11.1 Introduction

Management of COVID-19 disease in pregnancy poses unique challenges, as it requires consideration of maternal physiologic changes, fetal and placental physiology, and a multidisciplinary approach to decision-making, particularly in patients with severe or critical disease. Though the majority of pregnant patients who test positive for SARS-CoV-2 remain asymptomatic or have mild disease and recover without undergoing delivery [1], a significant number develop critical illness and may have prolonged and complex disease courses [2].

The prevalence of SARS-CoV-2 infection in pregnant women approximates the overall population prevalence. Based on data from the H1N1 influenza and SARS pandemics during which pregnant women were at a higher risk of infection and had worse clinical outcomes [3, 4], it was anticipated that parturients during the SARS-CoV-2 outbreak would follow similar patterns.

Current studies, however, have found that pregnant women have similar rates of infection with SARS-CoV-2 and clinical courses and outcomes when compared with reproductive-aged non-pregnant women [5, 6]. In a systematic review of 538 pregnancies from China, Italy, and the United States, 15% of patients met criteria for severe disease, and only 1.4% were considered critical. This is in contrast to the SARS, H1N1, and MERS pandemics, during which pregnant women suffered disproportionately from critical respiratory disease and mortality [4, 7].
11.2 Background

11.2.1 Epidemiology in the Obstetric Population

Since April 2020, universal SARS-Cov-2 testing of pregnant women and their companions has been widely implemented [8] in obstetric clinics, triage, and labor and delivery in many hospitals in the United States and has aided in recognizing symptomatic as well as asymptomatic carriers. In one New York hospital at the peak of the pandemic, 15% of asymptomatic maternity patients tested positive for SARS-CoV-2 infection despite having screened negative with a telephone screening tool, and 58% of their asymptomatic, screen-negative support persons also tested positive for SARS-CoV-2 infection [9].

Prevalence differs between endemic regions and non-endemic regions. A second hospital in New York City reported a 13.5% prevalence of asymptomatic infection in women presenting for childbirth [8]. In comparison, the prevalence of positive SARS-CoV-2 test results among asymptomatic patients was much lower (<3%) in a pregnant population outside of the highly endemic region of New York City [10].

No large population studies exist on maternal mortality related to COVID-19 disease, but several maternal deaths from cardiopulmonary complications and multiorgan failure have been reported, often in women with no underlying medical conditions [11–13]. There is no evidence, however, that the maternal mortality rate is higher than that of the general population.

11.2.2 Patient Characteristics

Pregnant patients with symptoms of SARS-CoV-2 are most commonly (65%) infected in the third trimester [5, 14–17]. In a review of 195 parturients from China, Italy, and the United States, 66% of these women delivered at or after 37 + 0 weeks gestational age (wga), 26% delivered between 28 + 0 and 36 + 6 wga, and only 9% delivered earlier than 28 + 0 wga [18]. The average time to delivery after onset of severe or critical COVID-19 disease was 13 days [14, 19].

As of July 2020, maternal fatality rates remain low but may be underreported. Risk factors for development of respiratory and multiorgan failure are yet to be determined, but it has been suggested that increased pregestational BMI, abnormal heart and respiratory rates on admission, and underlying cardiopulmonary comorbidities are associated with severe disease [16].

11.3 COVID-19 Disease Manifestations in Pregnancy

The most common clinical manifestations of COVID-19 disease in pregnancy are fever and cough (>65%) and less often dyspnea, sore throat, and myalgia (<10%). Laboratory findings include a modest increase in liver enzymes, lymphopenia, and thrombocytopenia [20]. Severe or critical COVID-19 disease in pregnancy typically
begins with the onset of hypoxemic respiratory failure followed by acute respiratory distress syndrome (ARDS) and may progress to multiorgan dysfunction; most commonly this includes renal failure, thromboembolic disease, cardiovascular complications, inflammatory complications, secondary infections, and neurologic sequelae.

Disease severity in pregnancy is determined according to the same NIH classification system used in non-pregnant individuals. Disease severity categories are asymptomatic, mild, moderate, severe, and critical (see Table 11.1) [21].

