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Obstetric Emergency Update: SARS-CoV-2 and Hypertension

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Title: Obstetric Emergency Update: SARS-CoV-2 and Hypertension

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**Key Words:** Coronavirus disease 2019; pregnancy; assessment; management; pre-eclampsia; gestational hypertension; severe hypertension of pregnancy; eclampsia; postpartum

**Key Points:**

- Pregnant women are at higher risk of COVID-19 infection, severe disease, morbidity, and mortality than their nonpregnant counterparts and the fetus is at increased risk of preterm delivery, cesarean delivery, and stillbirth.
- A high index of suspicion is essential as symptoms of COVID-19 can be mistaken for or may mimic physiologic conditions and complications of pregnancy.
- Assessment and management of COVID-19-positive pregnancies should follow the ACOG and Society for Maternal-Fetal Medicine guidelines.
- COVID-19 treatment in pregnancy is aligned with that of nonpregnant patients with a few caveats.
- Hypertension in the pregnant or postpartum patient should be immediately recognized and addressed as it is a leading contributor to both maternal and perinatal morbidity and mortality.
- Preeclampsia is defined as two blood pressures more than four hours apart with a systolic reading of equal or greater than 140 mm of Hg and/or a diastolic reading equal or greater
than 90 mm of Hg along with either proteinuria or certain lab values. Preeclampsia should be considered in any pregnant or postpartum patient presenting with hypertension deserving further evaluation.

- Severe hypertension in pregnancy is defined as systolic blood pressure of greater or equal to 160 mm of Hg and/or a diastolic blood pressure of greater or equal to 110 mm of Hg and should be immediately identified to determine if treatment is warranted.
- Hypertension in pregnancy and the postpartum period can be harbingers of cardiovascular disease, stroke, renal failure and eclamptic seizures.
- While the postpartum period is typically considered to be from birth to up to six weeks afterward, hypertension and cardiovascular complications may arise as late as 12 months after delivery.

**Synopsis:**

The purpose of this chapter is to bring attention to two topics of significant importance to the care of pregnant women and women who have recently given birth. Covid 19 and Hypertension can have a significant impact on morbidity and mortality for these pregnant and postpartum women. While women in their childbearing years are for the most part young and healthy, it is critically important to recognize that these patients have more stringent guidelines for vital signs and lab values which should be noticed as abnormal for rapid treatment as necessary.
SARS-CoV-2 and Pregnancy

INTRODUCTION

Much of the study of SARS-COV-2 remains in its infancy, especially regarding pregnancy.

Although the absolute risk of severe morbidity and mortality remains low, data from the Centers for Disease Control and Prevention indicate that the risk for both intensive care unit (ICU) admission and invasive ventilation in pregnant symptomatic women is increased 3-fold compared with nonpregnant symptomatic women\(^1\), whereas the risk of extracorporeal membrane oxygenation is increased 2.4-fold and the risk of death from COVID-19 is increased by 70%. Women with comorbidities, those over 35 years of age, and Latina and Black women are all at increased risk for adverse maternal outcomes\(^2\). Severe-critical disease in pregnancy is associated with worse outcomes, and the Delta variant brought additive risk for severe-critical disease\(^2,3\).

The care of all COVID-19-positive pregnant patients requires a high index of suspicion and meticulous follow up planning. Management of severe-critical patients requires complex care by a team including obstetrics, maternal-fetal medicine, neonatology, critical care, infectious disease, and obstetric anesthesiology\(^3\).

IMMUNOLOGY AND PHYSIOLOGY OF PREGNANCY

Immunologic changes that occur routinely in pregnancy may lead to worse outcomes in COVID-19-positive women. Researchers at Johns Hopkins University noted a reduced antiviral antibody response in COVID-19-positive pregnancies\(^4\). In addition, the immune response in pregnancy
naturally heightens cellular/innate immunity, which functions to prevent the fetus from being seen as “foreign”. However, the compensatory or relative decrease in adaptive/humoral immunity leaves the mother more susceptible to infection. These changes may predispose pregnant women to increased severity with COVID-19 infection.

Many of the normal physiologic changes of pregnancy leave expectant mothers with limited reserve as well as symptoms resembling those of COVID-19. Again, it is essential to consider many of these symptoms as ramifications of COVID-19 until proven otherwise. That is to say, the symptoms should not be considered as those of normal pregnancy without seeing and evaluating the patient. Table 1 delineates important physiologic changes of pregnancy which place expectant mothers at increased risk of COVID-19 infection.

