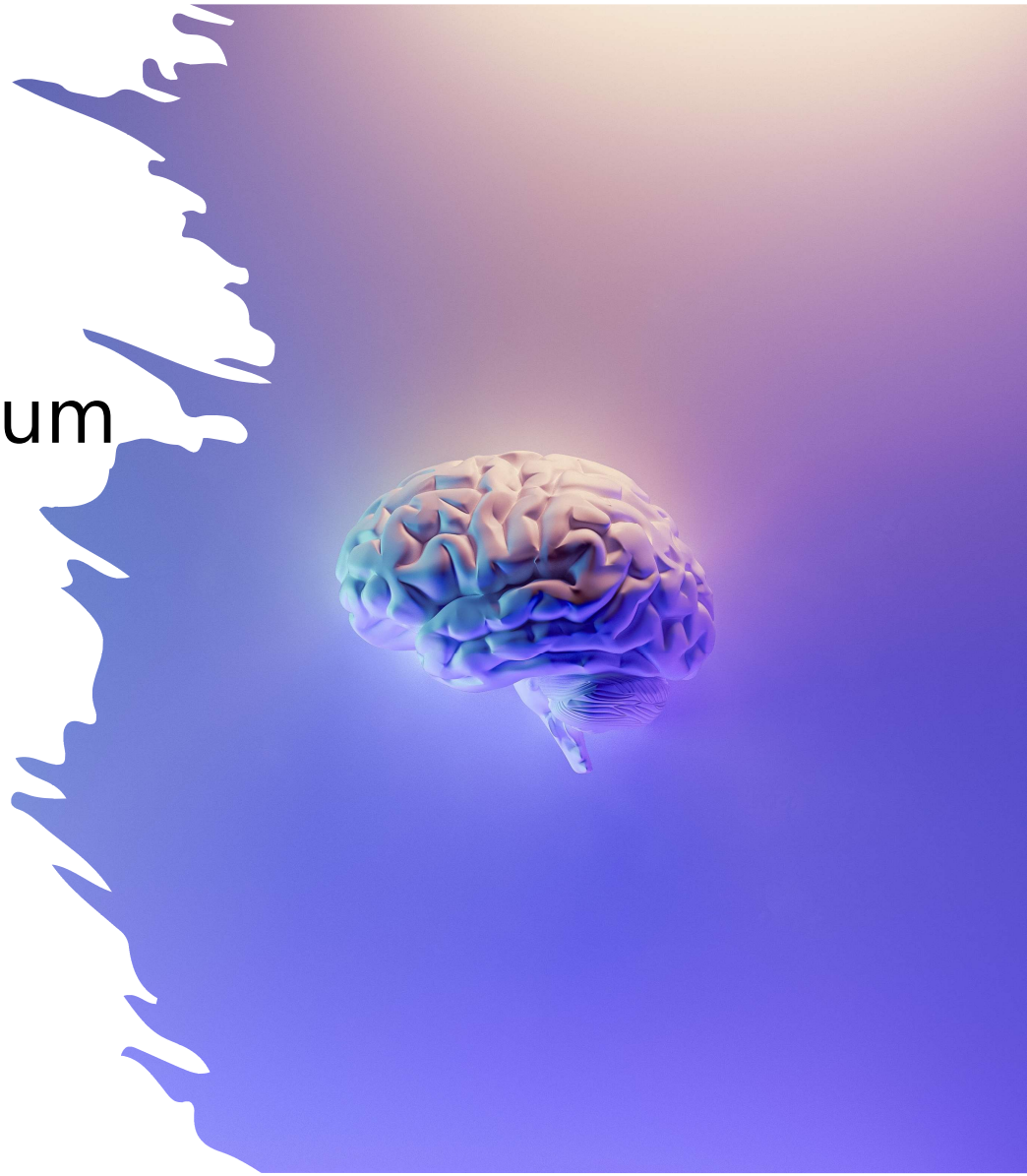
Neurological Emergencies in Antenatal and Post-partum Period



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Epilepsy/seizure disorders
Myasthenia gravis
Multiple sclerosis
Preeclampsia/Eclampsia
PRES
RCVS
CVST
Acute ischemic stroke
Acute hemorrhagic stroke

Basics

Don't get anchored

[ ] Preeclampsia, eclampsia, and RCVS overlap with PRES
[ ] 8-39% pts. with RCVS have PRES as well! (PMID: 27741996)
[ ] Stroke causes 1 out of 7 maternal deaths: Don't delay imaging

