Headache in Pregnancy

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1

Classification and Diagnosis of Headache Disorders & MRI/CT Imaging

- **Primary** headaches – **NO IMAGING CORRELATE**
  - Migraine
  - Tension-type
  - Cluster and other trigeminal autonomic cephalagias (TACs)
  - Miscellaneous
- **Secondary** headaches – **FREQUENT IMAGING DIAGNOSIS**
  - Mass Lesions
  - Infections
  - Increased Intracranial Pressure
  - Vascular Disease
  - Inflammation

2

Imaging in Emergencies of Pregnancy

CT of head (no contrast)

Ionizing radiation; less information than MRI; generally avoid

CTA of head/neck

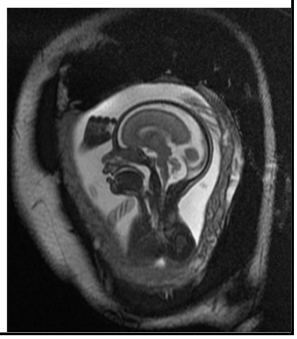
Contrast dye – generally proscribed; MRA - alternative

MRI/MRA (no contrast)

Concerns: EM fields causing teratogenicity; acoustic noise

Results: No fetal effects from EM fields

No neonatal hearing loss



Conclusions:

- Maternal diagnosis may be more important than fetal risk.
- Imaging appears safe even in early pregnancy.
- GBCA should rarely be used during pregnancy.
- Contrast agents are safe with breast feeding.

3

Headache in Pregnancy Emergency or Expected?

1st trimester

- Primary headaches
  - Migraines
    - Most common cause of headaches in pregnancy, including "thunderclap headache"
    - Persist/worsen during 1st trimester with emesis
    - Improve/resolve during 2nd & 3rd semesters
    - New onset migraines may occur pregnancy
    - Imaging is rarely needed: reassure, monitor

2nd/3rd trimesters

- Tumor – increased vascularity, inflammation

Post-partum

- Post-dural puncture headache – immediate symptoms
- Cerebrovascular disease – symptoms first 6 weeks

4

A Hospital Based Retrospective Study of Acute Postpartum Headache

- Retrospective study of consecutive postpartum (up to 6 weeks after delivery) women, mean age of 29.5 years.
- 54% of women had a past headache history
- **63 women with acute postpartum headache**
  - 17 (27.0%) were diagnosed with a primary headache disorder
  - **46 (73.0%) were diagnosed with a secondary headache disorder**
  - Headaches occurred 4.7±7.3 days postpartum
  - Primary headache
    - Migraine (76.5%)
  - **Secondary headache**
    - Post-dural puncture headache (PDPH) (45.7%)
    - **Postpartum preeclampsia (26.1%)**
    - **Cerebrovascular headache disorders (21.7%)**
      - pituitary apoplexy, cerebral venous thrombosis, Moyamoya, reversible cerebral vasoconstriction syndrome, posterior reversible encephalopathy syndrome, and vertebral artery dissection
  - **If a woman in the postpartum period has an acute headache that does not slide easily into a primary headache or PDPH category, then an MRI of the brain should be obtained and her blood pressure should be closely monitored, with an elevation treated appropriately.**

Vgontzas & Robbins, MD *Headache* 2018;00:00-00

5

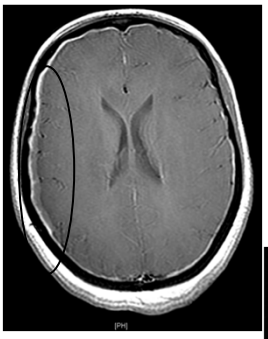
Headaches Associated with Pregnancy

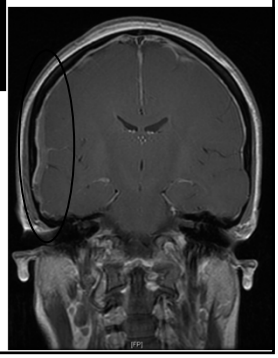
- **<u>Primary Headaches:</u>**
  - Migraine with or without aura
  - Tension-type headaches
- **<u>Secondary Headaches caused by:</u>**
  - **Anesthetic Complications: PDPH, pneumocephalus, subdural hematoma, CVT**
  - Cerebrovascular Disease:
    - Hypertensive disorders: pre-eclampsia, eclampsia, HELLP, PRES
    - RCVS / postpartum cerebral angiopathy
    - CVT with increased intracranial pressure, venous infarction
    - Intracranial hemorrhage: subdural hematoma, IPH, SAH
    - Ischemic stroke: arterial dissection, acute arterial infarction
  - Pituitary Expansion: adenoma, hemorrhage, lymphocytic hypophysitis
  - Mass Lesion Expansion: tumor, AVM, aneurysm

6

Postpartum Post Dural Puncture Headache (PDPH)

- Unintentional dural puncture: 0.15-1.5% of cases of epidural analgesia during labor, with a 50-80% risk of developing a PDPH.
- ICP decreases due to CSF leakage through a dural puncture.
- Alteration in the severity of pain with head position.
- MRI with contrast: pachymeningeal enhancement, sagging of the cerebellar tonsils and brainstem.
- Downward traction of the brain affecting draining veins may lead to unilateral or bilateral SDHs, CVT, SAH.

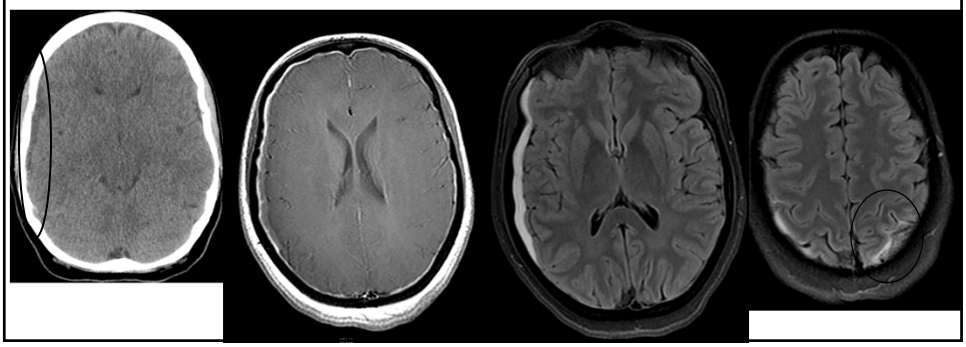




7

Post-partum Headache, SDH, SAH, CVT

25 yr. woman developed a post-partum positional headache after C-sectioning under epidural anesthesia. HCT showed a small SDH. The MRI showed bilateral SDHs, diffuse pachymeningeal enhancement, and a small SAH near a cortical vein thrombosis. MRV was normal. Her PDPHs resolved after an epidural blood patch. A repeat MRI was unchanged three days later and headaches resolved. She was discharged to home on no medications.



