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Critical Illness in Pregnancy

Part II: Common Medical Conditions Complicating Pregnancy and Puerperium

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The first of this two-part series on critical illness in pregnancy dealt with obstetric disorders. In Part II, medical conditions that commonly affect pregnant women or worsen during pregnancy are discussed. ARDS occurs more frequently in pregnancy. Strategies commonly used in nonpregnant patients, including permissive hypercapnia, limits for plateau pressure, and prone positioning, may not be acceptable, especially in late pregnancy. Genital tract infections unique to pregnancy include chorioamnionitis, group A streptococcal infection causing toxic shock syndrome, and polymicrobial infection with streptococci, staphylococci, and *Clostridium perfringens* causing necrotizing vulvitis or fasciitis. Pregnancy predisposes to VTE; D-dimer levels have low specificity in pregnancy. A ventilation-perfusion scan is preferred over CT pulmonary angiography in some situations to reduce radiation to the mother's breasts. Low-molecular-weight or unfractionated heparins form the mainstay of treatment; vitamin K antagonists, oral factor Xa inhibitors, and direct thrombin inhibitors are not recommended in pregnancy. The physiologic hyperdynamic circulation in pregnancy worsens many cardiovascular disorders. It increases risk of pulmonary edema or arrhythmias in mitral stenosis, heart failure in pulmonary hypertension or aortic stenosis, aortic dissection in Marfan syndrome, or valve thrombosis in mechanical heart valves. Common neurologic problems in pregnancy include seizures, altered mental status, visual symptoms, and strokes. Other common conditions discussed are aspiration of gastric contents, OSA, thyroid disorders, diabetic ketoacidosis, and cardiopulmonary arrest in pregnancy. Studies confined to pregnant women are available for only a few of these conditions. We have, therefore, reviewed pregnancy-specific adjustments in the management of these disorders. CHEST 2015; 148(5):1333-1345

ABBREVIATIONS: CTPA = CT pulmonary angiography; DKA = diabetic ketoacidosis; ECMO = extracorporeal membrane oxygenation; LMWH = low-molecular-weight heparin; LV = left ventricle; MI = myocardial infarction; PE = pulmonary embolism; PRES = posterior reversible encephalopathy syndrome; RCVS = reversible cerebral vasoconstriction syndrome; UFH = unfractionated heparin

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This is the second of the two-part review on critical illness in pregnancy.[1] Medical conditions complicating pregnancy and puerperium are discussed.

ARDS in Pregnancy

Common causes of ARDS in pregnancy include obstetric disorders like amniotic fluid embolism, severe preeclampsia, and puerperal sepsis, and medical disorders like acute pyelonephritis, aspiration of gastric contents, and community-acquired pneumonia (Table 1).[2-4] ARDS is 10 times more common in gravidas.[5] Experimental data suggest that this may be because of a two-hit model in which increased proinflammatory cytokines due to pregnancy and parturition constitute the first hit, and infection, hemorrhage, or aspiration compose the second hit.[6] Experience from the 2009 influenza A(H1N1) pandemic has highlighted the challenges in managing severe ARDS in pregnancy.[7-9]

Noninvasive ventilation has been successfully used in some patients with ARDS in pregnancy.[10-12] More severe ARDS usually requires invasive ventilation using a lung-protective strategy; inability to maintain $Pao_2 > 70$ mm Hg and/or arterial oxygen saturation > 95% on supplemental oxygen or noninvasive ventilation or a worsening clinical course are indications for intubation and ventilation.[13] The plateau pressure target of < 30 cm H_2O (common in nonpregnant cases) may not be practical in obese patients or in late pregnancy, where intraabdominal pressure can increase physiologically up to 14 mm Hg.[2-4,13-15] Here, monitoring transpulmonary pressures may help in optimizing ventilator settings.[16,17] Fetal oxygenation is best represented by maternal Pao_2 rather than arterial oxygen saturation, and frequent blood gas analysis is required to maintain $Pao_2 > 70$ mm Hg, the level needed to maintain acceptable fetal acid-base balance.[18,19]

TABLE 1] Causes of ARDS in Pregnancy and Puerperium

Unique to Pregnancy	Not Unique to Pregnancy
Tocolytic-induced pulmonary edema	Aspiration
Eclampsia	Sepsis: pneumonia, urosepsis
Chorioamnionitis	2009 Influenza A(H1N1)
Amniotic fluid embolism	Varicella pneumonia
Trophoblastic embolism	TRALI, multiple transfusions
Abruptio placentae	Air embolism
Ovarian hyperstimulation syndrome[a]	Drug overdose
Endometritis	Fat emboli
Retained products of conception	Pulmonary contusion
Septic abortion	Inhalation injury
	Near drowning
	Pancreatitis

TRALI = transfusion-related acute lung injury.
[a]This may also rarely occur in nonpregnant women undergoing treatment of infertility.

The normal $Paco_2$ in pregnancy is 28 to 32 mm Hg with a maternal-fetal Pco_2 gradient of 10 mm Hg.[3] Permissive hypercapnia, acceptable in nonpregnant patients with ARDS, may have significant fetal effects.[2,4,13] Although mild hypercapnia increases uterine blood flow, $Paco_2 > 60$ to 70 mm Hg decreases uterine blood flow and increases fetal intracranial pressure.[20-23] At the same time, maternal hypocapnia may also lead to decreased uteroplacental blood flow and fetal alkalosis with a leftward shift of the oxygen dissociation curve, causing fetal hypoxia.[22-24]

When lung-protective ventilation strategies fail to maintain blood gas targets, alternative approaches, including prone positioning, extracorporeal membrane oxygenation (ECMO), and high-frequency oscillation, may be needed. Although prone positioning may be possible in early pregnancy, it has obvious limitations close to term because of its effect on the uterus, fetus, and intraabdominal pressure; lateral positioning may help by relieving aortocaval compression.[2,3] Large clinical trials using high-frequency oscillation as a salvage mode have not shown benefit in nonpregnant patients.[25,26] Case series suggest some benefit with ECMO in pregnant patients.[27,28] Anticoagulation treatment, usually required for ECMO, is believed to have contributed to death of three of six pregnant patients with 2009 influenza A(H1N1) treated with ECMO in one study[28]; lower intensity of anticoagulation improved maternal and fetal outcomes in a recent study.[27]

Termination of pregnancy by delivery is generally recommended in patients with ARDS due to obstetric causes.[4] For ARDS due to other causes, the usual obstetric indications should guide the timing and mode of delivery, as evidence that termination of pregnancy will improve maternal outcome is lacking.[2,3] In one series, six of 10 women with ARDS in the third trimester requiring mechanical ventilation were delivered for fetal distress; one fetus died, and three had perinatal asphyxia.[18]

Sepsis in Pregnancy and Puerperium

Sepsis is the fourth most common cause of death during pregnancy and the puerperium.[29-33] It accounts for 9.7% of maternal deaths worldwide in 2013[34] and 5% to 8% of