Labs: Be thorough, and capture all differentials

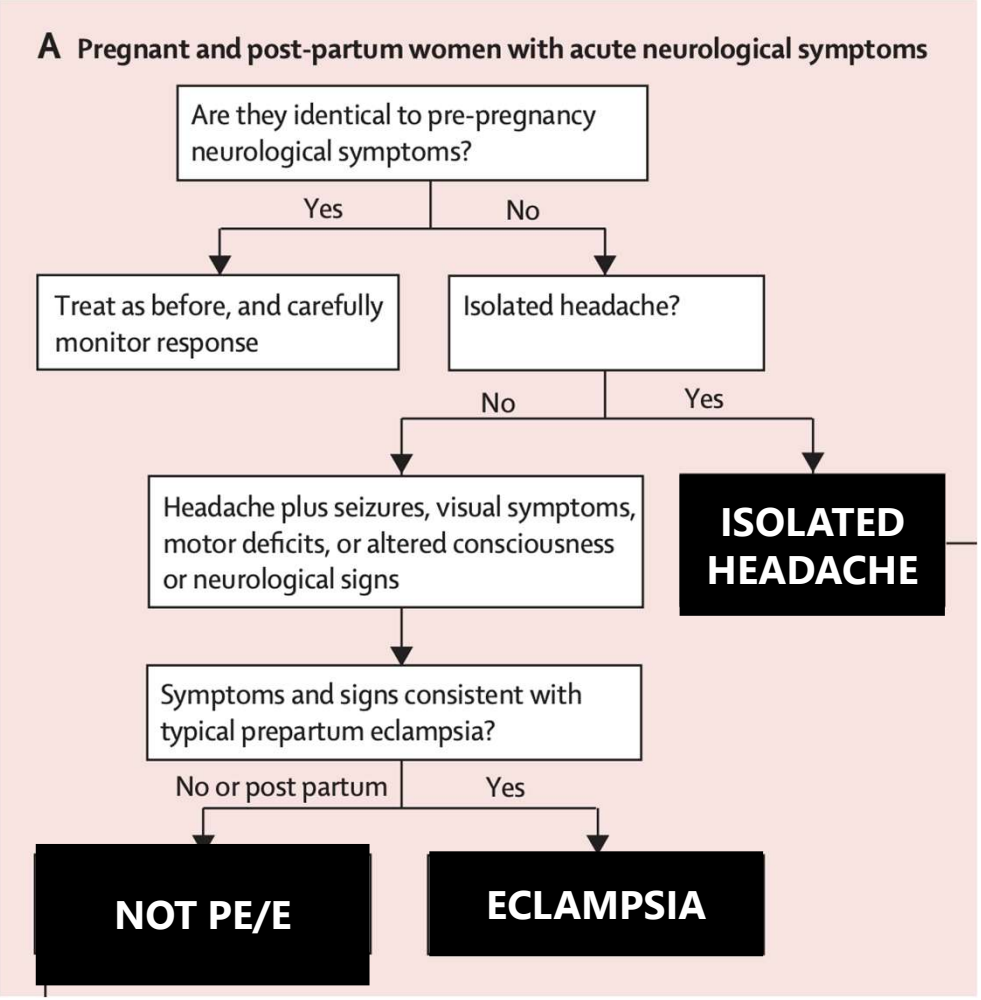
[ ] CBC, CMP, LFTs, ammonia, LDH, haptoglobin
[ ] Ur. Pr/Cr, UA
[ ] Septic work-up

Neuroimaging: DO NOT DELAY IMAGING IN NEURO EMERGENCIES!

[ ] CT: Very low fetal exposure, IV contrast safe 9[Ref 1,2,3]
    * Moving away from abdominal shielding (PMID 34177249)
[ ] MRI: Can take time, but better imaging
    * Gadolinium risk to fetus unclear, avoid in pregnancy. Safe when breastfeeding (PMID 34177249, 30470268)
[ ] Non-contrast MRV should be routinely ordered, to r/o CVST (cerebral venous sinus thrombosis).

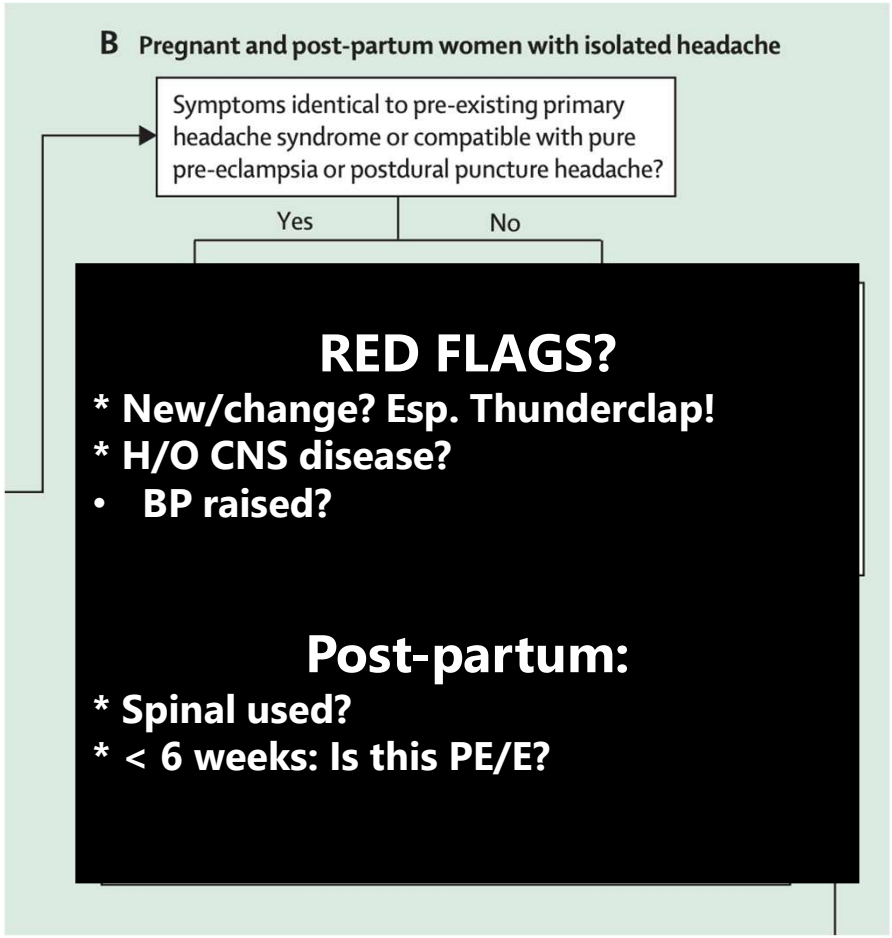
PMID 27741996: Diagnosis of neurological emergencies in pregnant/postpartum women (2016)
Ref 1-4: 33896537, 27741996, 34177249

