



Secondary Headaches During Pregnancy: When to Worry

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Abstract

Purpose of Review Headaches in pregnancy are a frequent cause of worry for both patients and healthcare providers. Physiological changes during this period increase the risk of a number of secondary headache disorders, and often also have an impact on primary headache disorders. This article reviews recent research into distinguishing worrisome vs non-worrisome headache presentations during pregnancy.

Recent Findings Recent research suggests that secondary causes of headache are highly prevalent during pregnancy, in between 25 and 42.4% of women seeking medical attention. Secondary causes of headache in pregnancy are most commonly homeostatic disturbances and hypertensive disorders of pregnancy, vascular problems, space-occupying lesions, and infections. Migraine itself also increases the risk of hypertensive disorders of pregnancy. Specific red flags for a secondary cause of headache in pregnancy include absence of any headache history, more severe pain, systemic features such as elevated blood pressure, and abnormal laboratory tests including thrombocytopenia or thrombocytosis, elevated liver function tests, elevated C-reactive protein, or proteinuria, in addition to traditional red flags, such as a change in headache pattern.

Summary Secondary causes of headache are common in women seeking medical attention during pregnancy. Red flags for secondary causes of headache during pregnancy may be remembered with the mnemonic PREGNANT HA (proteinuria, rapid onset, elevated blood pressure or temperature, gestational age in third trimester, neurological signs or symptoms, altered level of consciousness, no headache history or known history of a secondary headache disorder, thrombocytopenia or thrombocytosis, high liver function tests or CRP, or agonizingly severe pain). Increased education of patients and their providers may help improve selection of patients for workup of a secondary cause.

Keywords Headache · Pregnancy · Secondary headache · Migraine · Worrisome headache

Introduction

Headache in a pregnant patient is a common reason for Neurology referral, on both an inpatient and an outpatient basis. Pregnancy itself is sometimes included as a red flag for a secondary cause of headache in an expanded form of the classic SNOOP mnemonic [1, 2]. Although worrisome causes of headache are indeed frequent in pregnant women, primary headache disorders such as migraine and tension-type headache are more common. A careful evaluation for

secondary causes can reduce death and disability, while judicious selection of patients in need of investigation can save resources and avoid unnecessary radiation exposure to the mother and fetus.

Epidemiology

Primary headache disorders are highly prevalent in women of childbearing age, with migraine affecting up to 25% of women in this age group, and tension-type headache having a lifetime prevalence of around 80% [3]. Migraines improve in 67–89% of women during pregnancy, largely in the second and third trimesters [4, 5]. However, some women have worsening of migraine, and some develop new symptoms such as new auras, likely provoked by the hormonal fluctuations of pregnancy.

The prevalence of secondary headache disorders in pregnancy is difficult to establish due to variability in study design.

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Many patients with secondary causes of headache may not present to medical attention for some time, or may present to obstetricians rather than neurologists, leading to underrepresentation of some disorders more traditionally the purvey of obstetricians such as preeclampsia/eclampsia.

A US-based study from 2015 found a secondary cause of headache in 35% (49/140) of patients referred from obstetrics for neurological consultation due to acute headache, with primary headache disorders in the remaining 65% [6••]. The majority of all patients, at 59.3% of the sample and 91.2% of those with primary headache disorders, were diagnosed with migraine. Among the patients in this study diagnosed with a secondary headache disorder, 51% received a diagnosis of a hypertensive disorder of pregnancy, including 38.8% diagnosed with preeclampsia, followed by posterior reversible encephalopathy syndrome (PRES), eclampsia, hemolysis with elevated liver enzymes and low platelet counts (HELLP), acute arterial hypertension, and reversible cerebral vasoconstriction syndrome (RCVS), in decreasing order of prevalence. Other causes of secondary headache in the study included, again in decreasing order of prevalence, pituitary adenoma and/or apoplexy, infection, pneumocephalus related to anesthesia, cerebral venous sinus thrombosis (CVST), intracerebral hemorrhage (ICH), and ictal headache. The authors reported aura in 39.6% of the patients diagnosed with primary headache disorders. Of note, the majority of those presenting with aura (69.4%) had no previous history of aura.