COVID-19-RELATED COMPLICATIONS IN PREGNANCY

COVID-19 brought significant additional risk of specific pregnancy complications including venous thromboembolism, hypertensive disorders of pregnancy, cesarean delivery, preterm birth, and stillbirth.

Venous thromboembolism includes cerebral venous sinus thrombosis, arterial thrombosis, cerebral vascular accident, pulmonary embolism, and deep vein thrombosis. A study by the National Institute of Child Health and Human Development Maternal Fetal Medicine Units Network reported thromboembolism rates in severe-critical, mild-moderate, and asymptomatic pregnant women with COVID-19 as 6%, 0.2%, and 0%, respectively.

Hypertensive disorders, including HELLP syndrome, eclampsia, preeclampsia with or without severe features, gestational hypertension, and chronic hypertension with
superimposed preeclampsia, were present in 40.4% of pregnancies with severe-critical disease vs. 18.8% of pregnancies with asymptomatic COVID-19 positivity\(^6\). While an elevated incidence in severe-critical disease may be anticipated, it is crucial to note that the risk of hypertensive disease is significantly elevated in asymptomatic, COVID-19-positive pregnancies. Many of the laboratory abnormalities seen with COVID-19 will be the same as those seen with hypertensive complications of pregnancy. It is essential to determine the etiology of these laboratory abnormalities as treatment will differ depending on the underlying cause. The diagnosis and management of hypertension in pregnancy are robust topics deserving significant attention; therefore, the subject is discussed in detail later in this chapter.

Cesarean birth occurred in 59.6% of severe-critical disease pregnancies compared to 11.9 percent of asymptomatic patients\(^7\). Preterm delivery has been documented in 16.4%–41.8% of pregnancies with severe-critical disease, depending on the reporting entity\(^2,7\). Some of the early data may have been skewed by iatrogenic causes versus spontaneous preterm labor. Over 1.25 million women have delivered since the onset of COVID-19 in the U.S.A. Data collected between March 2020 and September 2021 show that the adjusted relative risk of stillbirth was 0.59 prior to COVID-19, whereas that risk increased to 1.47 in the period before the arrival of the Delta variant. Within the Delta-predominant period, risk further increased to 4.40 or 2.07% of COVID-19-positive pregnancies\(^8\).

**TRIAGE**

American College of Obstetricians and Gynecologists (ACOG)/Society for Maternal-Fetal Medicine (SMFM) Outpatient Assessment and Management for Pregnant Women with COVID-19.
Suspected or Confirmed COVID-19 provides the current guidelines for triage. Follow this flowsheet for guidance with assessment, triage, intensified outpatient monitoring, transfer to obstetric unit or ICU, or transfer to outside facility. (Figure 1).

**PATIENT EVALUATION**

The patient should be assessed in an isolation room, and the patient should wear a mask. Healthcare workers should maintain droplet and contact precautions using gowns, gloves, masks, face shields, and goggles. N-95 masks have been reserved for c-section, vaginal twin delivery, O.R. management of postpartum hemorrhage, and intubation.³

Clinical risks and exposure history should be assessed. Pregnancy alone is a risk factor for poor outcomes. Importantly, outcomes worsen in those with hypertensive disorders (preexisting or pregnancy-induced), chronic cardiopulmonary disease, diabetes (preexisting or gestational), obesity, renal disease, advanced maternal age, cancer, sickle cell disease; body mass index > 35 kg/m²; immunocompromised state, and tobacco use.⁹

**PHYSICAL EXAM**

Upon presentation, promptly obtain vital signs, including pulse oximetry reading. Note that the normal SpO₂ in a healthy pregnant woman is ≥95%. Also note that the degree of hypoxia is often worse than what the clinical symptoms may suggest.⁰ Initiate fetal heart monitoring if estimated gestational age is ≥24 weeks. Avoid supine positioning to allow adequate blood flow to the fetus, especially after 24 weeks’ gestation. Perform a routine physical exam with detailed attention to lungs and heart. Obtain laboratory parameters including the following:
• Expedited COVID-19 PCR test upon arrival (be aware that polymerase chain reaction [PCR] can be false negative; therefore, treat any symptomatic pregnant patient as if they are PCR-positive)

• Complete blood count to evaluate for thrombocytopenia/hemolysis

• Comprehensive medical panel for abnormal liver function tests

• Arterial blood gases in patients with low SpO₂ (Normal pregnancy values differ from those of nonpregnant patients. Normal first trimester values: pH (7.42-7.46), PaO₂ (105-106), PaCO₂ (28-29), Serum HCO₃ 18. Normal third trimester values: pH 7.43, PaO₂ (101-106), PaCO₂ (26-30), Serum HCO₃ 17.)