The American College of Obstetricians and Gynecologists (ACOG) supports the use of telehealth platforms whenever possible to reduce patient and physician exposures while providing pregnancy care, particularly in patients with uncomplicated pregnancies. Telehealth interventions including remote antenatal blood pressure and glucose monitoring, symptom monitoring, and SMS/text messaging, among other interventions, have been shown to be non-inferior when compared to in-person visits in low-risk populations [22]. In-person visits should be reserved for high-risk patients and those for whom face-to-face evaluation is required per obstetric and maternal fetal medicine guidelines.

In accordance with guidelines from the Society for Maternal-Fetal Medicine, pregnant women with mild COVID-19 disease plus comorbidities (particularly any cardiopulmonary pathology) should be observed in a medical facility, and those with moderate to critical disease should be hospitalized. Pregnant women with severe to critical disease should be cared for at a high-acuity hospital with an intensive care unit, as well as obstetric and neonatal care teams [23].

### 11.4 Management of COVID-19 Disease in Pregnancy

#### 11.4.1 Maternal Hemodynamic Goals

Uteroplacental blood flow increases from 50 mL/min up to 1 L/min or more at term, is not autoregulated, and depends on maintenance of maternal mean arterial pressure (MAP) ≥ 65 mmHg. Strategies to maintain adequate MAP include judicious volume resuscitation, vasopressor support, and left uterine displacement to relieve aortocaval compression.

| Asymptomatic | Mild | Moderate | Severe | Critical |
|--------------|------|----------|--------|----------|
| + SARS-CoV-2 test, no symptoms | Any signs or symptoms (fever, cough, malaise, headache, myalgia, sore throat) without shortness of breath or abnormal chest imaging | Evidence of lower respiratory disease by clinical assessment or imaging and a saturation of oxygen (SaO₂) >93% on room air at sea level | Respiratory frequency > 30 breaths per minute, SaO₂ ≤ 93% on room air at sea level, ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO₂/FiO₂) <300, or lung infiltrates >50% | Respiratory failure, septic shock, and/or multiple organ dysfunction |

**Table 11.1 NIH classification system for disease severity [21]**
11.4.2 Vasopressor Choice in Pregnancy

Commonly used vasopressors in pregnancy are phenylephrine, ephedrine, and norepinephrine. Norepinephrine, the vasopressor of choice in septic shock, has gained favor in obstetric management, particularly in the setting of hypotension during cesarean delivery [24]. Norepinephrine’s safety profile is well established in pregnancy, but FHR monitoring should be considered if there is concern over uteroplacental perfusion. Phenylephrine and ephedrine can be used safely in pregnancy but have limited potency in critical illness. Epinephrine and dopamine are more arrhythmogenic than norepinephrine, but they, along with dobutamine, may also be used safely during pregnancy, as determined by the overall clinical status.

Vasopressin is structurally similar to oxytocin and may result in activation of uterine V1A and oxytocin receptors [25]. It should be used with extreme caution and in conjunction with uterine tocodynamometry and FHR monitoring due to the risk of inducing uterine contractions.

11.4.3 ARDS Management in Pregnancy

ARDS management principles must be adapted to accommodate the physiologic changes of pregnancy. Hypoxia and acidosis are poorly tolerated by both mother and fetus; even healthy parturients can tolerate only brief periods of hypoxia due to pregnancy-associated diaphragmatic elevation up to 4 cm, decreased functional residual capacity (FRC), increased oxygen consumption, and susceptibility to pulmonary edema. Maternal PaO2 is elevated at 100–105 mmHg due to increased alveolar ventilation, and maternal SpO2 must remain >95% (PaO2 > 70 mmHg) to ensure sufficient fetal oxygenation.