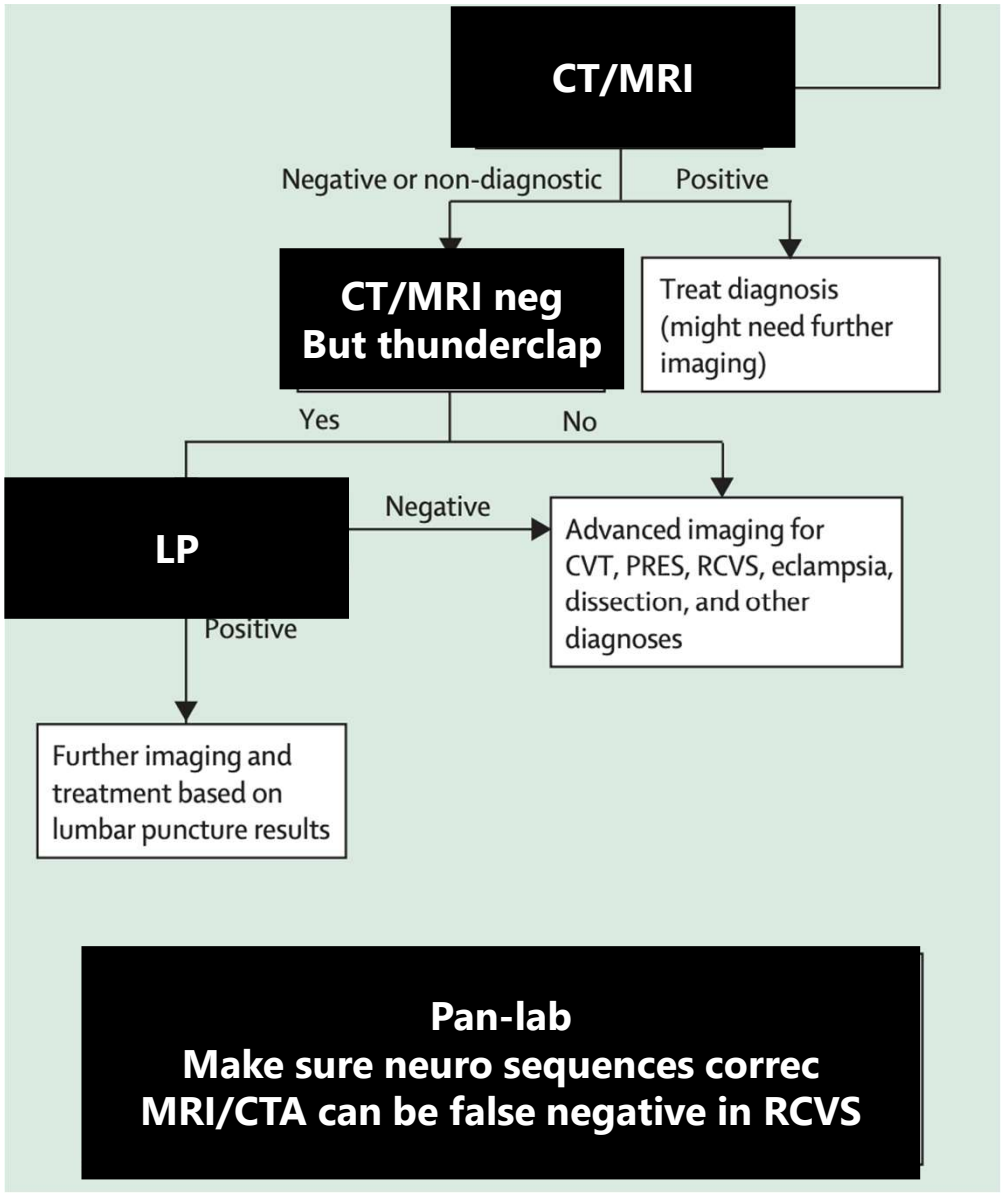
Approach



Reference: 23332362

Approach





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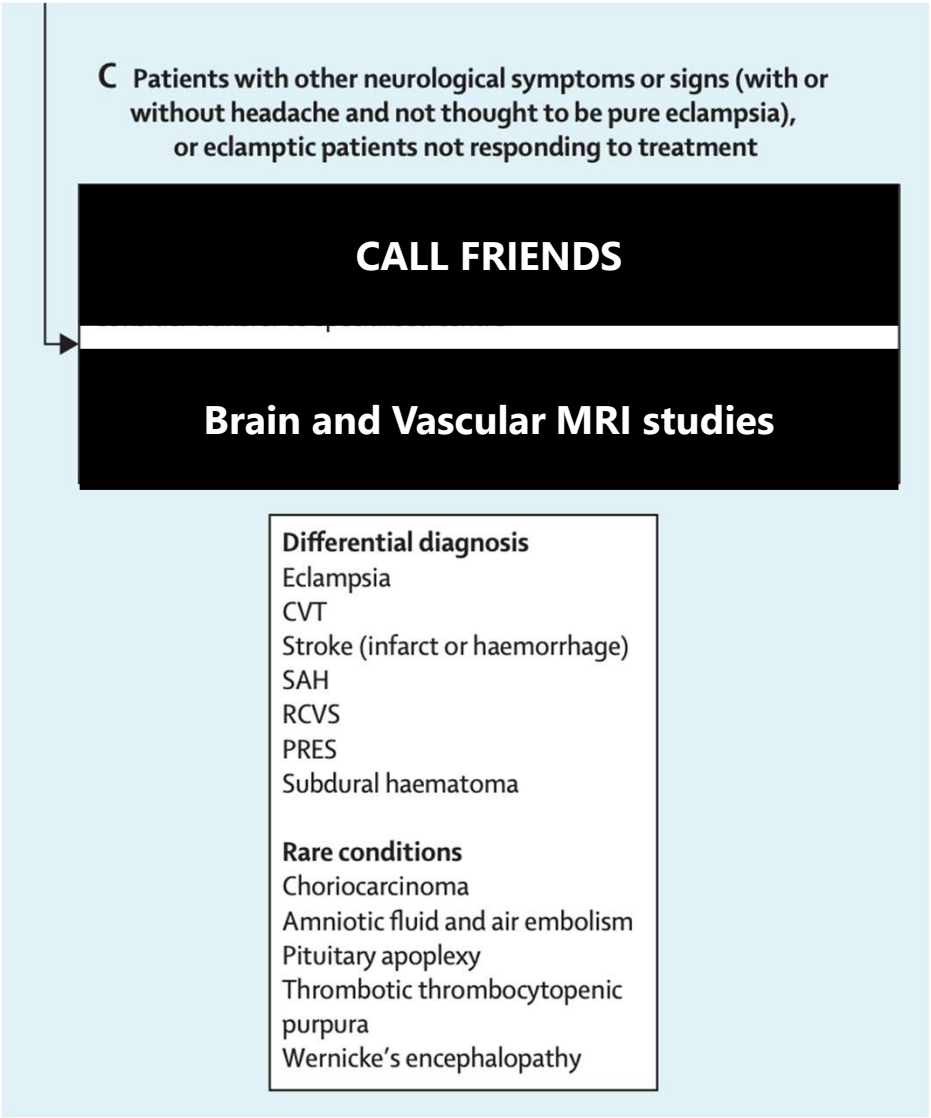