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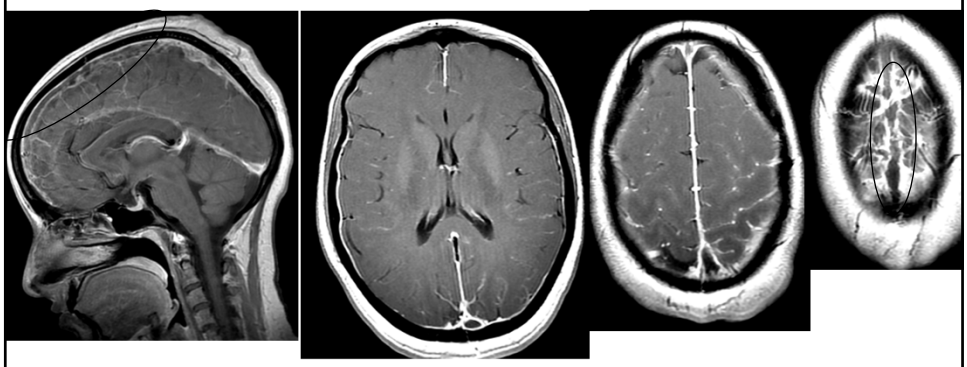
PDPH causing CVT

A week later she presented again with several days of increasing headaches. MRI/MRV showed thrombotic superior sagittal sinus, transverse sinuses, sigmoid sinuses, R IJV and superficial cortical veins.



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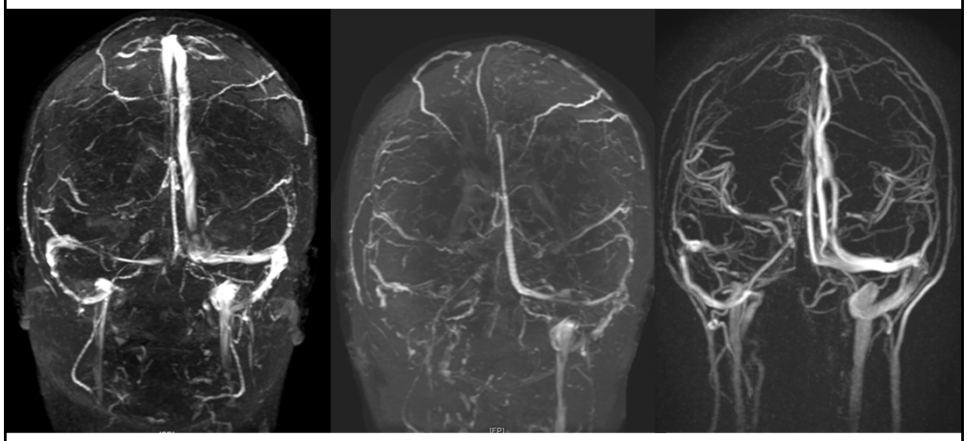
PDPH causing CVT

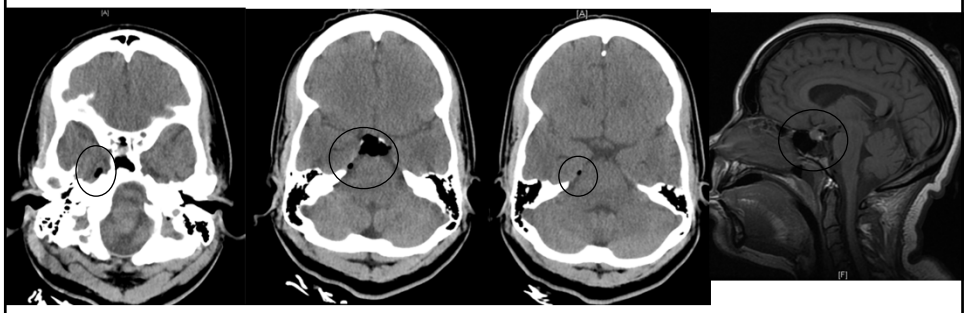
The woman continued on warfarin, neurologically intact. Repeat MRV 15 months later showed recanalization of the superior sagittal sinus, distal right transverse sinus and the right internal jugular vein.



PPD2 PPD7 15 months later

10

Post-partum sudden onset of unresponsiveness: perimesencephalic air and anesthesia



A 23-year-old woman underwent emergent sectioning under epidural anesthesia. At about 10 minutes after the infant was delivered, she suddenly complained of a headache, vomited and immediately became unresponsive. She was intubated immediately, and a stroke code was called. She had dilated, unreactive pupils; no brainstem reflexes; and no motor response to pain. Her NIHSS score was 31. A CT scan, then an MRI scan, were obtained.
In about an hour she was awake with a normal neurological examination, denying a headache.