• Urine protein or protein/creatinine ratio in patients with suspicion for gestational hypertension/pre-eclampsia

• Prothrombin time/partial thromboplastin time/ international normalized ratio

• Ferritin levels in the presence of concern for cytokine storm⁹

D-Dimer is naturally elevated in pregnancy and is thus not useful. Chest x-ray, if indicated, should be performed with an abdominal shield.

Notify an obstetrician immediately of any PCR-positive patient or patient under investigation and any abnormality in vital signs, physical exam, radiologic or laboratory studies.

DISEASE SEVERITY AND DISPOSITION
Table 2 outlines disease severity, symptoms, findings and appropriate disposition for COVID-19 positive pregnant women.

MANAGEMENT

Therapeutic Options

In general, NIH COVID-19 treatment guideline therapies that would be given otherwise, should not be withheld in the treatment of COVID-19-positive pregnant/lactating women. Still, it is prudent to consult an obstetrician before initiating medical therapy.

- Antenatal steroids for the sole purpose of fetal lung maturity: Use with caution and only before 34 weeks’ gestation⁵.
- Anticoagulants in ICU setting: Consider in all hospitalized COVID-19-positive patients⁵.
- Antibiotics for the treatment of pneumonia are acceptable. Try to avoid quinolones.
- Acetaminophen: Consider as the first-line analgesia in milder cases.
- Non-steroidal anti-inflammatory drugs: Consider over opioids for additional analgesia with obstetrical consult. Opioids may pose higher clinical risk³.
- Avoid nitrous oxide in suspected or confirmed patients with COVID-19.
- Oxygen: Consider in the presence of maternal hypoxia. Consider for fetal indications.
- Magnesium sulfate: For seizure prophylaxis only in preeclampsia with severe features. Consider risk of eclampsia versus risk of respiratory depression³. Seizure prophylaxis dose is 6-g load followed by 2 g/hour.
- Monoclonal antibodies: Accepted treatment for infected as well as inadequately vaccinated exposures
- Remdesivir: Accepted
- Dexamethasone: If indicated, employ fetal lung maturity dosing for the first two days of use if less than 34 weeks’ gestation.
- Baricitinib: If patient meets clinical FDA qualifications
- Tocilizumab: If patient meets clinical FDA qualifications
- Paxlovid: If patient meets clinical FDA qualifications

**Obstetrical Management**

Obstetrical care/intervention for COVID-19-positive patients without severe-critical disease is similar to that of non-COVID-19 pregnancies. In less severe disease, induction of labor and cesarean section are reserved for normal obstetric indications. Consider the risks of preterm delivery versus the risk of prolonged fetal hypoxemia in cases of prolonged maternal hypoxemia.

**Postpartum Management**

Avoid neonatal exposure

Monitor/advise the mother of potential COVID-19 complications up to six weeks postpartum.

**HYPERTENSION IN PREGNANCY AND POSTPARTUM**

**Introduction**
Hypertension in the pregnant or postpartum patient should be immediately recognized and addressed as it is a leading contributor to both maternal and perinatal morbidity and mortality.\textsuperscript{12}

In pregnancy and the postpartum period, the diagnosis of hypertension is defined as systolic of equal to or greater than 140 mm of Hg and/or a diastolic pressure of equal to or greater than 90 mm of Hg of at least two readings, four hours apart.\textsuperscript{12} While most diagnoses of postpartum hypertension disorders are made within weeks of delivery, signs and symptoms can present as late as one year after birth.\textsuperscript{13} For non-obstetric providers in the urgent care and emergency setting, it is crucial for enhanced awareness of hypertension in pregnancy and the potential for late presentation in the postpartum setting.