Reference: 23332362

Epilepsy / seizure disorder

0.3-0.6% of pregnant women have epilepsy.
Best outcomes if seizure free for at least 9-12 months before pregnancy.

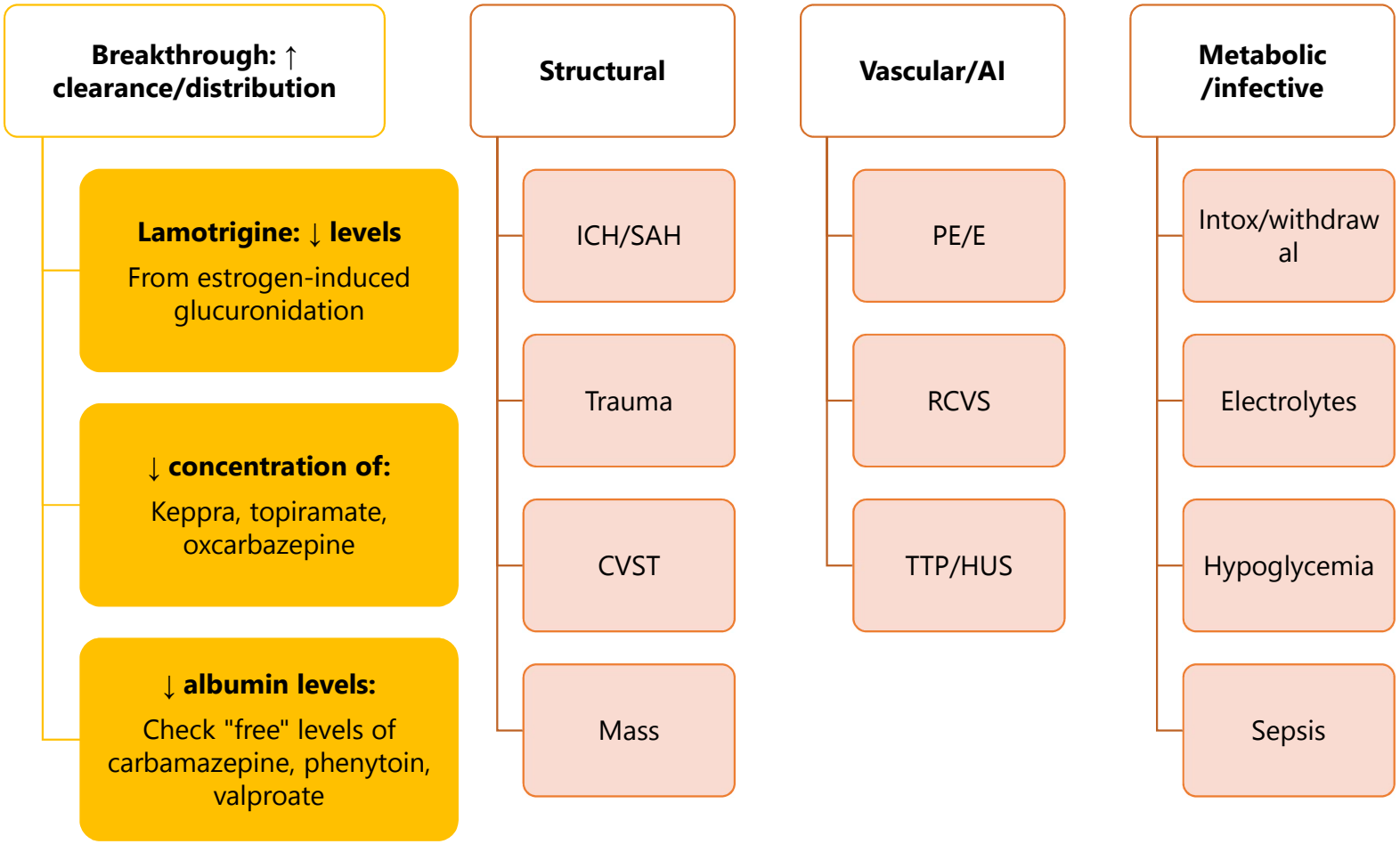
Maternal:

* ↑ BP, CO, IAP
* ↑ blood flow to muscles/brain → ↓ flow to uterus
* Risk of seizures during labor 9x higher vs. rest of pregnancy

Fetal:

* Fetal mortality 1.2 – 3x higher
* Still birth, perinatal death, prematurity
* ICH
* Hemorrhagic disease of the newborn

Epilepsy / seizure disorder



Epilepsy / seizure disorder

If suspecting/unclear Eclampsia: **Magnesium Sulfate 4-6 g loading dose IV over 20-30 minutes, followed by 1-2 g/hour IV. OK to give additional 2-4 g of Magnesium Sulfate over 5 minutes.**

* Benzodiazepine 1st line: **Ativan** 0.1 mg/kg IV or **Versed** 10 mg IM or 1-2 mg IV.