Early treatment for hypoxia is recommended. Noninvasive options include HFNC and prone positioning (self-proning in less severe disease), but the risks of aspiration, aerosolization of viral particles, and compression of the gravid abdomen should be considered. Prone in pregnancy is challenging but, if done correctly, is highly effective at reducing diaphragmatic and aortocaval compression. Special considerations include NPO status and avoiding compression of the gravid abdomen with pillows, padding, or a RotoProne® (or similar) bed. Right or left lateral displacement are also safe positions in pregnancy; a minimum lateral tilt between 30° and 45° is needed to achieve an appreciable increase in caval diameter [26].

Intubation and mechanical ventilation are reserved for critical cases of hypoxemic respiratory failure. Application of high positive end expiratory pressure (PEEP) should be used cautiously in pregnant women, as the reduction in preload and cardiac output may be detrimental to uteroplacental flow. Neuromuscular blockade with cisatracurium is safe in pregnancy and should be considered in patients with PaO2/FiO2 ratio < 150. Inhaled nitric oxide (iNO), a selective pulmonary vasodilator, may be used if the potential benefit to the mother outweighs the risks to the fetus.
Increased minute ventilation in normal pregnancy creates a respiratory alkalosis (PaCO₂ of 27–32 mmHg), compensated by a reduction in serum bicarbonate to approximately 20 meq/L. This reduction in total buffering capacity decreases the parturient’s ability to tolerate acidosis [27]. Hypercapnia creates an unfavorable transplacental CO₂ gradient for removal of fetal metabolic waste, causing fetal acidemia. Therefore, permissive hypercapnia, a strategy to limit tidal volumes and reduce lung injury in ARDS, should be used cautiously in pregnancy, and maternal PaCO₂ should be kept well below 60 mmHg. Due to decreased chest wall compliance during pregnancy, plateau pressures ≤35 cm H₂O may be tolerated. Excessive hyperventilation and alkalosis should also be avoided, as hypocarbia results in uterine artery vasoconstriction and reduction of uteroplacental blood flow.

11.4.4 Extracorporeal Life Support (ECLS)/Extracorporeal Membrane Oxygenator (ECMO)

The use of ECMO for refractory ARDS during the SARS-CoV-2 pandemic is based on data from prior global pandemics that showed improvements in mortality in young patients afflicted with severe pulmonary disease [28, 29]. Pregnant women with critical COVID-19 disease represent an ideal group of patients who may benefit from ECLS due to their relative youth and lack of comorbidities when compared to the general population.

ARDS is the most common indication for initiation of ECLS in pregnancy [30]. Parturients on ECMO for ARDS demonstrate a survival rate of 80% (more favorable than the general population, with similar rates of complications), while fetal survival is approximately 65%. Maternal risk of complications such as bleeding and neurologic morbidity (hemiparesis, limb weakness) should be considered when initiating ECLS.

11.4.5 Thromboembolic Disease

The elevated risk of venous thromboembolism during normal pregnancy places parturients with COVID-19 disease at an even higher risk of thromboembolic complications. Generally in pregnancy, low-molecular-weight heparin (LMWH) is preferred over unfractionated heparin (UFH) [31]. However, due to its short half-life and reversibility with protamine sulfate, UFH is favored in severe or critically ill parturients, as they are at greater risk for unpredictable delivery timing and neuraxial placement, as well as postpartum hemorrhage [32]. UFH and LWMH do not cross the placenta, but alcohol-free preparations should be used in pregnancy.
11.5 Antenatal Considerations

11.5.1 Fetal Monitoring and Interventions

Antenatal maternal hypoxia has been shown to alter fetal cardiovascular growth and function, cause fetal neurologic deficits and fetal growth restriction (FGR), and increase risk for postnatal complications [33]. In patients with critical respiratory disease, decisions around fetal heart rate monitoring and frequency of monitoring should depend on the gestational age of the fetus, desires of the patient, and feasibility and safety of intervention [34].

In cases of fetal distress, the common practice of maternal supplemental oxygen therapy for fetal resuscitation should be abandoned, as it has no proven fetal benefit and may result in aerosolization of maternal respiratory secretions. Other maneuvers such as lateral positioning and hemodynamic support are appropriate alternatives.