A recent German study retrospectively assessed headache characteristics and diagnoses in 151 pregnant women undergoing neurology consult due to acute headache [7••]. More than half of their patients (57.6%) were diagnosed with a primary headache disorder, with 41.3% diagnosed with migraine with aura, 33.3% migraine without aura, and 21.8% tension-type headache. Similar to the previous study, many patients had new-onset aura in pregnancy. Among patients with a previous diagnosis of migraine without aura, 20.7% developed a new aura in pregnancy, and 17.2% of patients were diagnosed with new-onset migraine with aura. The other 42.4% of patients received diagnoses of secondary headache disorders. Most of these secondary headaches were diagnosed as related to infections (29.7%, with 17.2% viral infections and 12.5% sinusitis). Hypertensive disorders were deemed responsible for the next largest group (22%), with preeclampsia in 9.4%, PRES in 6.3%, and HELLP in 4.7%.

In another study, the authors also analyzed secondary causes of headache in the subset of the same 151 patients who underwent neuroimaging [8••]. Of the 50.3% of patients (76 of the original 151) who underwent imaging, 27.6% had an identifiable pathology on neuroimaging. Secondary causes seen in this study included intracranial hemorrhage (28.6%, not specified as to whether this included both ICH and SAH), CVST (23.8%), acute ischemic stroke (AIS) (14.3%), PRES (19%), and acute sinusitis (14.3%). A further 14.2% of

women had incidental findings that were not deemed related to headache.

It should be noted that the study population in both of these reports may have underrepresented certain diagnoses and overrepresented others, as it only included patients referred to Neurology due to their headaches and also excluded those who declined testing recommended by their physicians.

Taken together, these studies suggest that hypertensive disorders of pregnancy; vascular problems including ICH, CVST, and AIS; and infections are the most frequent culprits in secondary headaches during pregnancy.

Specific Causes of Headache in Pregnancy

The following section will highlight recent research into specific causes of secondary headache in pregnancy.

1. Hypertensive and Homeostatic Disorders

Preeclampsia and Eclampsia

Worldwide, eclampsia is a leading cause of maternal death, affecting 2–8% of all pregnancies globally [9]. The risk of morbidity and mortality may be mitigated by prompt diagnosis and treatment. A prospective Ethiopian study of 93 women diagnosed with eclampsia, at an average gestational age of 32 weeks, found a high prevalence of prodromal symptoms [10]. Sixty-four of the 83 ante- and intra-partum patients (77%) reported headache, with a high prevalence of other symptoms including visual disturbance in 49%, epigastric pain in 18%, and nausea/vomiting in 10%. The presence of prodromal headache did not differ between patients with moderate vs severe hypertension, defined as diastolic blood pressure 100–110 mmHg vs > 110 mmHg respectively (headache was seen in 80% with severe and 74% with moderate hypertension). Time from prodromal symptom onset to diagnosis of eclampsia averaged 5.5 days (range 1–15 days), but only 26% of the patients sought care for these symptoms. This study highlights the importance of considering preeclampsia/eclampsia in any pregnant patient presenting with headache, particularly those past 20 weeks of gestation. Diagnosis of preeclampsia/eclampsia may be established through the presence of elevated blood pressure and either of proteinuria or end-organ damage as indicated by the presence of thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, or new headache unresponsive to medication that is not accounted for by an alternate diagnosis, or visual symptoms [9]. Although patients with preeclampsia/eclampsia are likely to be diagnosed by their obstetrician/gynecologist before reaching a neurologist, it is important to keep a high index of suspicion for these conditions given their treatment potential and high complication rate if untreated.

Posterior Reversible Encephalopathy Syndrome

In the pregnant population, PRES may be thought to exist on a spectrum with preeclampsia/eclampsia [11]. The pathophysiology of PRES is poorly understood but is thought to reflect vasogenic edema. Importantly, in a pregnant patient, blood pressure may or may not appear to be elevated, since blood pressure in the second and third trimesters is naturally lower than at baseline due to decreased systemic vascular resistance [12].

One single-center retrospective cohort study examined 81 women diagnosed with eclampsia, of whom 45 were also diagnosed with PRES [13]. No differences in blood pressure were seen between groups, but patients diagnosed with PRES had higher levels of proteinuria than those without features of PRES on imaging. The authors identified headache accompanied by visual impairment in 27 (60%) of patients with PRES, and none of the patients without ($p = 0.001$). Visual impairment without headache was also more common in those diagnosed with PRES at 12 (26.7%) vs 2 (5.6%) patients. Headache without visual disturbance was more common in those not diagnosed with PRES, seen in only 2 (4.4%) with PRES and 18 (50%) without PRES. The non-PRES group was also more likely to have epigastric tenderness, seen in 2 (4.4%) vs 9 (25%), respectively. Although this study did not assess the prevalence of PRES in pregnant women in general, a PRES-like presentation should prompt evaluation for preeclampsia given the potentially life-threatening complications for mother and baby.