Can repeat either dose after 5-10 minutes if seizure continues.

* Other options: **Phenytoin** 1,250 mg IV at a rate of 50 mg/minute
* **Keppra (levetiracetam)**

Refractory status:

* Propofol (with assistance from Anesthesia). At this point, the patient is intubated.
* Versed: If propofol can't be used
  - [ ] Severe hypotension/shock
  - [ ] Hypertriglyceridemia/pancreatitis.

PMID 33896537: Neurological emergencies during pregnancy

Epilepsy / seizure disorder

ANTENATAL

- Folic acid 0.4 mg 3 months prior to conception.
- Ideally, should be seizure free for 9-12 months.
- Teratogenic risk vs. benefits of AEDs. Most concerning with valproic acid– neural tube defects.
- Fetal anatomical survey.
- Therapeutic level monitoring.
- Avoid sleep deprivation, drugs, EtOH, etc

PERINATAL

* A-B-C
* Left lateral positioning
* IV Ativan 2 mg Q 5 mins
  (or alternate)
* Check FSGLU, electrolytes, WBC

STATUS Epilepticus:

* Keppra load + Magnesium
* Propofol gtt
* Stabilize patient. Consider delivery (get OB/MFM)

Myasthenia Gravis

Avoid pregnancy for at least 2 years post diagnosis: ↑ mortality
Most likely exacerbation: 1st trimester or immdediately post-partum

Maternal:

* Respiratory failure: Risk of intubation however, only 0.1-0.2%[1]
* Immobility and related risks
* **No good evidence that it effects pregnancy outcomes**

Fetal:

* Transient fetal MG: 10-20% cases
  - [ ] 2 – 4 days after birth
  - [ ] Resp distress, muscular weakness, feeble cry, poor sucking, ptosis

Ref 1: 35133311

Myasthenia Gravis

* Involve neurology: **Cholinesterase inhibitors +/- systemic steroids**
    - [ ] **Steroids[1]:** Can exacerbate at higher dose.
    - [ ] **Pyridostigmine[2]:** Safe. Need higher doses (↑ renal clearance)
    - [ ] **IVIG/PLEX[3]:** Reserve for crisis. IVIG maybe preferred as PLEX can cause
* **Monitor FVC** Q 4-8 hrs. Normal 60 ml/kg
    - [ ] Concerning < 30 ml/kg: ICU monitoring
    - [ ] Very concerning < 15 ml/kg: Risk of intubation

* **NIF not useful** in patients with known NMD (PMID: 21748507, 30743297)

* **Vaginal delivery recommended**:
    - [ ] Assistance in 2nd stage as striated muscles involved
    - [ ] CS for OB indications only

Ref 1: 30730343 Ref 2: 34177249 Ref 3: 26600443

Myasthenia Gravis

Reference the 2020 consensus guidance for drugs to avoid

International Consensus Guidance for Management of Myasthenia Gravis

2020 Update

Pushpa Narayanaswami, MBBS, DM, Donald B. Sanders, MD, Gil Wolfe, MD, Michael Benatar, MD, Gabriel Cea, MD, Amelia Evoli, MD, Nils Erik Gilhus, MD, Isabel Illa, MD, Nancy L. Kuntz, MD, Janice Massey, MD, Arthur Melms, MD, Hiroyuki Murai, MD, Michael Nicolle, MD, Jacqueline Palace, MD, David Richman, MD, and Jan Verschuuren, MD

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Neurology® 2021;96:114-122. doi:10.1212/WNL.0000000000011124

Reference: 33144515

Myasthenia Gravis: WATCH THE DRUGS

Antibiotics/ID agents	CVS	Other common agents
Chloroquine/HCQS: Use only if necessary	BB: Potentially dangerous Be very careful, even with ophthalmic formulations	IV Mag: Only if absolutely necessary. Infuse slowly
Quinine: Prohibited, except rarely in malaria	Class Ia agents: Procainamide	Steroids: Transiently worsen MG in 1st 2 weeks
Aminoglycosides	Statins	Botulinum tox: AVOID
Fluoroquinolones		D-penicillamine: Strongly AVOID Deferoxamine
Macrolides		Iodinated contrast agents: Modern better, watch closely
		Sux: May not work → reduced AcH receptor density in muscles

Reference: 33144515


No good data on exacerbating MG: Theoretical risk
MYASTHENIA
Frontline Rx for PE/E Preeclampsia leading cause of maternal mortality
Pre ECLAMPSIA
Magnesium Throwdown