There are several classifications of hypertension in pregnancy (see Table 4).\textsuperscript{14} Each one of these classifications have their own indications for timing of delivery and also postpartum follow-up. Any patient with a diagnosis of hypertension in pregnancy, despite the classification, could develop preeclampsia and has the potential to develop severe range blood pressures. For the pregnant or postpartum patient, severe range blood pressures are defined as systolic blood pressure of greater or equal to 160 mm of Hg and/or a diastolic blood pressure of greater or equal to 110 mm of Hg and should be immediately identified to determine which treatment is warranted. This severe hypertension for pregnant and postpartum patients will give them the diagnosis of preeclampsia with severe features.\textsuperscript{12} Consideration should be given to any severe range blood pressure as it could be a sign of preeclampsia and impending eclampsia and should be treated to prevent congestive heart failure, myocardial ischemia, renal injury or failure, and
ischemic or hemorrhagic stroke\textsuperscript{12}. The parameters of severe hypertension are much lower in pregnant and postpartum patients than the general population.

DISCUSSION

GESTATIONAL HYPERTENSION

Gestational hypertension is defined as elevation in blood pressure after 20 weeks gestation, two elevations more than 4 hours apart, in a patient with no previous history of hypertension.\textsuperscript{12} These patients do not have lab abnormalities or proteinuria, however they are monitored closely and could develop preeclampsia. In fact, patients with gestational hypertension are managed similarly to patients with preeclampsia and may not be distinguishable. Patients with gestational hypertension should have a way of monitoring their blood pressure and be aware of any signs or symptoms of preeclampsia, as any patient with gestational hypertension could move on to develop preeclampsia and/or severe hypertension.

CHRONIC HYPERTENSION

Patients that have been identified having hypertension prior to 20 weeks gestation are thought to have a history of chronic hypertension. Chronic hypertension can just be a history of hypertension prior to pregnancy, or if someone has not been diagnosed with a hypertensive disorder prior to pregnancy but present early in their pregnancy before 20 weeks gestation with hypertension.\textsuperscript{15} Patients with chronic hypertension can develop superimposed preeclampsia, so should be monitored for signs and symptoms of preeclampsia. These patients should also
have baseline labs including evaluation for proteinuria to see if there are any underlying signs of end organ damage and can also be used if these lab values change during their pregnancy.

**PREECLAMPSIA/ECLAMPSIA**

Preeclampsia is defined as elevated blood pressure on two occasions (more than four hours apart) with proteinuria, usually after 20 weeks gestation. Patients can become preeclamptic without having proteinuria based on certain lab values or symptoms alone (see boxes below: Preeclampsia with and without severe features). There are two types of preeclampsia: preeclampsia without severe features and preeclampsia with severe features. A patient having “preeclampsia without severe features” needs to be monitored closely. Should a patient develop severe range blood pressure on two readings greater than four hours apart, the diagnosis becomes “preeclampsia with severe features” which requires treatment with Magnesium Sulfate for seizure and eclampsia prophylaxis. Two documented severe range blood pressures or persistent severe range blood pressure also require immediate treatment with antihypertensive medication (see Table 3). A repeat blood pressure should be obtained within 15 minutes of any severe range reading to ensure proper diagnosis and treatment.

Preeclampsia with severe features can also be defined with certain lab thresholds and would require Magnesium Sulfate treatment (see box below). Preeclampsia can happen during pregnancy but can also happen in the postpartum period. This can be confusing because the cure for preeclampsia is thought to be delivery of the baby. However, someone could present
with initial signs for a diagnosis of preeclampsia with or without severe features once the baby is delivered up until 6 weeks and sometimes up until one year postpartum. Therefore, even in a postpartum patient, preeclampsia should be considered and treated as such.

**SEVERE HYPERTENSION**

It is especially important to pay attention to severe range blood pressures as these thresholds are very different for a pregnant and postpartum patient. If a patient has blood pressures that are severe they need to be addressed immediately, sometimes within minutes. Sustained severe range blood pressure within 15 minutes warrants treatment. There are several different antihypertensives that are given to control severe range blood pressures in pregnancy (see table 3). There is no one anti-hypertensive medication that is preferred over another to control severe hypertension in pregnancy. The decision can be made clinically. For example, if a patient presents and does not have IV access, you could consider oral nifedipine for immediate treatment. However, for all these patients IV access is indicated and should be started as soon as possible.