2. Cerebrovascular Disorders

Pregnancy is a period of increased risk for a number of vascular disorders. Plasma volume, cardiac output, stroke volume, and heart rate all increase. Systemic vascular resistance decreases, along with a decrease in both systolic and diastolic blood pressure, until sometime between a gestational age of 20 and 32 weeks. This may lead to venous stasis. Pregnancy is also a relatively hypercoagulable state, with increased levels of several pro-coagulant factors and a decrease in some anti-coagulant factors such as antithrombin III and protein S. Further increasing the potential for hypercoagulability, pregnancy may lead to development of functional protein C resistance.

Acute Ischemic Stroke

The risk of ischemic stroke is increased in the peri- and postpartum period but may actually be lower during pregnancy up until the few days prior to delivery [14, 15]. The strongest risk factor for stroke in pregnancy is preeclampsia/eclampsia.

Hemorrhagic Stroke: Intracerebral Hemorrhage, Subarachnoid Hemorrhage, and Reversible Cerebral Vasoconstriction Syndrome

Intracranial hemorrhage from various causes is a concerning potential underlying diagnosis for headache.

A study comparing rates of hemorrhagic stroke in young women (ages 18–45) found that 19/130 (14.6%) of the events occurred during pregnancy or the 12-week post-partum period, of which 7 were during pregnancy itself [16]. They reported 5 patients with arteriovenous malformation (AVM)-related intracerebral hemorrhage (ICH) between weeks 15 and 27, 1 with aneurysmal subarachnoid hemorrhage (SAH) at 17 weeks, and only 1 patient with reversible cerebral vasoconstriction syndrome (RCVS) during pregnancy leading to SAH at 33 weeks. This last patient was also reported to have comorbid diagnoses of migraine and preeclampsia. In this study, RCVS with ICH and/or SAH was much more prevalent in the post-partum group, seen in 10 patients, with 6/10 having a history of migraine. In general, RCVS is more typically associated with the post-partum period, but may also be diagnosed during pregnancy, in particular during the third trimester and in the context of preeclampsia [17].

Studies regarding the natural history of vascular malformations and aneurysms during pregnancy are conflicting, with several studies suggesting either no relationship between AVM and aneurysm-related bleeding during pregnancy, or a decreased prevalence of bleed in this time period [18–20]. However, other recent studies suggest that the second and third trimesters may be a time of increased risk for hemorrhagic stroke due to AVMs, while the third trimester may be a period of higher aneurysm rupture rates, possibly due to rising blood pressure, increased plasma volume, and altered vascular reactivity [21–23]. The risk of non-aneurysmal SAH seems elevated in the peri-partum period, but not throughout pregnancy, which may reflect underlying RCVS [15].

Cerebral Venous Sinus Thrombosis

Although pregnancy is often cited as a risk factor for cerebral venous sinus thrombosis (CVST), this appears to be driven largely by the concern for hypercoagulability in pregnancy and by an increased risk of CVST in the peri- and postpartum periods. Unfortunately, many studies report pregnancy and the puerperium as a single risk factor. One study did report a rate of pregnancy in 24/381 (6.3%) and the puerperium in 53 (13.9%) of their patients, and it is thought that the risk of CVST increases as the patient nears labor and delivery [24].

A recent systematic review of CVST in pregnancy and the puerperium identified 66 patients who had previously been reported to have CVST during this period [25]. They found that time from symptom onset to diagnosis averaged 5.9 days (95% CI 4.2–7.6). Isolated headache at presentation was

associated with a good outcome after multivariate analysis ($p = 0.04$), with coma or obtundation associated with worse prognosis ($p = 0.03$).

A large retrospective cohort study of CVST identified headache as a presenting symptom in 86.1% of women, with a large number of cases in the puerperium (18.3%) [26]. Seizures were also prevalent, seen in 26.3% of all women. The headache may be subacute or acute in onset, and potentially associated with neurologic deficits, papilledema, or pulsatile tinnitus. In one study, the headache associated with CVST was commonly holocephalic and throbbing in nature [27].