Myasthenia Gravis vs. Pre-eclampsia/Eclampsia: Using IV Mag

Use 1 g/hr
as opposed to 2 g/hr

Monitor Mg
Monitor DTRs

Don't use BB
for HTN Rx

MG EXACERBATED / CRISIS

D/C IV $MgSO_4$

Rx w/ IV calcium gluconate
Use Keppra for seizure Rx

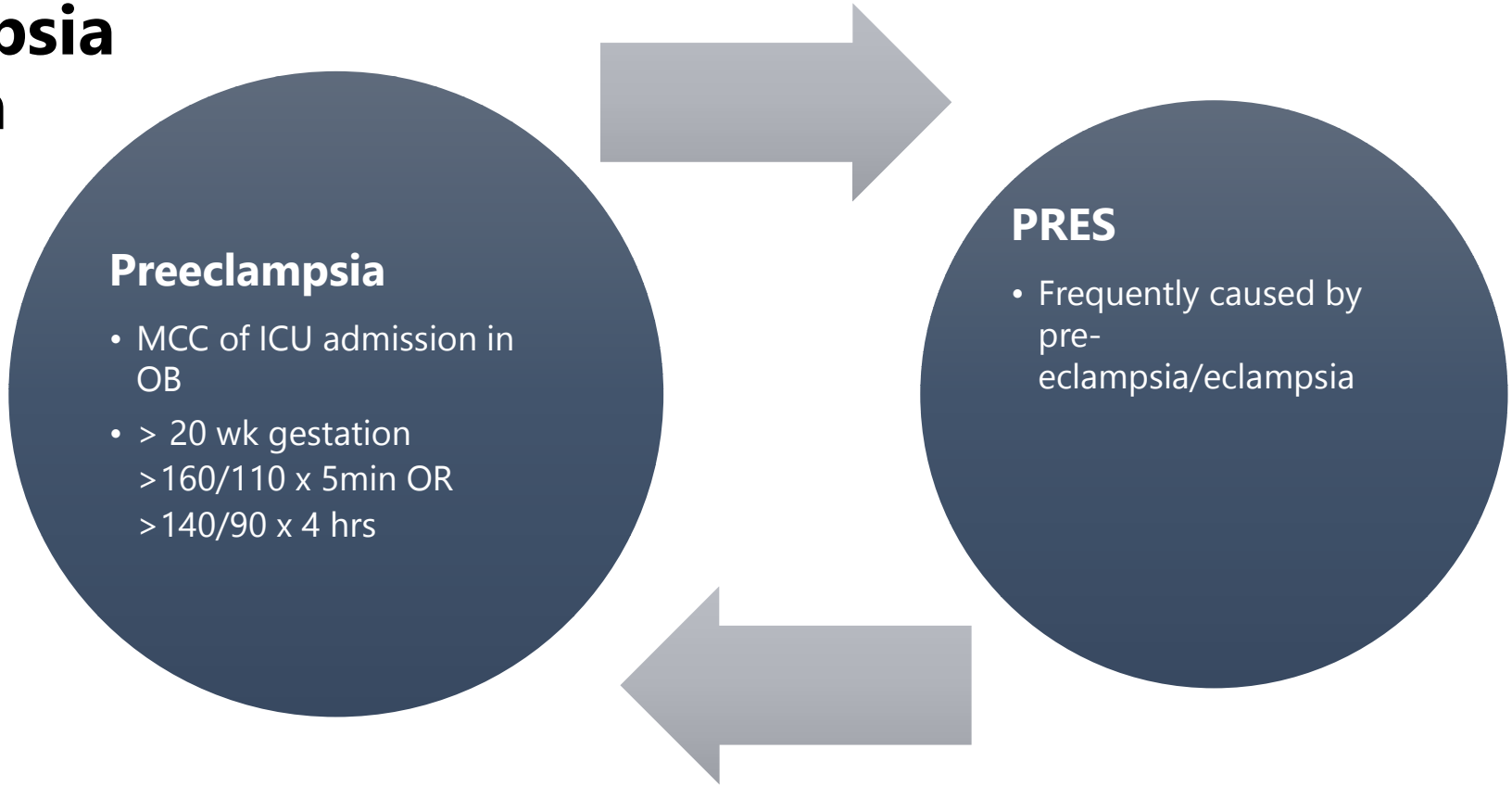
References: 33896537, 30730343

Multiple Sclerosis

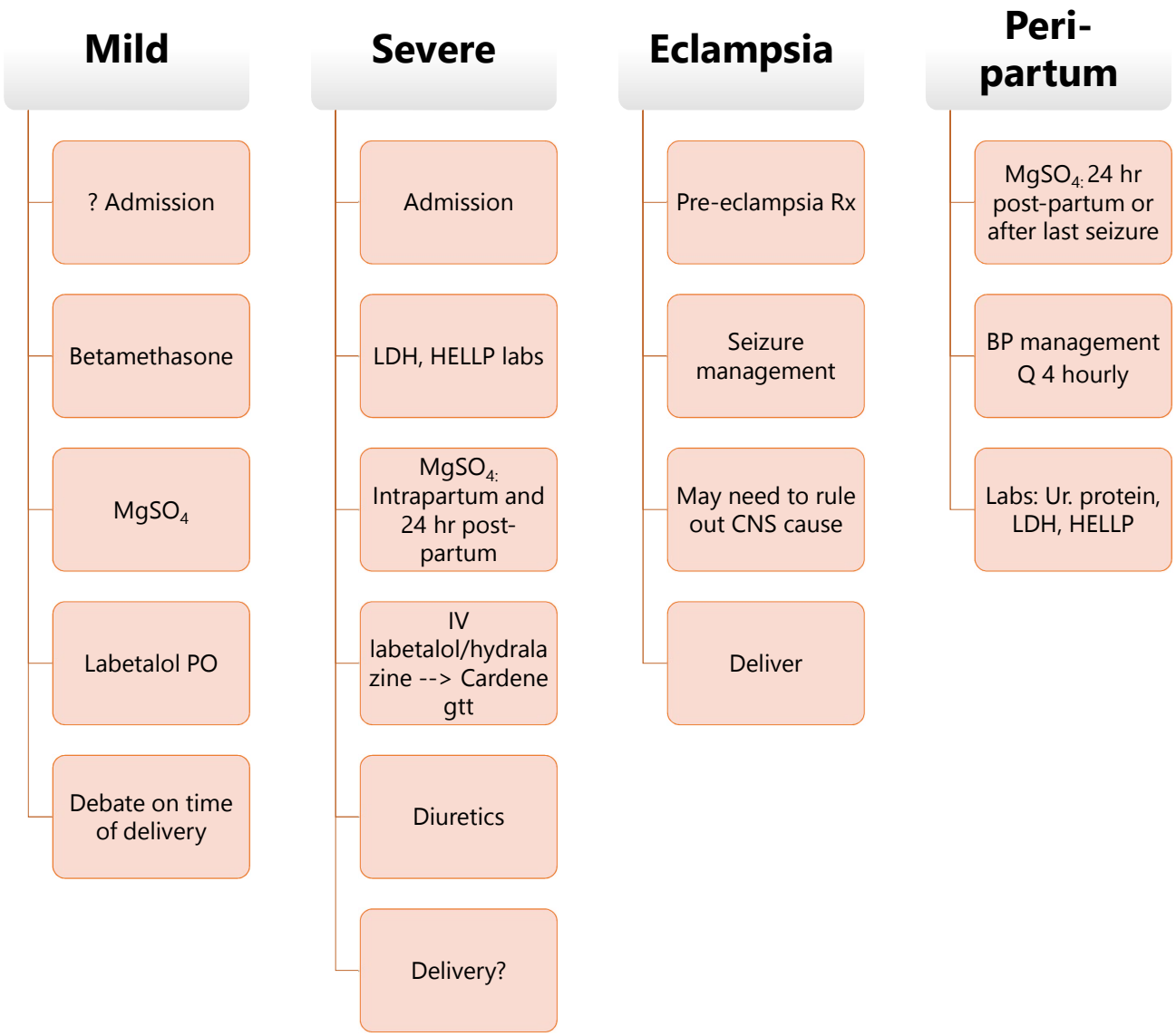
Usually diagnosed b/w 20-50, so likely pregnancy early in disease → Less disability