11.5.2 Corticosteroids, Pregnancy Category B

Betamethasone or dexamethasone are administered in pregnancies at risk of preterm delivery to reduce neonatal complications and mortality. The RECOVERY trial reports a reduction in mortality in non-pregnant hospitalized patients with severe and critical COVID-19 who received daily dexamethasone [35]. As of July 27, 2020, ACOG recommends administration of antenatal steroids to patients who require supplemental oxygen or mechanical ventilation and are in the early (24w0d–33w6d) or late preterm period (34w0d–36w6d) [23] as indicated for fetal benefit.

11.5.3 Intrapartum Fever

The differential diagnosis for intrapartum fever (intraamniotic infection, respiratory tract infection, urinary tract infection, drug/neuraxial related, DVT) should be expanded to include COVID-19 disease, particularly when the patient has respiratory symptoms and decreased oxygenation.

11.5.4 Preterm Labor

In women with known or suspected COVID-19, the preferred tocolytic is nifedipine. Nifedipine is a suitable alterative to indomethacin, which is subject to the theoretical yet unproven risk of NSAID use in COVID-19 disease, and to beta-sympathomimetics (i.e., terbutaline), which are associated with high rates of maternal tachyarrhythmias.
Magnesium sulfate should be administered on a case-by-case basis for maternal seizure prophylaxis and/or fetal neuroprotection due to the risks of pulmonary edema and neuromuscular weakness, particularly respiratory weakness. Serum magnesium levels may be drawn in patients who are unable to participate in clinical assessments aimed at recognizing signs and symptoms of magnesium toxicity.

11.5.5 Nutrition and Glucose Control

Many intensive care units utilize a caloric calculation of 25 kcal/kg/day of ideal body weight. An extra 300 kcal/day should be added during pregnancy (500 kcal/day in multiple gestation). No current guidelines exist for glucose control in critically ill parturients, but a target glucose level between 70 and 140 mg/dL has been suggested to avoid fetal complications associated with hyperglycemia.

11.6 Timing and Mode of Delivery

Greater than 90% of infected mothers recover from COVID-19 disease without undergoing delivery [36–40]. Data related to the timing of delivery in women with acute respiratory distress syndrome (ARDS) is limited, and there is much debate surrounding the topic of therapeutic delivery to improve maternal outcome in ARDS. It has been suggested that delivery of the fetus may improve maternal respiratory status by improving FRC and pulmonary mechanics and reducing metabolic stress [41, 42]. Decisions regarding delivery in this setting should be made based on a case-by-case basis by a multidisciplinary team including intensivists, obstetricians/maternal fetal medicine specialists, neonatologists, and obstetric anesthesiologists.

Cesarean delivery should be based on obstetric (fetal or maternal) indications and not COVID-19 status alone. Early in the SARS-CoV-2 pandemic, the majority of pregnancies (>90%) were delivered via cesarean section due to limited understanding of the risks of vertical transmission of disease as well as a desire to control the timing of delivery and prevent emergent intubations that would increase the risk of exposure for healthcare workers [43]. ACOG Committee Opinion 761 states that in the absence of maternal or fetal indications for cesarean delivery, a plan for vaginal delivery is safe and appropriate and should be recommended [44]. Vaginal delivery is preferred in asymptomatic, mild, or moderate disease, to reduce the risk of hemorrhage, infection, and thromboembolic disease associated with cesarean delivery [38, 44], while cesarean delivery may be favored in a severe or critically ill parturient who is unable to tolerate or participate in labor.
11.7 Safety of Common Therapies for COVID-19 Disease in Pregnancy (Table 11.2)

11.7.1 Convalescent Plasma

Early studies suggest a possible clinical benefit to administering ABO-compatible convalescent plasma, a high antibody titer plasma pooled from donors previously infected with SARS-CoV-2. Though pregnant women are excluded from ongoing RCTs for COVID-19, convalescent plasma was successfully used for eight pregnant Ebola patients [45], without any serious adverse maternal or fetal reactions. Potential complications include transfusion-related reactions and immunosuppression.

