. Both of these patients were most likely in the second week of the disease and were already in the inflammatory phase of the disease at the time of presentation, though they were tested only after admission to the ICU. Both of these patients had a long ICU stay before mortality.

One woman (case 4) who died due to COVID-related death was a known case of chronic renal disease and was asymptomatic for any COVID-related symptoms at the time of admission to the antenatal unit in the hospital. The patient was tested for the deadly virus in accordance with the then-existing ICMR guidelines as the patient was a resident of a defined containment zone. Careful watch for signs of deterioration was done, and the patient was given the routine obstetric and medical treatment as per the protocol. She underwent an emergency cesarean delivery in view of deteriorating renal function despite ongoing hemodialysis on day 10 from the day of the positive RT-PCR test. The patient's condition rapidly deteriorated after the surgery, and she succumbed to her illness secondary to renal failure. Lab reports are discussed in Table 2.

All of these patients were shifted to the ICU and put on invasive ventilation prior to their demise, unlike studies from Brazil, where 21.4% fatal cases received only noninvasive ventilation.<sup>20</sup> This is because there was a slow rise in the number of cases in the capital, and at no point, we faced shortage of healthcare providers or intensive care resources during the first wave.

More deaths are reported in the postpartum period than the antepartum period, which is similar to that reported from Brazil by Takemoto MLS et al.<sup>20</sup>

Of seven peripartum patients, three women had intrauterine fetal demise (cases 1, 6, and 7), one was a maternal mortality in the antepartum period itself (case 2), and two women had preterm delivery of low-birth-weight babies (cases 4 and 8) with prolonged neonatal intensive care unit (NICU) stay for the baby. Only one patient (case 3) had delivery of a healthy neonate at term gestation with no subsequent morbidity and a negative COVID test post delivery. Similar poor fetal and neonatal outcomes were