* Often disease modifying drugs are continued in relapsing-remitting
* Pregnancy is “protective” BUT risk of relapse in $1^{st}/2^{nd}$ trimesters
* If relapse: Treat as you would normally

Preeclampsia
Eclampsia



Preeclampsia Eclampsia



PRES: Posterior Reversible Encephalopathy Syndrome

* Uncontrolled HTN + white matter edema + reversible w/ early Rx

* MRI:
  - [ ] Hypointense T1 and hyperintense T2
  - [ ] Symmetric posterior cerebrum (can be unilateral)

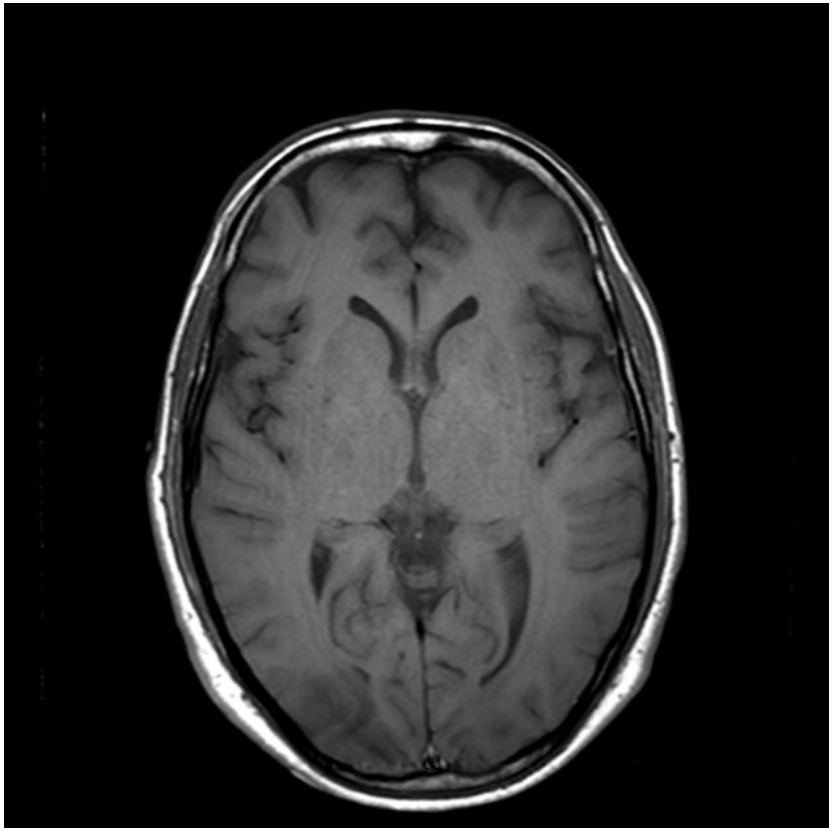
* Causative theory: Dysregulation in cerebral autoregulation

* Prognosis:
  - [ ] Resolution typically in days – several weeks
  - [ ] More edema → usually worse prognosis
  - [ ] Brainstem involvement → worse prognosis

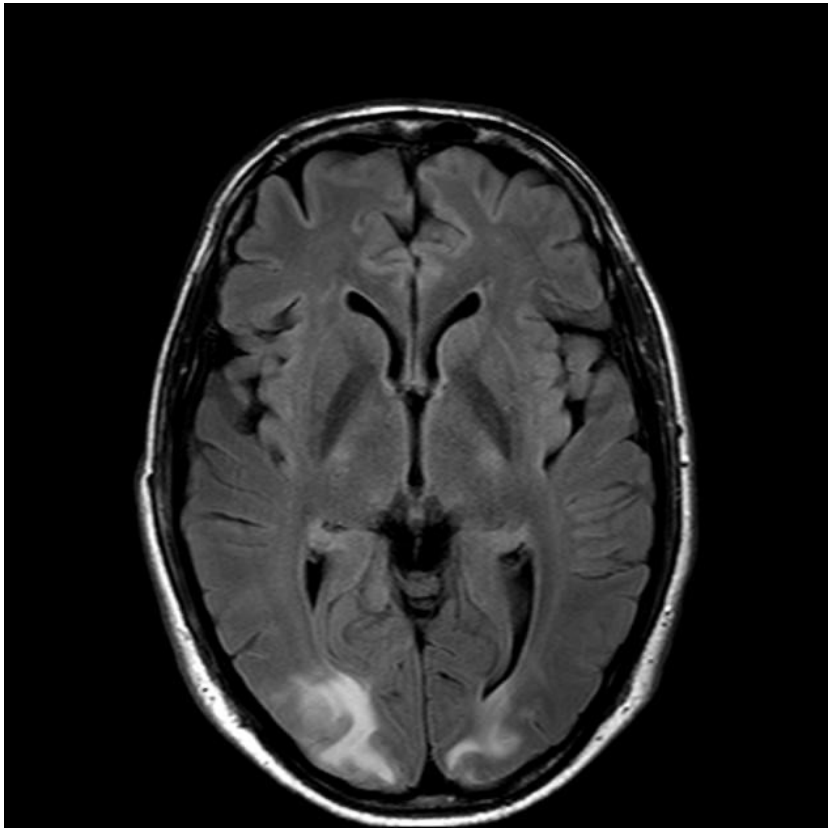
* Rx: Rx BP aggressively: Goal SBP 130 – 150 mmHg
  - [ ] Do not reduce drastically: 10-20 mmHg over 20 – 30 mins