11.8 Uterotonics and Postpartum Hemorrhage (PPH)

Four uterotonic medications are available in the United States for the management of postpartum hemorrhage (PPH): oxytocin, carboprost (prostaglandin F2α), methylergonovine, and misoprostol (prostaglandin E1). Early administration of oxytocin and mechanical tamponade are preferred first-line treatments for PPH in severe or critical COVID-19 disease due to the significant risk of bronchospasm with administration of carboprost and pulmonary vasoconstriction with methylergonovine. Standardized recommendations have not been established, but given these risks, avoidance of carboprost and methylergonovine may be prudent in severe or critical COVID-19 disease. Due to thromboembolic risk, tranexamic acid should be administered with extreme caution and only in patients without renal insufficiency and neurologic or thromboembolic disease.

11.9 Anesthetic Management

The pre-anesthetic evaluation is an important component of management of all pregnant women on labor and delivery, but special considerations must be observed in COVID-19 disease.

1. **Airway evaluation:** A thorough evaluation should be performed while observing institutional practices around personal protective equipment (PPE). Endotracheal intubation can be challenging in pregnancy due to edema of the upper airway and difficult to perform with the increased breast volume. Airway exam may worsen as labor progresses and should be reassessed just prior to cesarean delivery if indicated [46]. Pregnant women are at high risk for aspiration due to increased intraabdominal pressure and impaired gastric emptying and should be pre-medicated with gastric prophylaxis prior to any procedure.

2. **Cardiopulmonary evaluation:** All COVID-19 positive patients should have a physical exam focused on cardiopulmonary status. If found to be hypoxic with or without dyspnea, obtain a blood gas and chest X-ray, and consider CT of the
| Therapy          | Original indication                        | Indication for use in COVID-19                                      | Mechanism of action                                                                 | Pregnancy safety category | Dosing                                                                                     | Available study data | Placental/ breastmilk transfer | Common adverse effects                                                                 | Contraindications                                                                 |
|------------------|--------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------|----------------------|--------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Remdesivir       | Hepatitis C, filoviruses (Ebola, Marburg)  | Severe or critical disease respiratory disease                      | Adenosine nucleoside analogue that interferes with viral RNA production             | C                        | 200 mg IV as a single dose on day 1, followed by 100 mg IV once daily × 4 days (may extend to 10 days total if no improvement). IV infusion over 30 to 120 min | Pregnant women excluded from RCTs. Faster time to recovery and a non-statistically significant trend toward lower 14-day mortalitya | No data. Its small molecular weight and high protein-binding rate suggest it may cross the placenta | Transaminitis, infusion reaction, impaired metabolism in renal insufficiency                              | Use with caution in patients with liver dysfunction                              |
| Ritonavir/ lopinavir | HIV                                      | Currently not recommended based on early studies showing a lack of benefit and significant side effects | Protease inhibitors                                                                | C                        | Lopinavir 400 mg/ ritonavir 100 mg PO (tablet) twice daily                                | Pregnant women excluded from RCTs. The first randomized, open-label, controlled study to be published reported lopinavir-ritonavir treatment did not significantly accelerate clinical improvement, reduce mortality, or diminish throat viral RNA detectability in patients with serious COVID-19 | Poor placental transfer due to strong protein binding for protease inhibitors   | Diarrhea, abdominal pain, altered liver enzymes                                      | Tablets are recommended; avoid use of the oral solution in pregnancy              |