Cervical Artery Dissection

Rates of cervical artery dissection are not generally increased during pregnancy but may be higher in the puerperium due to mechanical forces during labor and delivery. Only a few case reports of patients with carotid artery dissection in pregnancy have been published, all with headache as a presenting feature [28–30]. Vertebral artery dissection has recently been reported in association with preeclampsia in 2 patients, in both cases accompanied by headache and neck pain [31]. The authors hypothesized that a surge in blood pressure due to preeclampsia/eclampsia could lead to arterial dissection and recommended a low threshold for investigation of patients with headache and neck pain in the context of preeclampsia/eclampsia. Dissection-related headache may be associated with new-onset blurry vision, ptosis, periorbital eye pain, and miosis. There may be a history of antecedent trauma or neck manipulation, or a history of a connective tissue disorder. The headache is typically ipsilateral to the dissected artery and may be similar to migraine or cluster headache in characteristics [32].

3. Space-Occupying Lesions

Pregnancy is a period of increased growth of a number of space-occupying lesions, such as pituitary adenomas [33]. Meningiomas, which have progesterone receptors, may enlarge during pregnancy due to hormonal and/or vascular effects [34]. Primary glial brain tumors may also progress during pregnancy [35]. Pregnancy-associated tumors such as choriocarcinoma may metastasize to brain and present with headache and other neurological symptoms. Non-neoplastic space-occupying lesions such as colloid cysts or Chiari malformations are more likely to present with headache during labor than in pregnancy, due to Valsalva forces at this time.

4. Pituitary Apoplexy

Pregnancy is a period of increased risk for pituitary apoplexy, due to enlargement of both the normal pituitary and pituitary adenomas in response to hormonal and vascular changes in pregnancy. Patients typically present with acute onset of

severe headache, often accompanied by visual symptoms such as diplopia, visual field deficits, or decreased visual acuity, and in some cases with other focal neurological deficits or decreased level of consciousness [36, 37].

5. Pressure-Related Disorders

Headaches related to either high or low intracranial pressure, apart from those described above related to other structural pathologies, are not specifically felt to be increased in pregnancy. However, in the peri- and post-partum period, intracranial hypotension is one of the most common reasons for headache, so common that many patients are empirically treated by their obstetrical or anesthesia team for presumed post-dural puncture headache.

Idiopathic Intracranial Hypertension

Pregnancy is not felt to be a specific risk factor for IIH, and the presence of IIH does not typically alter pregnancy outcomes; similarly, pregnancy does not affect IIH visual outcomes [38–41]. However, IIH can present for the first time during pregnancy at rates similar to those of the age-matched non-pregnant population. Investigation for IIH is indicated in a patient with a suggestive history and physical examination, and CVST should be considered in the differential.

Intracranial Hypotension

Intracranial hypotension caused by dural puncture is a fairly common cause of post-partum headache. Spontaneous intracranial hypotension is rarely described during pregnancy, but there are a few case reports of patients presenting with typical orthostatic headache during pregnancy and receiving this diagnosis [42, 43]. This type of headache is made worse with standing and improved or resolved with recumbency and may be associated with muffled hearing and diplopia. It may be gradual or thunderclap in onset.

6. Other Disorders

Some rare disorders associated with migraine may be associated with pregnancy complications and may present for the first time during pregnancy with headache. For example, a study of patients diagnosed with cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) found that 12 out of their 25 patients had neurological symptoms in 17 of their 43 pregnancies, with migraine being a common neurological symptom [44]. Another group of disorders associated with migraine is mitochondrial disease, and due to the high-stress nature of pregnancy, patients with undiagnosed mitochondrial disease such as mitochondrial encephalomyopathy with lactic acidosis and stroke-like episodes (MELAS) or Kearns-Sayre

syndrome (KSS) may decompensate in pregnancy and may be at risk for other disorders such as preeclampsia [45]. Identification of suggestive features on history or examination should prompt a workup for these disorders.

Another unusual headache entity to consider in a pregnant patient has recently been reported by Rozen et al. in 2017 [46]. This case report details a 31-year-old woman who developed a severe, right-sided headache at a gestational age of 36 weeks, with no clear migrainous or autonomic features, but severe exacerbations lasting 20 minutes multiple times per day. MRI brain showed a new contact between the nasal septum and turbinate ipsilateral to the pain, and her pain resolved with intranasal budesonide to reduce local mucosal inflammation. The entity of nasal contact point headache is controversial, but due to the overall increase in blood volume as well as to estrogen effects on the nasal mucosa, nasal mucosa edema may develop especially in trimesters 2 and 3, possibly contributing to this disorder.