11

Headaches Associated with Pregnancy

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- **Secondary Headaches caused by:**
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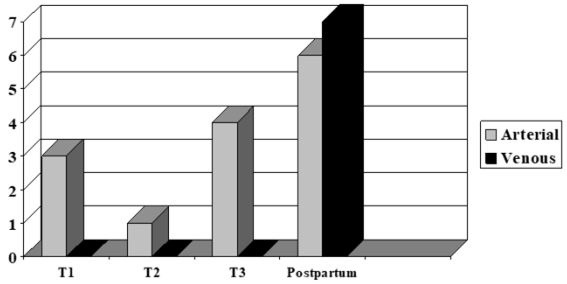
  - **Cerebrovascular Disease:**
    - **Hypertensive disorders: pre-eclampsia, eclampsia, HELLP, PRES**
    - **RCVS / postpartum cerebral angiopathy**
    - **CVT with increased intracranial pressure, venous infarction**
    - **Intracranial hemorrhage: IPH, SDH, SAH**
    - **Ischemic stroke: acute arterial infarction, arterial dissection**
  - Pituitary Expansion: adenoma, hemorrhage, lymphocytic hypophysitis
  - Mass Lesion Expansion: tumor, AVM, aneurysm

12

Timing of Infarction in Pregnancy



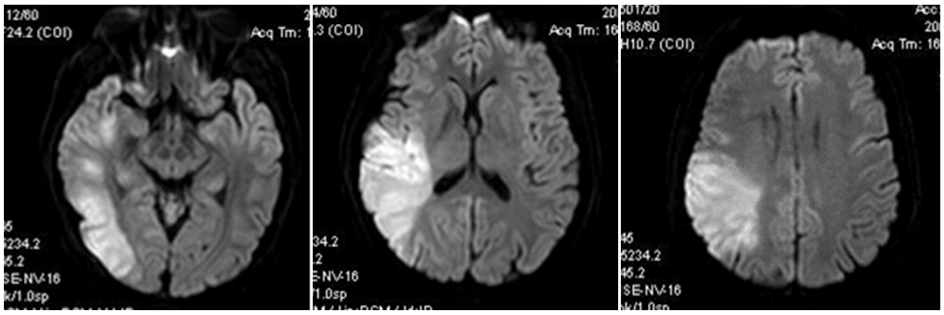
- Risk of hemorrhagic stroke is greater than the risk of ischemic stroke.
- Risk is increased in the six weeks <u>after</u> delivery, but not during pregnancy itself.

Jaigobin and Silver, Stroke & Pregnancy, Stroke 2000.

13

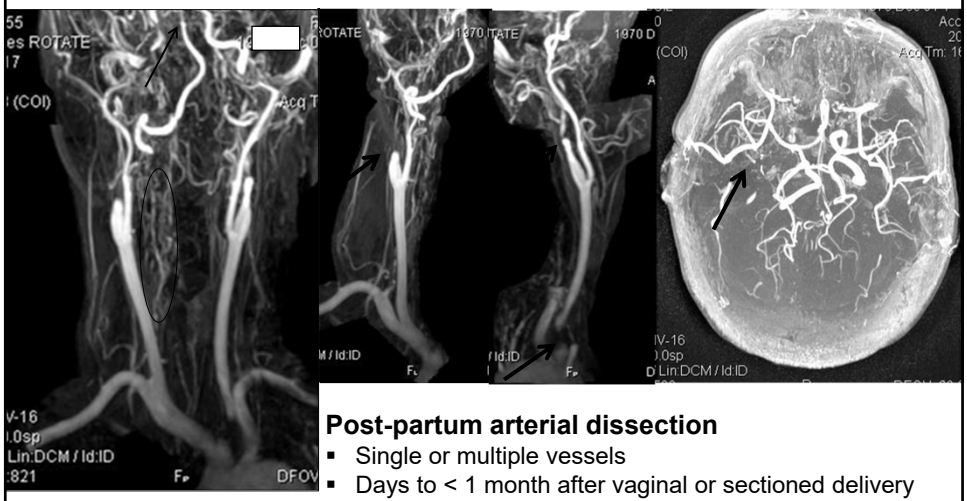
Post-partum ischemic stroke

36-year-old healthy woman had an uneventful first pregnancy with vaginal delivery. A week later she developed a headache, and dizziness, followed by left sided weakness and neglect.
An MRI showed an acute infarct in the territory of the posterior division of the right middle cerebral artery.



14

Post-partum ischemic stroke



Post-partum arterial dissection

- Single or multiple vessels
- Days to < 1 month after vaginal or sectioned delivery
- Not associated with underlying connective tissue disorders
- Reason for vulnerability unknown

15

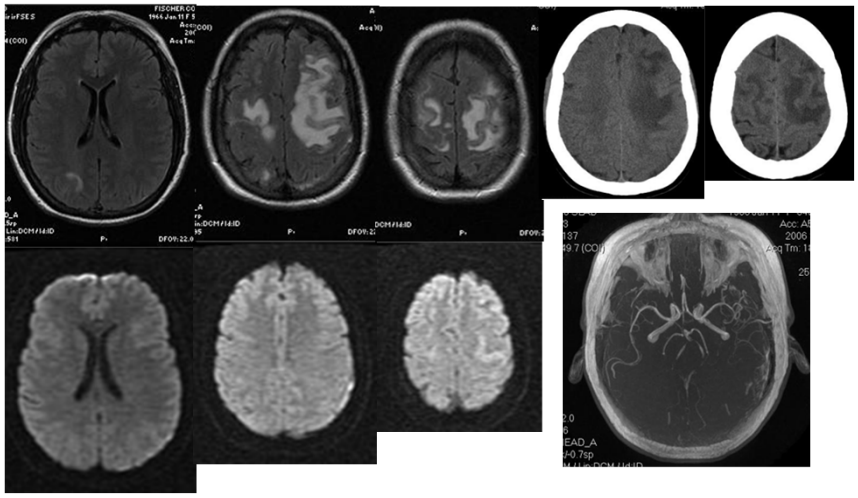
Hypertension in Pregnancy

- Complicate 10-20% of pregnancies with increasing incidence
- ~ 20% of maternal deaths in the US
- ~50,000 maternal deaths (10% of total) worldwide each year
- Presents very frequently with headaches prior to diagnosis
- More common in women with migraine
- **Categories for Hypertensive Disorders**
  - **Chronic Hypertension**:
    - >140/90 x 2 < 20 weeks or > 12 weeks post-partum
  - **Gestational Hypertension**:
    - >140/90 x 2 > 20 weeks without proteinuria, end organ dysfunction
  - **Preeclampsia/Eclampsia/HELLP**
    - 44% of ICH, 47% of ischemic stroke
    - 5-8% of pregnancies (10% develop eclampsia with seizures)
    - **> 20% cases in 6 weeks after delivery (increased stroke risk)**
    - multiorgan disease, >140/90 x 2 > 20 weeks with proteinuria, end organ dysfunction; severe features: > 160/110 x 2, > 5 gm/24 hours, brain/liver/lung/hematologic abnormalities; HELLP
  - **Preeclampsia superimposed on Chronic Hypertension**

