

Respiratory Failure and Mechanical Ventilation in the Pregnant Patient



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KEYWORDS

- Respiratory failure • Pregnancy • ARDS • Mechanical ventilation
- Noninvasive ventilation

KEY POINTS

- Several physiologic and anatomic changes in pregnancy promote the incidence of respiratory failure. The fetus needs a maternal PaO_2 greater than 70 mm Hg for sufficient oxygenation.
- Common causes of respiratory failure in pregnancy are pneumonia, different kinds of pulmonary edema, exacerbation of asthma, aspiration, pulmonary embolism, amniotic fluid syndrome, and pneumothorax.
- Acute respiratory distress syndrome is a severe complication of all mentioned respiratory diseases and may lead to support with extracorporeal membrane oxygenation.
- Intubation failure is frequent in pregnant patients. Mechanical ventilation should be applied as in nonpregnant patients. Higher peak pressure and positive end expiratory pressure may lead to normal transpulmonary pressure.
- Noninvasive ventilation is an option in alert patients in the hands of a skilled therapist.

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INTRODUCTION

Acute respiratory failure with need of ventilator support is rare in pregnant patients. Fewer than 2% of women in the periparturient period need treatment in the intensive care unit (ICU). The main diseases that lead to ICU admission in nondeveloping countries are hypertensive diseases, hemorrhage, and sepsis.^{1,2} Respiratory failure is a common complication of these and other diseases in the obstetric or postpartum patient; therefore, respiratory failure is one of the main indications for ICU admission.

PHYSIOLOGIC CHANGES OF RESPIRATORY SYSTEM IN PREGNANCY

Pregnancy leads to anatomic and physiologic changes of lung and the respiratory system that can promote respiratory failure.

Changes regarding the respiratory system are³ as follows:

- Edema and hyperemia of the upper airways
- Reduced tonus of the lower esophagus sphincter
- Increased respiratory drive with greater tidal volume leading to increased minute ventilation due to elevated levels of progesterone
- Decreased functional residual capacity (FRC)
- Elevated diaphragm due to the enlarging uterus (up to 5 cm)
- Decreased compliance of the ventilatory system (reduction of chest wall compliance, lung compliance is unaltered)
- Increased O₂ consumption and CO₂ production due to the demands of the fetus
- Respiratory alkalosis with a decrease of bicarbonate

DETERMINANTS OF OXYGEN DELIVERY AND HYPOXEMIA IN THE FETUS

The oxygen delivery to the fetus is determined by the following:

- Uterine blood flow
- Maternal arterial oxygen content
- Concentration of maternal hemoglobin
- The hemoglobin–oxygen–dissociation curve of mother and the fetus.⁴

The adequate oxygen content for the fetus is maintained by a left shift of the oxygen–dissociation curve of fetal hemoglobin; the umbilical venous blood returning to the fetus has a PaO₂ of only 25 to 30 mm Hg.⁵

Maternal hypoxia results in fetoplacental vasoconstriction, which reduces placental blood flow and fetal oxygen transfer.⁶ Placental vasoconstriction also can be provoked by endogenous or exogenous catecholamines, alkalosis, hypotension, and contractions.⁷

A theoretic model based on animal studies showed that a maternal O₂ saturation of 95% to 88% resulted in a fetal saturation of 70% to 55%.⁸ However, maternal hypoxemia with an inhalation of 10% O₂ for 10 minutes showed no adverse effect in fetal monitoring.⁹

Hypocapnia also results in decrease of uterine blood flow,¹⁰ whereas mild hypercapnia showed no effect on uterine blood flow, and a higher PaCO₂ is associated with a better APGAR score.¹¹

CAUSES OF RESPIRATORY FAILURE IN PREGNANCY

Pneumonia

Pneumonia in pregnancy is still the third leading cause of indirect obstetric maternal death.^{12,13} In most cases, community-acquired pneumonia and viral pneumonia are the main admission diagnoses in this group to hospital or ICU.

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