Effects of Primary Headache Disorders on Pregnancy

Migraine has been shown to be associated with an increased risk of hypertensive disorders in pregnancy, including gestational hypertension and preeclampsia/eclampsia [47]. A recent systematic review reported an increased odds ratio of 1.23–1.69 for gestational hypertension, and 1.08–3.5 for preeclampsia, in patients with migraine vs those without [48]. A study of 219 pregnant women with a gestational age of 12 weeks or less examined serological markers indicating an increased risk of preeclampsia [49]. Eight women (3.7%) tested as being at high risk for early preeclampsia, and 24 women (10.9%) tested at high risk for late preeclampsia. Migraine was nearly twice as prevalent in the group at risk for early preeclampsia, in 4/8 patients (50%) vs 59/211 (28%) of those at low risk. This study underscores the importance of appropriate history-taking, examination and vital signs, and consideration of laboratory testing in women with migraine, as the presence of headache in these patients may not simply be a manifestation of their underlying primary headache disorder but may herald the development of a secondary cause such as preeclampsia.

A recent systematic review also identified an increased risk of ischemic stroke in those with migraine, at an OR of 7.9–30.7, as well as an elevated rate of ICH in the 2 studies cited, at a range of OR between 2.6 and 9 [48]. The authors note that these results may be confounded by the design of the studies, which may have coded headache in the context of preeclampsia as migraine, clouding the issue of whether the stroke was occurring in the context of migraine alone or headache with another stroke risk factor such as preeclampsia. This study did not identify an increased risk for CVST or SAH in pregnant patients with a history of migraine vs those without. The

reason for the elevated risk of AIS is unclear but may be due to a combination of factors including pro-coagulable state and altered vascular reactivity. Patent foramen ovale (PFO), a potential cause of otherwise cryptogenic stroke, is thought to be a stroke risk factor in pregnancy and PFOs are known to be approximately 3–4 times more prevalent in patients with migraine with aura than the general population [50, 51]. A recent review noted that most PFO-related strokes in pregnancy in fact occur earlier in pregnancy, with 47% of 15 reported cases in the first trimester and 13% in the second trimester [52]. The authors note that 7/15 of the included cases had another risk factor for stroke, including migraine with aura, but details as to how many of these patients had a diagnosis of migraine with aura were not included. It could be hypothesized that PFO is a specific stroke risk factor during pregnancy for patients with migraine with aura. However, studies specifically examining this potential relationship are currently lacking.

Peri- and Post-Partum Headache

The rate of secondary causes for headache is very elevated in the peri- and post-partum period, with a shift in underlying causes as compared to during pregnancy. Vascular problems such as AIS, CVST, and RCVS, preeclampsia/eclampsia, and post-dural puncture headache increase. A recent study of acute post-partum headache identified a secondary cause in 73% of patients, including post-dural puncture headache in 45.7%, preeclampsia in 26.1%, and cerebrovascular disorders in 21.7% [53••]. Another rare cause of headache in the post-partum period is pneumocephalus secondary to anesthesia, which may present with thunderclap headache [54].

Specific Pregnancy Red Flags

A few recent studies have attempted to identify clinical and investigation factors associated with secondary headache diagnosis in pregnancy. In one study, prolonged attack duration ($p = 0.027$), presence of seizures ($p = 0.0015$), elevated blood pressure ($p < 0.0001$), presence of fever ($p = 0.014$), and abnormal neurological examination with findings referable to the acute symptoms ($p = 0.014$) were associated with presence of a secondary headache diagnosis [6••]. After logistic regression analysis, the authors identified a significantly increased relative odds of a secondary headache only in those with no headache history as well as in those with elevated blood pressure. Abnormal neurological examination carried an OR of 2.7 (0.85–0.88), which did not reach statistical significance at $p = 0.091$; the authors related this to the high prevalence of sensory symptoms in patients with migraine with aura. A few factors were associated with increased odds of being diagnosed with a primary headache disorder, including

Table 1 PREGNANT HA: A mnemonic for red flags for secondary headache in pregnancy