16

Headache due to Untreated Pre-Eclampsia

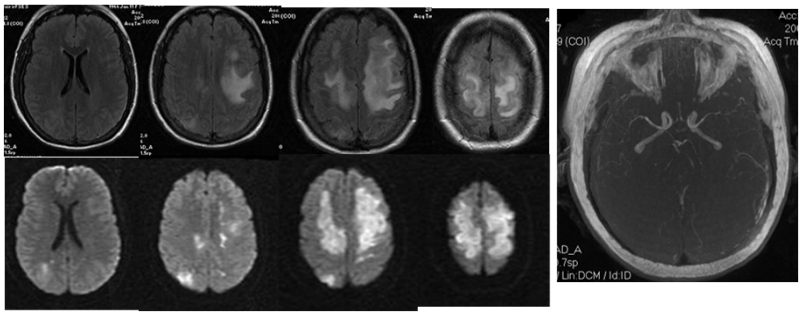
40-year-old woman G2P1 had an increasing headache starting on day 3 after delivery. Her BP increased but was not treated. Imaging on day 18 was consistent with posterior reversible encephalopathy syndrome (PRES).



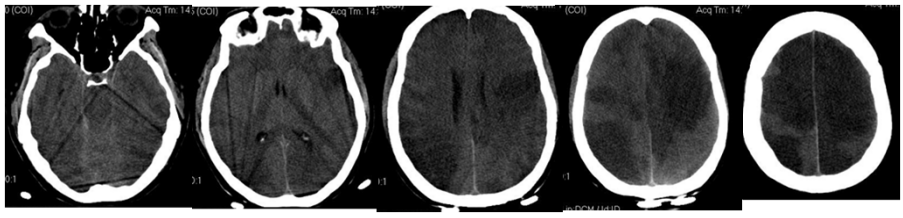
17

Untreated, Fatal Pre-Eclampsia (PRES) with Ischemic Strokes Due to RCVS.

Blood pressure continued to be untreated. She developed bilateral weakness and became unresponsive. On day 22 infarcts were seen on DWI. Arterial spasm was seen on MRA.



On day 24 she arrested before a CT scan. She died on day 25 after delivery .



18

Posterior Reversible Encephalopathy Syndrome (PRES)

- Presenting with headache
- Nomenclature
  - Not exclusively posterior; not always reversible
  - Hypertensive encephalopathy
  - Pre-eclampsia; eclampsia; HELLP
- Vasogenic cerebral edema (cortical, subcortical, spinal cord)
  - Vasoconstriction
  - Hyperperfusion
- Diverse clinical & radiographic presentations
  - Headache, seizures, visual symptoms, mental status changes
  - Parietal-occipital white matter; holohemispheric pattern; superior frontal region; cortex, subcortical nuclei, brainstem; spinal cord
  - Untreated: Reversible vasoconstriction syndrome (RCVS); intracerebral hemorrhage, ischemic stroke, coma, death

19

Hypertensive Disorders of Pregnancy

Pre-Eclampsia

- 3-8% pregnancies in US
- **20% occurs in 6 weeks after delivery**
- BP ≥ SBP 140 or DBP 90 x 2 over 6 hours
- Urine protein > 0.3 g/24 hours (not necessary for diagnosis)
- Pre-eclampsia < 20 weeks: molar pregnancy?
- Severe features: SBP 160 or DBP 110, end organ damage
- AMA, HTN, A-A, vascular risk factors, multi-fetal gestation, prior history, APLAS
- Women with a history of preeclampsia 60% more likely to have a non-pregnancy related ischemic stroke.

Eclampsia

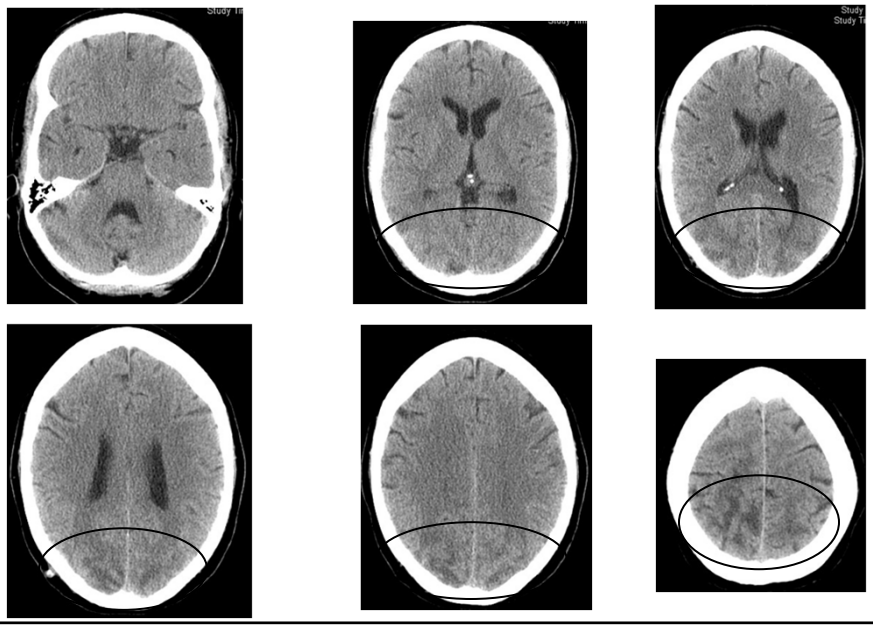
- Pre-eclampsia with seizure
- Seizure activity unrelated to other central nervous system disorders (epilepsy, meningitis, mass lesion, intracranial hemorrhage), with or without resultant coma

HELLP: H-Hemolysis **EL**-Elevated liver function tests **LP**-Low platelets

- 20% of eclamptic women (white, multiparous)