(continued)
| Therapy                          | Original indication | Indication for use in COVID-19 | Mechanism of action | Pregnancy safety category | Dosing                                                                 | Available study data                                                                 | Placental/breastmilk transfer | Common adverse effects | Contraindications                  |
|---------------------------------|---------------------|---------------------------------|---------------------|--------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------|------------------------|------------------------|
| Unfractionated heparin          | Venous thromboembolism (VTE) prophylaxis, multiple uses | VTE prophylaxis or treatment in severe or critical disease | Enzymatic activation of antithrombin III | C                        | Prophylactic: 5000/7500/10,000 units SC every 8 h, depending if first/second/third trimester; therapeutic: Heparin drip titrated to anti-Xa levels | Pregnant women excluded from RCTs. A study of 449 COVID-19 patients found that deep vein thrombosis (DVT) prophylaxis decreased 28-day mortality by 20% in patients with a d-dimer ≥3000 ng/mL or a sepsis-induced coagulopathy score ≥ 4 without increasing rates of major bleeding. | No placental transfer, large molecular weight; avoid preparations containing alcohol | Heparin-induced thrombocytopenia (HIT), bleeding | Hypersensitivity reaction, history of HIT |
| Drug          | Pregnancies at risk for preterm delivery ± maternal benefit in COVID-19 | Dexamethasone should be administered to patients in the early and late preterm period (24w0d–33w6d or 34wod–36w6d) who require supplemental oxygen or mechanical ventilation | Induce the production of surfactant proteins and lipid synthesis, decrease fetal lung fluid, and alter preterm responses to oxidative stress | B | 6 mg IM or IV q12 h x 4 doses for FLM. Consider extending course for maternal benefit based on results of RECOVERY trial | Pregnant women excluded from RCTs. The RECOVERY trial reports a reduction in mortality in non-pregnant hospitalized patients with severe and critical COVID-19 who received daily dexamethasone | High placental/breastmilk transfer | Transient hyperglycemia and neutrophilia, neuropsychiatric symptoms | Use with caution in uncontrolled maternal hyperglycemia, neuropsychiatric conditions, adrenal suppression and immunosuppression |
|--------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Dexamethasone|                                                                                                    |                                                                                                                                  |                                                                                                                                 |     |                                                                                                                                                                                                 |                                                                                                                                                                                                 |                                                                                                                                 |                                                                                                                                 |                                                                                                                                 |

(continued)
### Table 11.2 (continued)

| Therapy         | Original indication | Indication for use in COVID-19                                                                 | Mechanism of action                                                                 | Pregnancy safety category | Dosing                                                      | Available study data                                                                 | Placental/breastmilk transfer | Common adverse effects | Contraindications     |
|-----------------|---------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------|-----------------------|-----------------------|
| Tocilizumab     | Rheumatoid arthritis, juvenile idiopathic arthritis, giant cell arthritis | Patients with moderate to severe COVID-19 disease, uncertain effect on patients already on mechanical ventilation | Monoclonal anti-IL-6 antibody, leads to a reduction in cytokine and acute phase reactant production | C                         | IV: Limited data available; dosing used in clinical trials commonly 8 mg/kg (maximum 800 mg/dose) as a single dose; may repeat dose in 8–12 h if signs/symptoms worsen or do not improve | Pregnant women excluded from RCTs. Safety and efficacy have not been established; early retrospective cohort data suggests treatment with tocilizumab might reduce the risk of invasive mechanical ventilation or death in patients with severe COVID-19 pneumonia | Significant placental and breastmilk transfer, though there does not seem to be an increased risk for congenital anomalies | Elevated LFTs, infusion reaction, increased serum cholesterol | Hypersensitivity        |

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aTang N, Bai H, Chen X, Gong J, Li D, Sun Z.. Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy. J Thromb Haemost. 2020;18(5):1094-1099. https://doi.org/10.1111/jth.14817

bBeigel JH, Tomashek KM, Dodd LE, et al. Remdesivir for the Treatment of Covid-19 — Preliminary Report. N Engl J Med. 2020. https://doi.org/10.1056/nejmoa2007764

cHorby P, Lim WS, Emberson J, et al. Dexamethasone for COVID-19-Preliminary Report Effect of Dexamethasone in Hospitalized Patients with COVID-19-Preliminary Report RECOVERY Collaborative Group*. medRxiv. 2020. https://doi.org/10.1101/2020.06.22.20137273
chest or transthoracic echocardiography to rule out other cardiopulmonary pathology.

3. Evaluate labs, particularly complete blood count, chemistry panel, coagulation factors (including anti-Xa level if on heparin), and fibrinogen (>350 mg/dL in pregnancy).