	Red flag	Associated conditions
P	Proteinuria	Preeclampsia/eclampsia
R	Rapid onset (thunderclap)	SAH, ICH, RCVS, pituitary apoplexy, intracranial hypotension
E	Elevated BP or temperature	Preeclampsia/eclampsia, PRES, RCVS, infection
G	Gestational age 3rd trimester	Preeclampsia/eclampsia, PRES, CVST, ICH
N	Neurological signs/symptoms	Preeclampsia/eclampsia (seizures), PRES (seizures, visual disturbance), RCVS, SAH, CVST, pituitary apoplexy (visual or focal neurological), space-occupying lesion, IHH
A	Altered level of consciousness	Preeclampsia/eclampsia, PRES, CVST, ICH, pituitary apoplexy, space-occupying lesion
N	No headache history, or history of a secondary headache disorder	Any
T	Thrombocytopenia/thrombocytosis	Preeclampsia/eclampsia, CVST
H	High liver function tests or CRP	Preeclampsia/eclampsia, CVST (CRP)
A	Agonizingly severe	Any

psychiatric comorbidity and presence of phonophobia. Most patients (56.4%) presented in the third trimester, with a trend towards more secondary than primary headache disorders at this time (67.3% vs 50.5% respectively, $p = 0.056$).

A retrospective study of 151 pregnant women presenting with an acute headache, either to an emergency room or in an inpatient setting, analyzed clinical and paraclinical features in those undergoing diagnostic investigations and neuroimaging, respectively; the underlying diagnoses in these papers have been outlined above [7••, 8••]. The authors performed a multivariate logistic regression analysis and found a number of clinical factors that were deemed to be independent predictors of secondary headache, including a history of secondary headache (OR 6.6, 95% confidence interval [CI] 1.3–33.1), elevated blood pressure (OR 7.2, 95% CI 2.3–22.6), fever (OR 12.1, 95% CI 1.3–111.0), and an abnormal neurological examination (OR 9.9, 95% CI 2.7–36.3) [7••]. Investigation abnormalities associated with a secondary headache diagnosis included abnormal platelets, C-reactive protein (CRP), liver function tests, proteinuria, and lumbar puncture results.

In their second study, the authors further analyzed the patients who underwent neuroimaging [8••]. Of the 50.3% of patients who underwent imaging, 27.6% had an identifiable pathology on neuroimaging. In this subset of patients, the authors found that very severe pain, altered level of consciousness, and seizures were predictive of abnormal pathology on imaging, regardless of trimester. They reported a number needed to scan of 3.8 for patients presenting with symptoms. They further analyzed the subset of patients who presented

with headache but who did not have clear focal neurological symptoms or examination deficits. Of these 69 patients, 27 (30.1%) were imaged, and 7/27 (25.9%) had identifiable pathology on imaging, including CVST, sinusitis, and ICH. Sudden pain onset trended towards predicting pathological imaging. Severe pain (above 9/10) was significantly more frequent among those with pathological imaging (43.8% vs 14.3%, $p = 0.016$), as was altered level of consciousness (14.3% vs 1.8%, $p = 0.03$). Visual disturbance was more common in patients without an identifiable pathology. Although an abnormal neurological examination was more common in those with an identifiable pathology at 52.4% vs 29.1%, this remained a trend ($p = 0.058$).

Table 1 includes a mnemonic summarizing the most recently reported red flags for a secondary cause of headache in pregnancy as described above.

Conclusions

Headache in a pregnant patient may be a source of significant concern to patients and healthcare providers alike and may signal either a benign process such as a primary headache disorder, or a more worrisome secondary headache disorder. It is important to consider both pregnancy-related and non-pregnancy-related causes of secondary headache. A careful history and examination, together with select investigations such as laboratory testing, is indicated to assess for the possibility of a secondary headache and select for patients requiring

neuroimaging. Specific red flags for a secondary headache in pregnancy may be remembered with the mnemonic PREGNANT HA, including proteinuria, rapid onset, elevated blood pressure or temperature, gestational age in third trimester, neurological signs or symptoms, altered level of consciousness, no headache history or known history of a secondary headache disorder, thrombocytopenia or thrombocytosis, high liver function tests or CRP, and agonizingly severe pain. Presence of any of these red flags should prompt a more thorough workup for a secondary cause, and treatment as indicated by the specific underlying condition.

Compliance with Ethical Standards

Conflict of Interest Claire H. Sandoe and Christine Lay each declare no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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