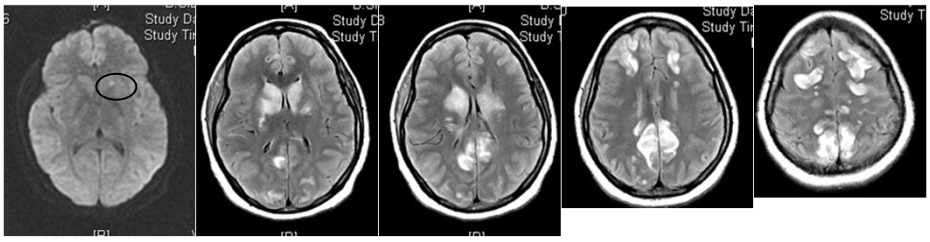
20

Eclampsia/Pre-eclampsia/HELLP: PRES

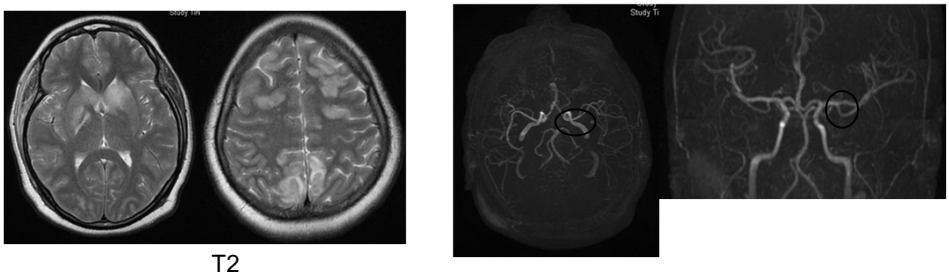


21

19 year old pregnant woman with elevated blood pressure and seizures



DWI FLAIR



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22

Pregnancy Related IPH

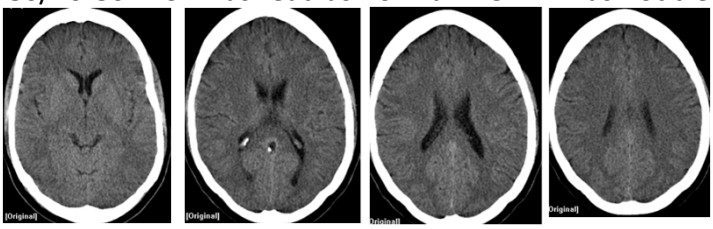
- 7.1 pregnancy related IPH per 100,000 at-risk person years
- 5.0 per 100,000 person-years for non-pregnant women in the same age range
- IPH increased in **post-partum period.**
- Causes: untreated hypertension, RCVS, mass lesions
- 7.1% of all pregnancy related mortality in the data base
- Significant independent risk factors: advanced maternal age, African American race, pre-existing or gestational hypertension, preeclampsia/eclampsia, coagulopathy, and tobacco use.

Bateman et al 2006

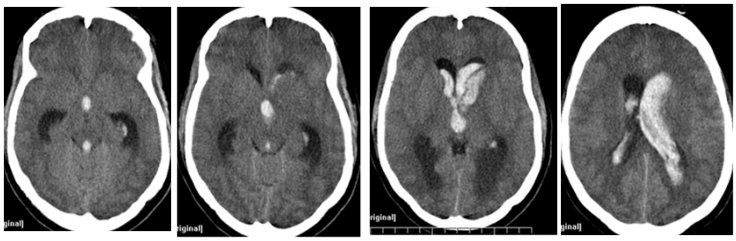
23

Postpartum Headache and Untreated Pre-Eclampsia

A 40-year-old woman had a 10/10 headache on PPD7 with BPs at 160-180/70-80. HCT was read as normal. Her BP was not treated.

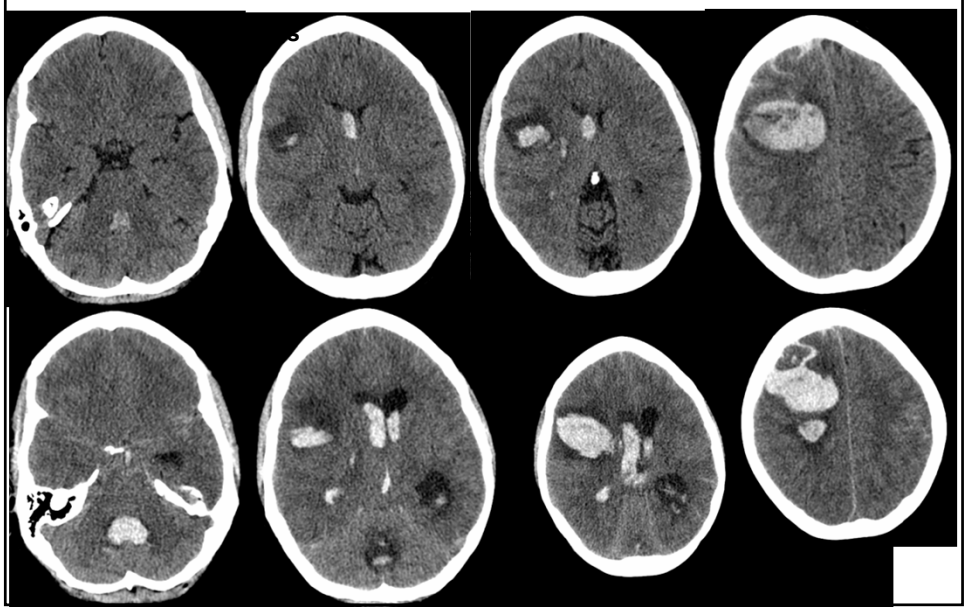


She was unresponsive on PPD 8 with a BP of 190/110. She died the next day. No underlying brain lesion was found on autopsy.