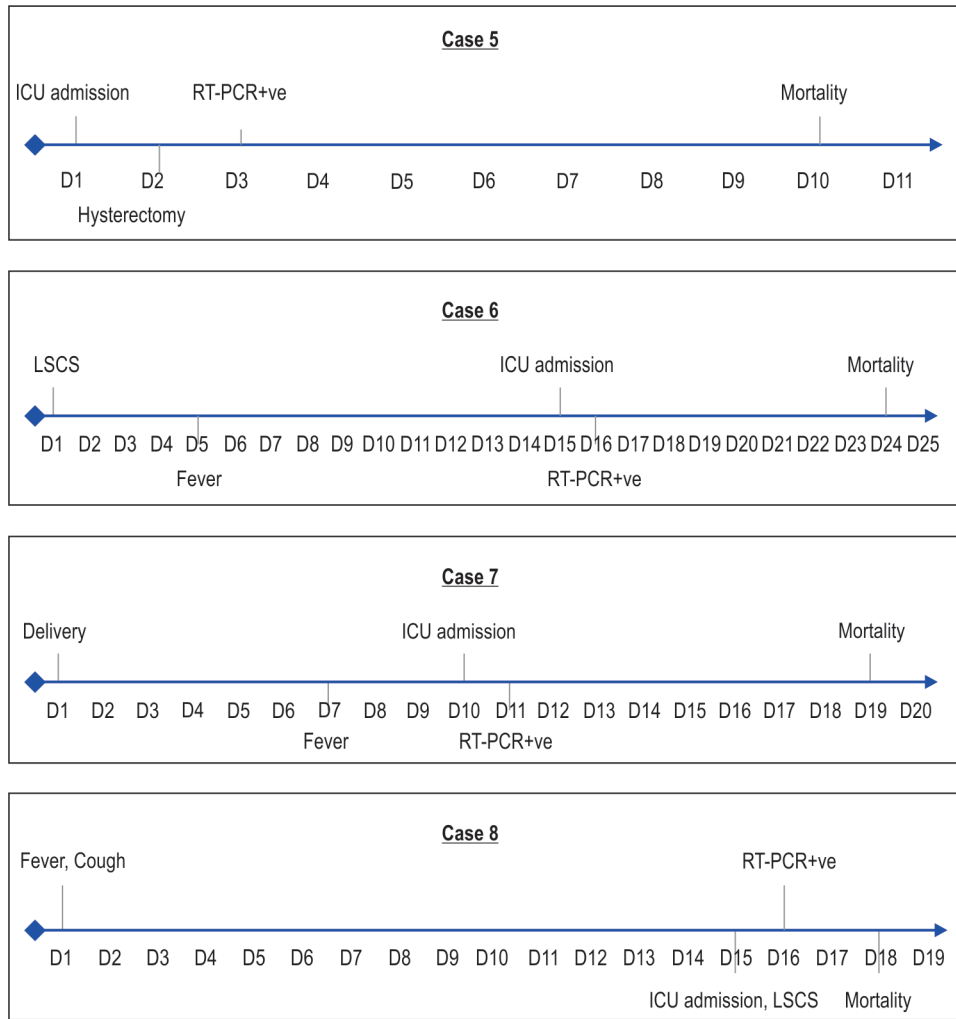


Fig. 2: Timeline of cases 5–8

Table 2: Laboratory data

Laboratory	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Hb (gm/dL)	10.6	9.6	7.3	9.1	8.5	7.9	6.3	9.2
TLC (/cumm)	20,000	9800	6700	12,500	17,700	22,200	11,500	8000
PC (Iac)	2.06	1.13	54,000	1.47	1.72	1.5	1.58	2.42
S. bil (mg/dL)	1.1	1.1		0.4	0.9	0.6	0.4	0.9
AST (IU/L)	118	60		523	38	37	35	172
ALT (IU/L)	67	18		372	23	46	5	189
S. creat (mg/dL)	1.2	0.5		4.3	1.5	0.5	11	0.6
pH	7.35	7.131	7.433	7.424	7.474	7.38	7.417	7.484
Lactate	4.3	3.3	2.5	1.6		1.1	0.61	2.5

seen among maternal mortality cases in Iran as described by Hantoushzadeh S et al.<sup>16</sup> Thus, unlike other COVID-positive mothers with mild or moderate infection,<sup>21–23</sup> there is a high rate of fetal demise among fetuses of mothers with severe infection during the peripartum period.

**CONCLUSION**

The exact pathophysiology of COVID-19 is still being unraveled. The best strategy is to take measures for protection from the virus.

It is still unpredictable as to who will develop a severe cytokine storm resulting in imminent death. However, in the event of any suspicion of infection such as symptoms or worsening of obstetric comorbidities, women should report to an appropriate facility at the earliest. This can facilitate continuous and stringent monitoring and immediate action at the slightest warning sign to prevent further morbidity and mortality. Pregnant women with comorbidities should be closely monitored and their condition optimized to prevent deterioration in the event of contracting SARS-CoV-2



infection. Whether delivery or cesarean section affects the course of illness in COVID-19 infection cannot be commented upon.