Dosing should be continued if the blood pressure continues to be in the severe range (see Table 3). Any pregnant patient that has severe range blood pressure is diagnosed with severe hypertension whether it's preeclampsia (now with severe features) or severe gestational hypertension. Whenever giving an antihypertensive for a patient with severe range blood pressures, magnesium sulfate should also be given secondary to the risk of eclampsia for seizure prevention.
PREVENTING ECLAMPSIA

Once a patient develops preeclampsia with severe features, magnesium sulfate should be started for seizure prophylaxis. The usual dosage of Magnesium Sulfate is 6 grams IV loading dose followed by 2 grams/hour.\textsuperscript{17} Magnesium sulfate should be given intrapartum until birth, and then continued for 24 hours postpartum. When administering magnesium sulfate, attention must be paid to clinical signs of magnesium toxicity, including loss of deep patellar reflexes and respiratory depression.\textsuperscript{17} Magnesium needs to reach a level for therapeutic treatment, but should be discontinued if there is concern for toxicity (see Table 2).\textsuperscript{12}

EVALUATION AND WORKUP FOR HYPERTENSION PREGNANT AND POSTPARTUM PATIENTS

Keeping all the classifications for hypertension of pregnancy in mind, one must be on alert for any blood pressure elevations in a pregnant or postpartum patient.

SIGNS AND SYMPTOMS

Preeclampsia can present with one or more of the following both during pregnancy and the postpartum period:

- Headache
- Visual changes - including scotomata
- Epigastric and/or Right upper quadrant pain
- Edema - dependent or otherwise
- Shortness of breath
- Chest Pain
- Nausea and/or vomiting
- Hyperreflexia

LABORATORY VALUES

The following laboratory tests may be helpful in determining the diagnosis:

- Complete blood count - thrombocytopenia
- Renal studies - elevated creatinine
- Liver Function tests - twice the upper limit of normal range
- Coagulopathy
- Proteinuria - Protein/Creatinine urine ratio >0.30 mg/dl or 24 hour urine collection for protein >300 mg.

SUMMARY

Pregnant and postpartum patients with COVID-19 and hypertension may present differently than the general populations. These patients are at high risk, in particular while pregnant as fetal outcomes need to be considered, however, they are still vulnerable and at risk postpartum up to one year after delivery. There is an interesting correlation between the fact that pregnant patients with COVID-19, whether symptomatic or asymptomatic, have a high rate of hypertensive disorders. More than 60% of pregnancy related deaths are considered preventable\(^\text{18}\), significant attention should be paid to your pregnant and postpartum populations.
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Table 1. Physiologic changes of pregnancy that place expectant mothers at increased risk during COVID infection

| Cardiovascular | Effect |
|----------------|--------|
| **Increased**  |        |
| Plasma volume by 40 to 50 percent, but erythrocyte volume by only 20 percent | Dilutional anemia results in decreased oxygen carrying capacity |
| Cardiac output by 40 percent | Increased CPR circulation demands |
| Heart rate by 15 to 20 beats per minute | Increased CPR circulation demands |
| Clotting factors susceptible to thromboembolism | |
| Dextrorotation of the heart | |
| Estrogen effect on myocardial receptors | Increased EKG left axis deviation |
| **Decreased**  |        |
| Supine blood pressure and venous return with aortocaval compression | Decreases cardiac output by 30 percent |
| Arterial blood pressure by 10 to 15 mm Hg | Susceptible to cardiovascular insult |
| Systemic vascular resistance | Sequesters blood during CPR |
| Colloid oncotie pressure (COP) | Susceptible to third spacing |
| Pulmonary capillary wedge pressure (PCWP) | Susceptible to pulmonary edema |

| Respiratory | Effect |
|-------------|--------|
| **Increased**  |        |
| Respiratory rate (progesterone-mediated) | Decreased buffering capacity |
| Oxygen consumption by 20 percent | Rapid decrease of PaO₂ in hypoxia |
| Tidal volume (progesterone-mediated) | Decreased buffering capacity |
| Minute ventilation | Compensated respiratory alkalosis |
| Laryngeal angle | Failed intubation |
| Pharyngeal edema | Failed intubation |
| Nasal edema | Difficult nasal intubation |
| **Decreased**  |        |
| Functional residual capacity by 25 percent | Decreases ventilatory capacity |
| Arterial PCO₂ | Decreases buffering capacity |
| Serum bicarbonate | Compensated respiratory alkalosis |