24

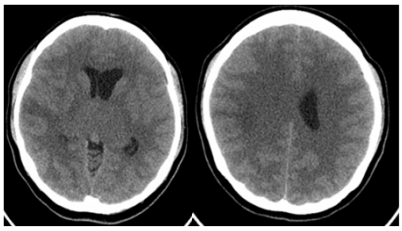
Post-partum IPH in a 34-year-old woman with HELLP

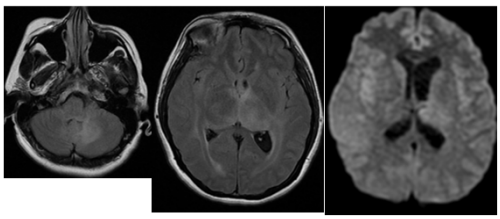


25

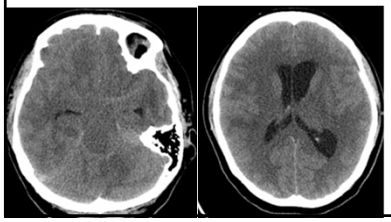
Postpartum PRES without HTN

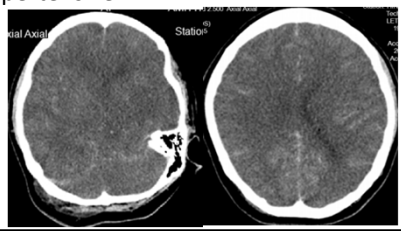
On PPD 46, 28 yr old woman, had a headache for 4 days. Her maximum BP was 147/89 with a normal examination. CT & MRI scans indicated PRES.





Headache, dizziness, n/v persisted with normal BPs. On PPD 54 she became unresponsive with PRES on CT scan. Follow up CT scans showed cerebral edema. She died on PPD 76, never noted to be hypertensive.

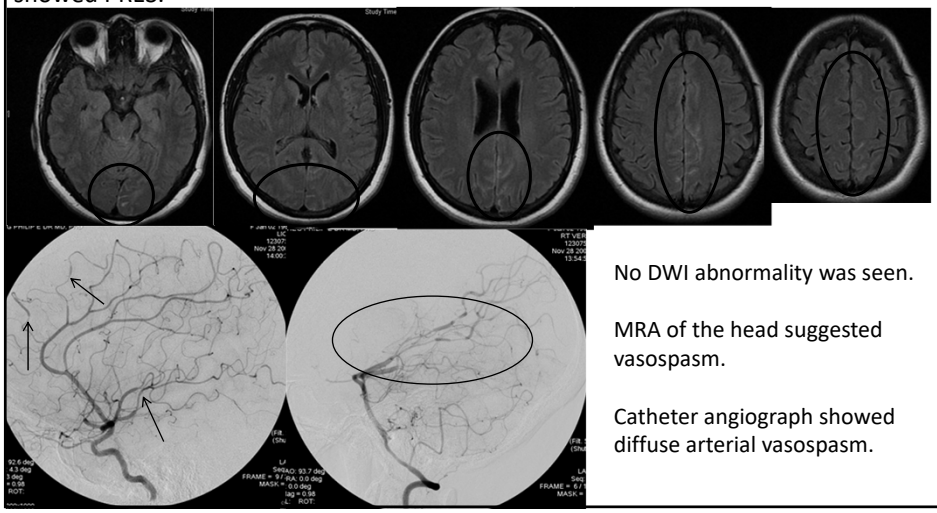




26

Severe peri-partum headache in 40 yr old without blood pressure elevation

A 40 yr old woman had sudden onset headache of 10/10 prior to delivery that persisted to post-partum day #7 without elevated BP. The CT was negative. An MRI showed PRES.



No DWI abnormality was seen.

MRA of the head suggested vasospasm.

Catheter angiograph showed diffuse arterial vasospasm.

27

Reversible Cerebral Vasoconstriction Syndrome

Sudden, severe headache, evidence of vasoconstriction in cerebral vessels, and documented resolution of vasoconstriction

Can cause ischemic strokes especially in border-zone territories

Associated with a variety of clinical states:

- **Pregnancy (postpartum cerebral angiopathy)**
- Migraine (migrainous vasospasm)
- Drug use (triptans, SSRIs, nicotine, mj, cocaine)
- Benign angiopathy of the CNS

Clinical:

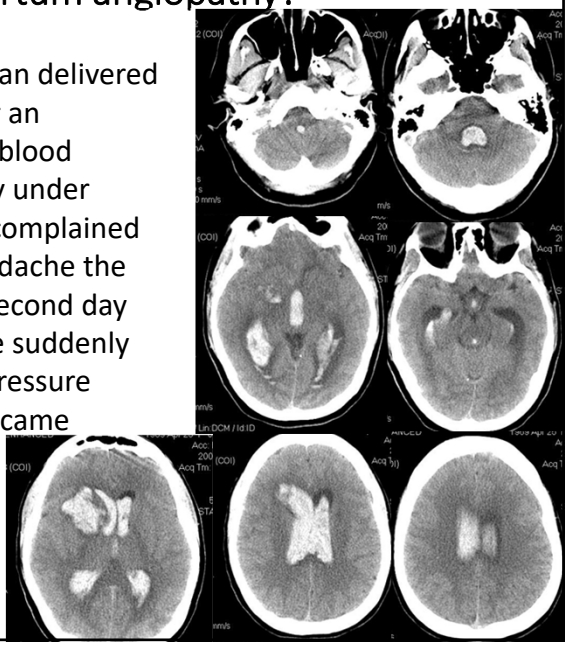
- Sudden onset severe, “thunderclap” headache
- Nausea
- Vision changes
- Photophobia
- Encephalopathy
- Focal deficits (ischemic, hemorrhagic)
- Generalized seizures (up to 30%)
- 1/3 with moderate-severe HTN

28

Post-partum IPH without blood pressure elevation – postpartum angiopathy?

A healthy 43-year-old woman delivered her 3nd child vaginally, after an uneventful pregnancy. Her blood pressures were consistently under 140/90 after delivery. She complained of an intermittent mild headache the day after delivery. On the second day after delivery her headache suddenly worsened, and her blood pressure increased markedly. She became unresponsive.

No brain lesion was found on autopsy.



