Emergent Neuroimaging During Pregnancy and the Postpartum Period

Guangzu Gao, MD[a], Rebecca L. Zucconi, MD[b], William B. Zucconi, DO[a,*]

KEYWORDS

• Patient-centered imaging • Pregnancy • Postpartum • Emergency neuroradiology

KEY POINTS

- Patient-centered neuroimaging in pregnancy and the postpartum period requires the radiologist to be well versed in latest imaging recommendations, while considering the needs and preferences of the individual patient and her family.
- A diagnostic challenge inherent to acute neurologic conditions during pregnancy and the postpartum period is that the presenting symptoms of several distinct pathologic conditions often overlap, and the conditions themselves are not mutually exclusive.
- The radiologist and imaging care providers must be effective and proactive members of the multidisciplinary care team commonly assembled in support of these patients.

INTRODUCTION

Acute neurologic symptoms during pregnancy can herald life-threatening disease processes and are anxiety provoking to both patients and clinicians. Implementation of a patient-centered care model in radiology can alleviate a patient's stress, reinforce appropriate imaging workup, improve patient satisfaction, and lead to improved outcomes.[1–5] The optimal approach entails seamless communication between the referring clinical teams, radiologic care providers, and the patient and relevant family members.[1,5,6] Exemplary patient-centered care includes a discussion of the goals, expectations and potential limitations of the imaging studies, duration of the examination, risks and benefits, monitoring of the examination, and providing timely results. To deliver on this promise, the radiologist must be a proactive member of the multidisciplinary care team, which may include consultants in obstetrics, and often emergency medicine, neurology, interventional neuroradiology, critical care, neonatology, and medical physics.[7,8] The radiologist must also be able to use the latest imaging recommendations with regard to appropriateness criteria, use of contrast, and radiation safety with consideration for the needs and preferences of the individual patient and her family.

A diagnostic challenge inherent to acute neurologic conditions during pregnancy and the postpartum period is that the presenting symptoms of several distinct pathologic conditions often overlap, and the conditions themselves are not mutually exclusive.[7–10] With a focus on patient-centered care, the authors present the evaluation, differential diagnosis, and recommended imaging protocols for the three most common acute neurologic symptoms in pregnancy and the postpartum

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[a] Department of Radiology and Biomedical Imaging, Yale Diagnostic Radiology, Yale School of Medicine, 20 York Street, PO Box 208042, New Haven, CT 06520-8042, USA; [b] Department of Medical Sciences, Frank H Netter MD School of Medicine, Quinnipiac University, 275 Mount Carmel Avenue, Hamden, CT 06518-1905, USA
* Corresponding author.
E-mail address: william.zucconi@yale.edu

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period: headache, seizure, and focal neurologic deficit. With the patient's symptoms as a reference point, the referring physician in consultation with the radiologist can effectively implement the optimal imaging procedures and expedite effective therapies.

PHYSIOLOGIC CHANGES OF PREGNANCY

The radiologist should be familiar with the physiologic changes of pregnancy that increase the risk for neurologic complications. Because of the elevation of estrogen, changes in the coagulation and fibrinolytic pathways place pregnant women in a hypercoagulable state. Pregnant women have an increased risk of thromboembolism, which persists 6 weeks into the postpartum period[11,12] because of an increase in several clotting factors, decreased inhibition of clotting mechanisms, and inhibition of fibrinolysis.[13,14] Total blood volume increases by 40% at term, leading to an increased risk of hypertension,[14,15] and rising progesterone levels in the third trimester contribute to increased venous compliance, capillary leakage, and vasogenic edema.[16] Hypercoagulability, hypertension, and increased vascular permeability help explain many of the imaging features seen in acute neurologic disease of pregnant and postpartum patients.

HEADACHE

An estimated 40% of postpartum women experience headaches.[17] Primary headache disorders, such as tension-type headache and migraine, are the most common cause.[18] Migraines are often improved in pregnancy, however, and should be diagnosed with caution so as not to miss a secondary cause.[19–21] Signs or symptoms that warrant additional workup include new, severe, or thunderclap headache, change in preexisting headache character or pattern, accompanying hypertension, or history of previous cerebrovascular disease.[7] Similarly, visual disturbance, altered mental status, or focal neurologic deficits warrant imaging.[18] MR imaging without contrast is the most appropriate imaging study for pregnant women with new headache when available, followed by computed tomography (CT) without intravenous contrast.[22]

Preeclampsia/Eclampsia

A common cause of new headaches in pregnancy is preeclampsia/eclampsia. Preeclampsia is characterized by new-onset hypertension (blood pressure >140/90 mm Hg) and proteinuria (24-hour urine collection >300 mg) that develops after 20 weeks' gestation.[23] It is a condition unique to pregnancy and the postpartum period, affecting an estimated 2% to 8% of pregnancies. Patients with preeclampsia often complain of headache and visual disturbances such as scintillating scotoma and may exhibit hyperreflexia.[24] Eclampsia is characterized by the addition of generalized tonic-clonic seizures and affects approximately 0.3% to 0.5% of all pregnancies,[23,24] most commonly during the third trimester, but can also occur postpartum.[23]

There are no specific imaging findings of preeclampsia, and brain imaging is not recommended in classic, uncomplicated cases.[25] Nonspecific signal hyperintensity on T2/fluid-attenuated inversion recovery (FLAIR) sequences can be seen in the brain parenchyma (**Fig. 1**), attributable to a hypertensive encephalopathy syndrome, or posterior reversible encephalopathy syndrome (PRES), a clinical and radiologic diagnosis with the neuroimaging findings of vasogenic edema, classically involving the posterior circulation territories.[26] PRES is, of course, not unique to preeclampsia/eclampsia patients. Severe hypertension, renal failure, and certain medications are among the many conditions predisposing to PRES.[27] The precise pathophysiology of PRES remains poorly understood, but likely relates to endothelial dysfunction, acute fluctuations of blood pressure, and impairment of cerebral auto-regulation resulting in brain edema, and in severe cases, infarction and hemorrhage.[26]

Head CT scan is abnormal in approximately 45% of patients with PRES,[26] with vasogenic edema most commonly visualized in the posterior cerebral hemispheres. MR imaging findings of PRES are best seen on T2-weighted and FLAIR images as hyperintensity (**Fig. 2**) and are more sensitive to involvement of the brainstem and cerebellum. The lesions less commonly demonstrate contrast enhancement, hemorrhage, or restricted diffusion, which portend a worse prognosis.[26] Eclampsia-specific PRES tends to involve the thalamus, midbrain, and pons less frequently than other PRES associations.[10] Preeclamptic or eclamptic patients with PRES also have less edema, hemorrhage, and contrast enhancement and tend to have more frequent complete resolution of imaging findings than other causes of PRES.[28] Most patients will respond to treatment at the vasogenic edema stage and achieve complete neurologic recovery within several weeks.[29] Although pharmacologic therapy with magnesium sulfate is given routinely for seizure treatment and