| Gastrointestinal | Effect |
|------------------|--------|
| **Increased**  |        |
| Intestinal compartmentalization | Susceptible to penetrating injury |
| **Decreased**  |        |
| Peristalsis, gastric motility | Aspiration of gastric contents |
| Gastroesophageal sphincter tone | Aspiration of gastric contents |

| Uteroplacental | Effect |
|----------------|--------|
| **Increased**  |        |
| Uteroplacental blood flow by 30 percent of cardiac output | Sequesters blood in CPR |
| Aortocaval compression | Decreases cardiac output by 30 percent |
| Elevation of diaphragm by 4 to 7 cm | Aspiration of gastric contents |
| **Decreased**  |        |
| Autoregulation of blood pressure | Uterine perfusion decreases with drop in maternal blood pressure |
| Breast | |

(continued)
Figure 1. Covid-19-Algorithm. From ACOG Bulletin, Critical Care in Pregnancy; with permission
Table 2. Severity scale for COVID-19 in pregnancy*⑧

| Severity at Presentation | Findings/Symptoms                                      | Disposition                                                                 |
|--------------------------|-------------------------------------------------------|------------------------------------------------------------------------------|
| Asymptomatic             | • Positive PCR test                                   | • Home with precautions and daily self monitoring, consider home pulse oximeter and/or BP cuff, prompt and regular follow up with OB. |
|                          | • No symptoms                                         | • Be seen if increased SOB; tachypnea; unremitting temperature > 39°C; SpO₂ < 95%; nontolerance of medications or fluids; confusion/lethargy; pleuritic chest pain; cyanotic lips/fingertips; preterm contractions, vaginal bleeding or decreased fetal movement⑧ |
| Mild Disease             | • Positive test                                        | • Home with precautions: IV fluids if indicated                                |
|                          | • Flu-like symptoms without dyspnea, shortness of breath or abnormal chest imaging findings | • Consider home pulse oximeter and/or BP cuff                                   |
|                          |                                                       | • Admit if unable to tolerate p.o.                                            |
|                          |                                                       | • Prompt follow up with OB                                                   |
| Disease        | Criteria                                                                 | Management                                                                 |
|---------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Moderate Disease | - SpO₂ ≥ 95% on room air  
- Evidence of lower respiratory tract disease with dyspnea, pneumonia on imaging, abnormal blood gases, or refractory temperature ≥ 39°C | - Admit for maternal/fetal assessment and treatment on obstetrical unit  
- Consider antibiotics for pneumonia, avoid quinolones if possible  
- Consider anticoagulation to prevent venous thromboembolism  
- Consider delivery for standard fetal indications |
| Severe Disease    | - SpO₂ ≤ 94% on room air  
- Respiratory rate > 30 bpm  
- PO₂/FIO₂ < 300 mmHg  
- >50% lung involvement on imaging | - Admit to ICU with consults  
- Include management listed under Moderate Disease |
| Critical Disease  | - Multiorgan failure or dysfunction  
- Shock | - Admit to ICU with multispecialty care team  
- Include management under Moderate Disease  
- Need for ventilation or high-flow nasal canula |

BP, blood pressure; ICU, intensive care unit; OB, obstetrician; PCR, polymerase chain reaction

*Adapted from Halscott, M.D., M.S. et al.; with permission*
Table 4. Classification of Hypertensive Disorders in Pregnancy

| Disorder                               | Characteristics                                                                                                                                                                                                 |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chronic hypertension                   | Systolic blood pressure of 140 mm Hg or greater, diastolic blood pressure of 90 mm Hg or greater, or both known to predate conception or detected before 20 weeks of gestation                                      |
| Gestational hypertension               | New-onset hypertension that develops after 20 weeks of gestation; in the absence of proteinuria*                                                                                                                     |
| Preeclampsia–eclampsia                 | Development of hypertension presenting after 20 weeks of gestation with proteinuria*; in the absence of proteinuria, preeclampsia can manifest as new-onset hypertension with any of the following features: thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, or cerebral or visual symptoms; eclampsia is the presence of new-onset grand mal seizures in a pregnant woman with preeclampsia |
| Chronic hypertension with superimposed preeclampsia | The onset of features diagnostic of preeclampsia in a woman with chronic hypertension beyond 20 weeks of gestation                                                                                                      |

*Proteinuria is defined as 300 mg or more of protein in a 24-hour urine collection or the ratio of measured protein level to creatinine level in a single voided urine collection that equals or exceeds 3 (each measured as mg/dL), termed the protein-to-creatinine ratio.