29

Variable Presentations of Postpartum Angiopathy

18 patients (mean age, 31 years; range, 15–41)

- Median gestation - 38 weeks.
- 12 (67%) - prior uneventful pregnancy
- Coagulopathy (n=6, 33%) protein S deficiency, antiphospholipid antibody syndrome, essential thrombocytosis, elevated INR, acute hepatic failure.
- Migraine headaches (n=5, 25%)
- Gestational hypertension (n=2, 11%)
- Vasoconstrictive medications (n=7, 39%).
- Neurological symptoms (began on median day 5 postpartum)
  - **headache (n=16, 89%)**
  - focal deficit (n=9, 50%)
  - visual disturbance (n=8, 44%)
  - encephalopathy (n=6, 33%)
  - seizure (n=5, 28%)

Abnormal brain (MRI/CT) imaging (n=13, 72%)

- intracranial hemorrhage (n=7, 39%)
- vasogenic edema (n=6, 35%)
- infarction (n=6, 35%)

Clinical outcomes

- full recovery seen in 9 (50%),
- death after a fulminant course in 4 (22%)
- residual deficits in 5 (28%)

Fugate et al. *Stroke. 2012; 43: 670-676*

30

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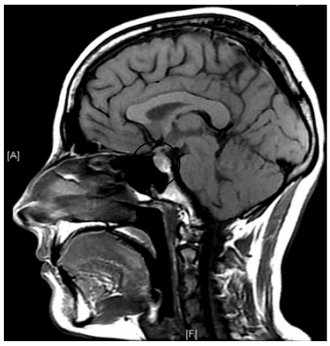
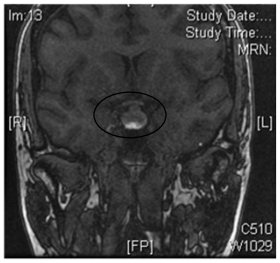
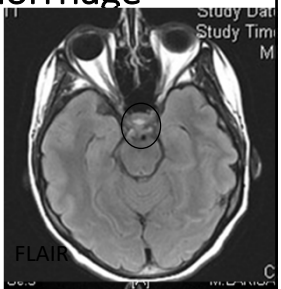
    - Ischemic stroke: arterial dissection, acute arterial infarction
  - **Pituitary Expansion: adenoma, hemorrhage, lymphocytic hypophysitis**
  - Mass Lesion Expansion: tumor, AVM, aneurysm

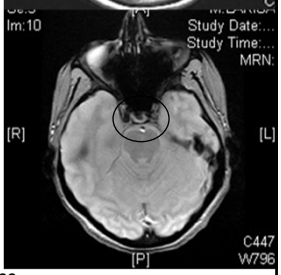
31

Headache due to Pituitary Hemorrhage









33-year-old woman, 31 weeks pregnant, developed headaches whenever she bent over, lowered her head, sneezed or coughed starting a couple weeks prior to imaging. She denied nausea, vomiting, sensitivity to light or sound. She denied visual changes.

Pituitary Apoplexy

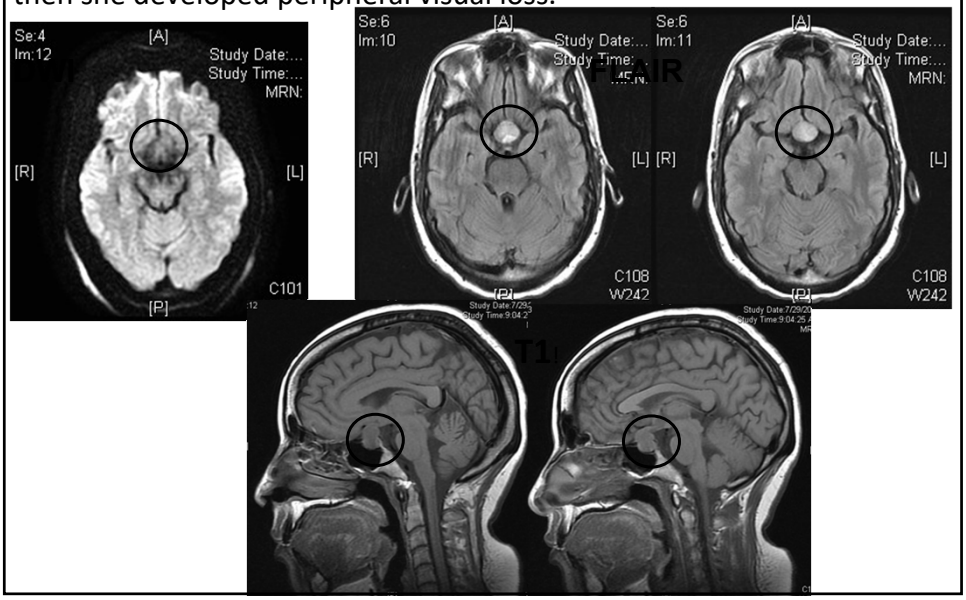
Sxs: headache, VF deficit, ophthalmoplegia, decreased consciousness, pituitary dysfunction

Causes: pregnancy, tumor, XRT, head trauma, blood pressure alterations, cardiac surgery, anticoagulation, dopamine agonists

32

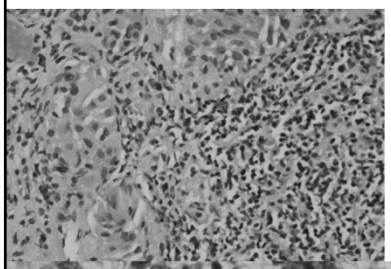
Headache and vision loss in a pregnant woman

A 34 yr. old woman, 32 weeks pregnant, had 3 weeks of headaches, then she developed peripheral visual loss.

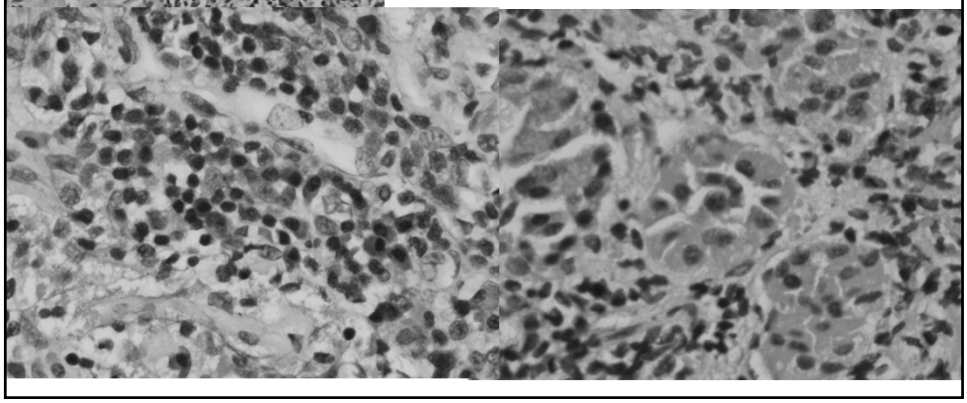


33

Headache and vision loss in a 34-year-old pregnant woman



She underwent an endoscopic transphenoidal biopsy.
The pituitary gland was enlarged with a posterior-superior hemorrhagic necrotic cyst.
No evidence of adenoma was noted on the frozen specimens.
The hypertrophic, normal gland was left intact.
The dura was repaired; a fat autograft was placed in the pituitary cavity defect.