4. Access/hemodynamic monitoring:
   (a) Mild disease: adequate IV access for blood, resuscitation, and uterotonics.
   (b) Moderate disease: adequate IV access, consider arterial line.
   (c) Severe-critical disease: adequate IV access, arterial line for frequent blood sampling.

11.9.1 Neuraxial Anesthesia

Neuraxial is preferred for both vaginal delivery and cesarean section. Spinal anesthesia/dural puncture is considered safe as there have been no documented adverse complications related to CNS transmission of viral particles, and COVID-19 disease is not a contraindication [47]. However, the accompanying abrupt drop in preload may not be tolerated in seriously ill women.

Decision to proceed with neuraxial may be complicated by thrombocytopenia and concurrent use of anticoagulants. Common practice is to avoid neuraxial in patients with platelet counts <70,000/μL, though different practitioners may use different cutoffs. Thrombocytopenia secondary to COVID-19 disease is rarely <70,000/μL, so other causes should be considered if platelet count becomes critically low. Early labor epidurals are encouraged because the block provided by the in situ catheter may be extended for cesarean delivery in an urgent or emergent situation. These patients should be evaluated regularly to ensure early recognition of epidural failure and allow the provider to troubleshoot or replace the catheter in a controlled manner. The risk of general anesthesia (aspiration, difficult airway management, uterine atony, low neonatal APGARS) is greater than the theoretical risk of causing meningitis/encephalitis from neuraxial procedures; therefore, neuraxial procedures may be performed in parturients with COVID-19 unless otherwise contraindicated or logistically prohibited. In the setting of COVID-19 disease, many patients started on anticoagulation with either LMWH or UFH. Anticoagulation guidelines from the American Society of Regional Anesthesia (ASRA) [48] should be followed when considering neuraxial procedures or catheter removals.

Other analgesics such as nitrous oxide for labor analgesia should be suspended in the absence of sufficient data about cleaning, filtering, and potential aerosolization of nitrous oxide systems. Similarly, IV patient-controlled opiate analgesics should be avoided due to risk of respiratory depression and potential need for emergent airway procedures.

During labor with neuraxial, maternal heart rate, maternal pulse oximetry with plethysmography, and fetal heart rate should be continuously monitored. Additional monitors should be applied on a case-by-case basis.
11.9.2 General Anesthesia for Cesarean Delivery

General endotracheal anesthesia (GETA) may be required if patient is already intubated or hemodynamically unstable or in cases of emergent cesarean delivery (fetal or maternal distress) without in situ epidural catheter. Intubation of SARS-CoV-2-positive patients is associated with a high risk of transmission to healthcare providers. Providers should don full PPE and decrease risk of transmission by performing rapid sequence induction after adequate preoxygenation and intubate with a video laryngoscope to facilitate placement while reducing aerosolization of respiratory secretions. Pregnant women have reduced FRC and therefore minimal apneic time despite adequate preoxygenation. Intubation may be challenging due to airway edema or presence of large breasts. COVID-19 patients with hypoxia concomitant with the physiologically decreased FRC from pregnancy will likely become more hypoxic, develop further atelectasis with intubation and mechanical ventilation, and possibly require postoperative critical care admission [47]. Providers should also be aware of the decrease in mean alveolar concentration (MAC) and mean local anesthetic concentration (MLAC) requirements in pregnancy and adjust anesthetic depth accordingly.

11.10 Conclusions

Management of obstetric patients who test positive for SARS-CoV-2 ranges from outpatient care of asymptomatic or mildly symptomatic patients to inpatient management of those with moderate to critical illness. Inpatients are best managed by a multidisciplinary team including obstetricians/maternal fetal medicine specialists, anesthesiologists, neonatologists, intensivists, and nurses with obstetric and ICU training. Care teams should meet early and frequently to determine optimal delivery timing, mode of delivery, anesthetic options, and hemodynamic goals, with special attention to contingency plans for maternal instability, fetal distress, and postpartum hemorrhage.

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