

Physiology of the Critically Ill Pregnant Patient with COVID-19

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Coronavirus disease (COVID-19) can lead to acute respiratory distress syndrome (ARDS). Pregnant patients with severe COVID-19 have physiologic changes that require consideration when evaluating and managing their disease.

CLINICAL SCENARIO

A 36-year-old gravida 1 para 0 woman at 34 weeks' gestation is admitted with acute hypoxic respiratory failure from COVID-19 pneumonia requiring high-flow nasal cannula (flow rate, 60 L/min; fractionated inspired oxygen, 0.8). Examination is notable for tachycardia, respiratory rate 26 with oxygen saturation 95%, and mild bibasilar crackles. Fetal testing is reassuring.

PREGNANCY-RELATED PHYSIOLOGIC CHANGES TO CONSIDER IN CRITICALLY ILL OBSTETRIC PATIENTS

Respiratory

Maternal O₂ consumption increases with pregnancy. Increased demand drives an increase in minute ventilation, facilitated by an increased tidal volume (V_T) without a change in respiratory rate. Thus, an increase in respiratory rate should prompt immediate investigation.

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Cardiac

Sinus tachycardia is an early finding for clinical deterioration; however, mild tachycardia (rate < 110) is commonly seen in the second and third trimesters.

Vascular

The gravid uterus can compress the inferior vena cava. If hypotension occurs, left lateral decubitus positioning relieves this pressure and increases venous return and resultant cardiac output.

Acid-Base

Normal pregnancy results in mild respiratory alkalosis (baseline pH, 7.42–7.46; partial pressure of carbon dioxide [pCO₂], 28–32 mm Hg; serum bicarbonate, 18–21 mEq/L), which helps improve fetal ventilation and excretion of CO₂ through the placenta (1). If bicarbonate becomes too low, it can impair uterine blood flow and lead to fetal hypoxia. A pCO₂ in the low 40s should raise concern.

Gastrointestinal

Decreased gastroesophageal sphincter tone plus increased intraabdominal pressure can increase the risk of aspiration. Consider this when initiating noninvasive positive pressure ventilation.

ACUTE HYPOXIC RESPIRATORY FAILURE AND COVID-19 IN PREGNANCY

Dyspnea is a common complaint related to hormonal and anatomic changes throughout pregnancy. Supplemental oxygen in pregnant patients is titrated to a higher oxygen saturation as measured by a pulse oximetry goal of 95% and/or arterial oxygen pressure goal of 70 mm Hg (2) to promote adequate maternal-fetal oxygen exchange.

ON THE FLY

A collection of concise, mobile-friendly resources to help create quick teachable moments.

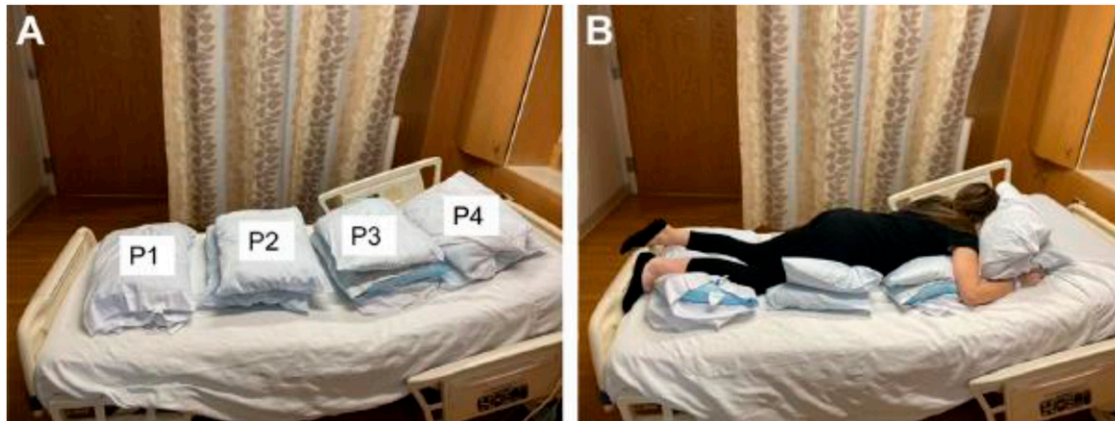


Figure 1. Prone positioning during pregnancy. (A) Suggested pillow locations. P1: pillows supporting shins and knees; P2: pillows supporting maternal pelvis; P3: pillows supporting maternal chest; P4: pillows supporting maternal head. (Note: head of bed elevated 10–20°). (B) Pregnant patient with gravid abdomen supported between P2 and P3. Reprinted by permission from Reference 5.

Outcomes for pregnant patients with severe COVID-19 are worse than outcomes for age-matched nonpregnant patients, as demonstrated by increased risk of intensive care unit admission (adjusted risk ratio (aRR), 1.5; 95% confidence interval [CI], 1.2–1.8) and mechanical ventilation (aRR, 1.7; 95% CI, 1.2–2.4) (3).

Prone positioning is safe at any gestation with appropriate propping and protection to the gravid uterus (Figure 1) to optimize ventilation and perfusion in severe COVID-19 with ARDS.

If mechanical ventilation is required, lung-protective techniques with low V_T (6 ml/kg of ideal body weight) should be used. In severe ARDS, extracorporeal life support can be implemented in pregnant patients, although maternal bleeding and preterm labor are common complications to consider (4).

Regarding extubation, if the rapid shallow breathing index is calculated, it should be considered with caution. Pregnancy-related increase in V_T might falsely lower the calculated score.

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