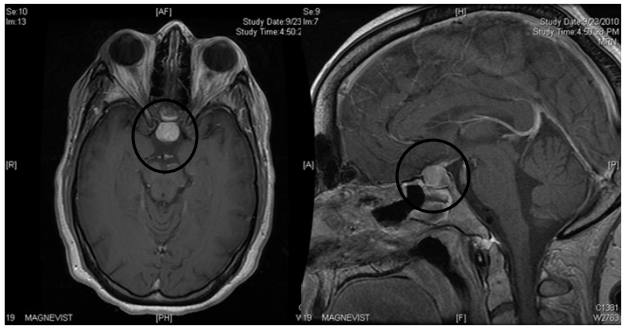
34

Classification of hypophysitis

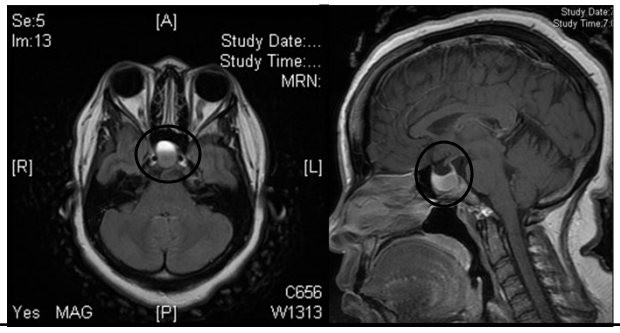
- Primary
  - Lymphocytic hypophysitis
    - Autoimmune disease of the anterior > posterior pituitary
    - Most common in peri-partum women
    - Can occur in non-pregnant women, men
    - Presents with headache, loss of vision, endocrine dysfunction
    - Dxs to consider: pituitary adenoma, pituitary apoplexy, meningioma, infectious or inflammatory processes
    - Anti-pituitary antibodies (APAs) not a diagnostic tool for LYH.
  - Granulomatous hypophysitis
  - Xanthomatous hypophysitis
- Secondary
  - Systemic Disease: Takayasu's disease,Crohn's disease, Langerhans cell histiocytosis, Sarcoidosis, Inflammatory pseudotumor
  - Infective: Bacterial, Viral, Fungal

35

Lymphocytic Hypophysitis
homogeneous enhancement, dural tail



Pituitary Macroadenoma
focal enhancement



36

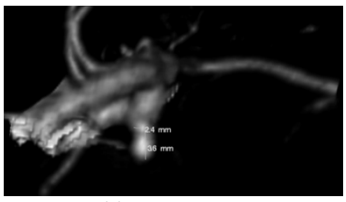
Headaches Associated with Pregnancy

- **Primary Headaches:**
  - Migraine with or without aura
  - Tension-type headaches
- **Secondary Headaches caused by:**
  - Anesthetic Complications: PDPH, pneumocephalus, subdural hematoma, CVT
  - Cerebrovascular Disease:
    - Hypertensive disorders: pre-eclampsia, eclampsia, HELLP, PRES
    - RCVS / postpartum cerebral angiopathy
    - CVT with increased intracranial pressure, venous infarction
    - Intracranial hemorrhage: subdural hematoma, IPH, SAH
    - Ischemic stroke: arterial dissection, acute arterial infarction
  - Pituitary Expansion: adenoma, hemorrhage, lymphocytic hypophysitis
  - **Mass Lesion Expansion: tumor, AVM, aneurysm**

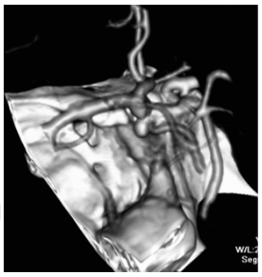
37

Expansion of Mass Lesion in Pregnancy

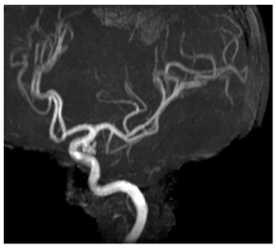
Cerebral Aneurysm



40 yrs old

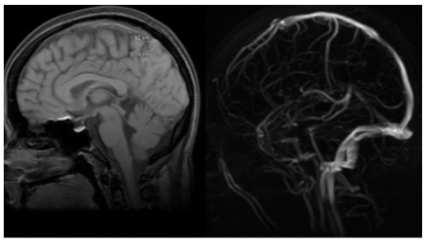


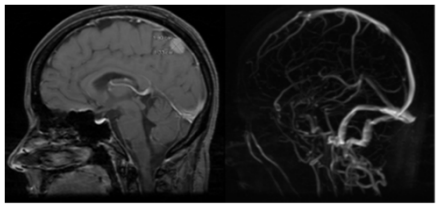
42 yrs old



44 yrs old: 31 weeks pregnant

Meningioma 9 weeks delivery





38

Headache & Stroke in Pregnancy

- Headache is an important premonitory symptom for emergencies, and especially cerebrovascular disease, in pregnancy.
- The stroke risk is increasing with older pregnant women and women with migraines.
- The majority of strokes and pathological headaches occur in the peri & post-partum periods.
- IPH & CVT are more common than ischemic stroke.
- Pre-eclampsia, eclampsia, HELLP, post-partum cerebral angiopathy/RCVS may be on a continuum, presenting with headache.
- Pre-eclampsia, eclampsia, HELLP, post-partum cerebral angiopathy/RCVS can lead to fatal IPH or infarcts.
- Monitoring blood pressure for weeks after delivery is crucial.
- Hypertensive disorders of pregnancy increase the risk of future ischemic stroke.

39