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From ACOG Hypertension, Clinical Updates in Women’s Health Care, January 2016.
Box 1. Diagnostic Criteria for Preeclampsia

**Blood pressure:**
- Systolic blood pressure of 140 mm Hg or more or diastolic blood pressure of 90 mm Hg or more on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal blood pressure
- Systolic blood pressure of 160 mm Hg or more or diastolic blood pressure of 110 mm Hg or more. (Severe hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy).

and

**Proteinuria**
- 300 mg or more per 24 hour urine collection (or this amount extrapolated from a timed collection) or
- Protein/creatinine ratio of 0.3 mg/dL or more or
- Dipstick reading of 2+ (used only if other quantitative methods not available)

Or in the absence of proteinuria new-onset hypertension with the new onset of any of the following:
- Thrombocytopenia: Platelet count less than 100,000 × 10⁹/L
- Renal insufficiency: Serum creatinine concentrations greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease
- Impaired liver function: Elevated blood concentrations of liver transaminases to twice normal concentration
- Pulmonary edema
- New-onset headache unresponsive to medication and not accounted for by alternative diagnoses or visual symptoms
Box 2. Preeclampsia with Severe Features

- Systolic blood pressure of 160 mm Hg or more, or diastolic blood pressure of 110 mm Hg or more on two occasions at least 4 hours apart (unless antihypertensive therapy is initiated before this time)
- Thrombocytopenia (platelet count less than 100,000 × 10⁹/L)
- Impaired liver function that is not accounted for by alternative diagnoses and as indicated by abnormally elevated blood concentrations of liver enzymes (to more than twice the upper limit normal concentrations), or by severe persistent right upper quadrant or epigastric pain unresponsive to medications
- Renal insufficiency (serum creatinine concentration more than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease)
- Pulmonary edema
- New-onset headache unresponsive to medication and not accounted for by alternative diagnoses
- Visual disturbances

As adapted from ACOG Practice bulletin Number 222: Gestational hypertension and Preeclampsia, June 2020.
### Table 3. Antihypertensive Agents Used for Urgent Blood Pressure Control in Pregnancy

| Drug                        | Dose                                                                 | Comments                                                                 | Onset of Action |
|-----------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------|
| Labetalol                   | 10–20 mg IV, then 20–80 mg every 10–30 minutes to a maximum cumulative dosage of 300 mg; or constant infusion 1–2 mg/min IV | Tachycardia is less common with fewer adverse effects.                  | 1–2 minutes     |
|                             |                                                                      | Avoid in women with asthma, preexisting myocardial disease, decompensated cardiac function, and heart block and bradycardia. |                 |
| Hydralazine                 | 5 mg IV or IM, then 5–10 mg IV every 20–40 minutes to a maximum cumulative dosage of 20 mg; or constant infusion of 0.5–10 mg/hr | Higher or frequent dosage associated with maternal hypotension, headaches, and abnormal fetal heart rate tracings; may be more common than other agents. | 10–20 minutes   |
| Nifedipine (immediate release) | 10–20 mg orally, repeat in 20 minutes if needed; then 10–20 mg every 2–6 hours; maximum daily dose is 180 mg | May observe reflex tachycardia and headaches                              | 5–10 minutes    |

Abbreviations: IM, intramuscularly; IV, intravenously.

From ACOG Practice bulletin number 222: Gestational Hypertension and Preeclampsia, June 2020.
### Table 2. Serum Magnesium Concentration and Toxicities

| Serum Magnesium Concentration | Effect                  |
|-------------------------------|-------------------------|
| mmol/L | mEq/L | mg/dL |                      |
| 2–3.5 | 4–7    | 5–9    | Therapeutic range    |
| >3.5  | >7     | >9     | Loss of patellar reflexes |
| >5    | >10    | >12    | Respiratory paralysis |
| >12.5 | >25    | >30    | Cardiac arrest        |

Data from Duley L. Magnesium sulphate regimens for women with eclampsia: messages from the Collaborative Eclampsia Trial. Br J Obstet Gynaecol 1996;103:103–5 and Lu JF, Nightingale CH. Magnesium sulfate in eclampsia and pre-eclampsia: pharmacokinetic principles. Clin Pharmacokinet 2000;38:305–14.