## REFERENCES

- Cascella M, Rajnik M, Aleem A, et al. Features, evaluation, and treatment of coronavirus (COVID-19) [Updated 2021 July 30]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK554776/>.
- Roser M, Ritchie H, Ortiz-Ospina E, et al. Coronavirus Pandemic (COVID-19) 2020. Available from: OurWorldInData.org. <https://ourworldindata.org/coronavirus>.
- Chen YMA. The 2003 SARS Outbreaks in Taiwan. *Emerging Infections in Asia* 2008;117–129. DOI: 10.1007/978-0-387-75722-3\_7.
- Alsolamy S, Arabi YM. Infection with Middle East respiratory syndrome coronavirus. *Can J Respir Ther* 2015;51(4):102. PMID: 26566382.
- Greenhalgh T, Jimenez JL, Prather KA, et al. Ten scientific reasons in support of airborne transmission of SARS-CoV-2. *Lancet* 2021;397(10285):1603–1605. DOI: 10.1016/S0140-6736(21)00869-2.
- World Health Organization. (n.d.). Indicator metadata registry details. World Health Organization. Retrieved September 26, 2021, from <https://www.who.int/data/gho/indicator-metadata-registry/indicator/4622>.
- Indian council of medical research. Revised strategy for COVID-19 testing in India. Available from: <https://www.mohfw.gov.in/pdf/Revisedtestingguidelines.pdf> [accessed on 18 May 2021].
- Ministry of Health and Family Welfare, Government of India. (n.d.). Containment Plan. <https://www.mohfw.gov.in/Pdf/Containmentplan16052020.Pdf>. Retrieved September 26, 2021, from: <https://www.mohfw.gov.in/pdf/Containmentplan16052020.pdf>.
- Nakamura-Pereira M, Betina Andreucci C, de Oliveira Menezes M, et al. Worldwide maternal deaths due to COVID-19: A brief review. *Int J Gynaecol Obstet* 2020;151(1):148–150. DOI: 10.1002/ijgo.13328.
- Ellington S, Strid P, Tong VT, et al. Characteristics of women of reproductive age with laboratory-confirmed SARS-CoV-2 infection by pregnancy status – United States, January 22–June 7, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69(25):769–775. DOI: 10.15585/mmwr.mm6925a1.
- Collin J, Byström E, Carnahan A, et al. Public Health Agency of Sweden's brief report: Pregnant and postpartum women with SARS-CoV-2 infection in intensive care in Sweden. *Acta Obstet Gynecol Scand* 2020;99(7):819–822. DOI: 10.1111/aogs.13901.
- Noelle B, Caitlin B, Cynthia GB, et al. COVID-19 infection among asymptomatic and symptomatic pregnant women: Two weeks of confirmed presentations to an affiliated pair of New York City hospitals. *Am J Obstet Gynecol MFM* 2020;2(2):100118. DOI: 10.1016/j.ajogmf.2020.100118.
- Qiancheng X, Jian S, Lingling P, et al. Coronavirus disease 2019 in pregnancy. *Int J Infect Dis* 2020;95:376–383. DOI: 10.1016/j.ijid.2020.04.065.
- Zaigham M, Andersson O. Maternal and perinatal outcomes with COVID-19: A systematic review of 108 pregnancies. *Acta Obstet Gynecol Scand* 2020;99(7):823–829. DOI: 10.1111/aogs.13867.
- Yu N, Li W, Kang Q, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: A retrospective, single-centre, descriptive study. *Lancet Infect Dis* 2020;20(5):559–564. DOI: 10.1016/S1473-3099(20)30176-6.
- Hantoushzadeh S, Shamshirsaz AA, Aleyasin A, et al. Maternal death due to COVID-19. *Am J Obstet Gynecol* 2020;223(1):109.e1–109.e16. DOI: 10.1016/j.ajog.2020.04.030.
- Mendoza M, Garcia-Ruiz I, Maiz N, et al. Pre-eclampsia-like syndrome induced by severe COVID-19: A prospective observational study. *BJOG* 2020;127(11):1374–1380. DOI: 10.1111/1471-0528.16339.
- Hu B, Huang S, Yin L. The cytokine storm and COVID-19. *J Med Virol* 2021;93(1):250–256. DOI: 10.1002/jmv.26232.
- Ye Q, Wang B, Mao J. The pathogenesis and treatment of the 'Cytokine Storm' in COVID-19. *J Infect* 2020;80(6):607–613. DOI: 10.1016/j.jinf.2020.03.037.
- Takemoto MLS, Menezes MdeO, Andreucci CB, et al. The tragedy of COVID-19 in Brazil: 124 maternal deaths and counting. *Int J Gynaecol Obstet* 2020;151(1):154–156. DOI: 10.1002/ijgo.13300.
- Garg R, Agarwal R, Yadav D, et al. Histopathological changes in placenta of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and maternal and perinatal outcome in COVID-19. *J Obstet Gynaecol India* 2023;73(1):44–50. DOI: 10.1007/s13224-022-01666-3.
- Malhotra J, Agrawal P, Garg R, et al. Coronavirus disease (COVID-19) and pregnancy: What obstetrician should know. *J South Asian Feder Obst Gynaecol* 2019;11(6):337–339. DOI: 10.5005/jp-journals-10006-1744.
- Agarwal N, Garg R, Singh S, et al. Coronavirus disease 2019 in pregnancy: Maternal and perinatal outcome. *J Educ Health Promot* 2021;10(1):194. DOI: 10.4103/jehp.jehp\_954\_20.