From ACOG Practice bulletin number 222: Gestational Hypertension and Preeclampsia, June 2020.
Outpatient Assessment and Management for Pregnant Women With Suspected or Confirmed Novel Coronavirus (COVID-19)

This algorithm is designed to aid practitioners in promptly evaluating and treating pregnant persons with known exposure and/or those with symptoms consistent with COVID-19 (persons under investigation [PUI]). If influenza viruses are circulating, influenza may be a cause of respiratory symptoms and practitioners are encouraged to use the ACOG/SMPM influenza algorithm to assess need for influenza treatment or prophylaxis.

Please be advised that COVID-19 is a rapidly evolving situation and this guidance may become out-of-date as new information and data on COVID-19 in pregnant women becomes available. Please refer to the Centers for Disease Control and Prevention (CDC) https://www.cdc.gov/coronavirus/2019-nCoV/index.html and ACOG COVID-19 web pages: https://www.acog.org/topics/covid-19 for comprehensive resources and guidance on COVID-19.

Assess Patient’s Symptoms and Exposures

Symptoms typically include fever ≥38°C (100.4°F) or one or more of the following:
- Cough
- Difficulty breathing or shortness of breath
- Chills
- Headache
- Sore throat
- New loss of taste or smell
- Unprotected exposure to known COVID-positive individual
- Muscle or body aches
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

Any Positive Answers

Recommend testing for SARS-CoV-2 infection*

Conduct Illness Severity Assessment

- Does she have difficulty breathing or shortness of breath?
- Does she have difficulty completing a sentence without gasping for air or needing to stop to catch breath frequently when walking across the room?
- Does patient cough more than 1 teaspoon of blood?
- Does she have new pain or pressure in the chest other than pain with coughing?
- Is she unable to keep liquids down?
- Does she show signs of dehydration such as dizziness when standing?
- Is she less responsive than normal or does she become confused when talking to her?

Any Positive Answers

Assess Clinical and Social Risks

- Comorbidities (Hypertension, diabetes, asthma, HIV, chronic heart disease, chronic liver disease, chronic lung disease, chronic kidney disease, blood dyscrasia, and people on immunosuppressive medications)
- Obstetric issues (eg, preterm labor)
- Inability to care for self or arrange follow-up if necessary

Any Positive Answers

Low Risk

- Refer patient for symptomatic care at home including hydration and rest
- Monitor for development of any symptoms above and re-start algorithm if new symptoms present
- Routine obstetric precautions

No Positive Answers

Moderate Risk

If no respiratory compromise or complications and able to follow-up with care

Admit patient for further evaluation and treatment. Review hospital or health system guidance on infection control measures to minimize patient and provider exposure

Elevated Risk

If yes to respiratory compromise or complications

Recommend she immediately seek care in an emergency department or equivalent unit that treats pregnant women. When possible, send patient to a setting where she can be isolated.

Notifying the facility that you are referring a PUI is recommended to minimize the chance of spreading infection to other patients and/or healthcare workers at the facility

Adhere to local infection control practices including personal protective equipment

Abbreviations: ABG, arterial blood gases; CDC, Centers for Disease Control and Prevention; HIV, human immunodeficiency virus.

*Testing recommendations may vary based on facility and/or local guidance, community spread, and availability of testing

This information is designed as an educational resource to aid clinicians in providing obstetric and gynecologic care, and use of this information is voluntary. This information should not be considered as inclusive of all proper treatments or methods of care or as a statement of the standard of care. It is not intended to substitute for the independent professional judgment of the treating clinician. Variations in practice may be warranted when, in the reasonable judgment of the treating clinician, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology. The American College of Obstetricians and Gynecologists reviews its publications regularly; however, its publications may not reflect the most recent evidence. Any updates to this document can be found on www.acog.org or by calling the ACOG Resource Center.

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