PMID 28003872: A reversible posterior leukoencephalopathy syndrome caused by preeclampsia

PRES: Posterior Reversible Encephalopathy Syndrome



Axial T1 MRI



T2 FLAIR MRI

Image source: Radiopedia

RCVS: Reversible Cerebral Vasoconstriction Syndromes

Various entities:

* Idiopathic thunderclap headache w/ vasospasm
* Benign angiopathy of CNS
* Migrainous vasospasm
* Call-Fleming Syndrome
* Drug-induced vasospasm
* Vasculitis related angiitis

Lot of overlap with other diseases: preeclampsia, CVA, etc. Unclear if distinct disease or different expression of same process

Smooth narrowing of multiple segments of intracranial arteries on CT/MRI

[ ] Angiography may look normal early in course

No evidence that any particular Rx works. Usually self-limiting
Try to treat underlying/associated disease: Eg. Vasculitis, migraine, SAH, etc
May try magnesium or CCB

CVST: Cerebral Venous Sinus Thrombosis

* Usually rare. Cause of stroke in 2% of pregnancy-related strokes
* Other RFs: Underlying thrombophilias, HTN, CS, infections

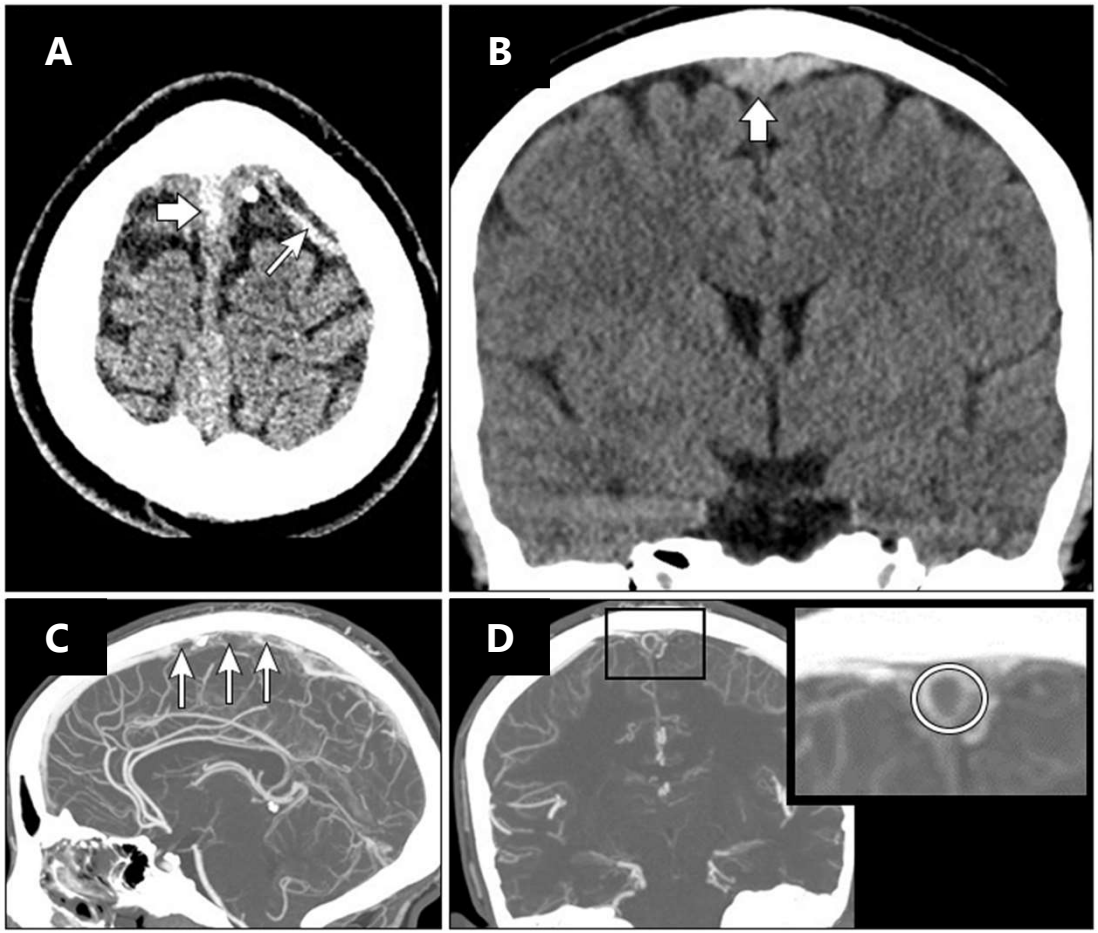
* 3rd trim to post-partum

* Headache, N/V, blurred vision → seizure (focal/gen) → CVA symptoms
* Headache usually precedes other symptoms
* Severity of symptoms related to clot burden

* Isolated IC HTN Syndrome:
  - [ ] Headache + papilledema/visual symptoms
  - [ ] Common presentation

* CTH → MRI w/ MRV (most sensitive)

CVST: Cerebral Venous Sinus Thrombosis



<u>Direct "signs" on CTH:</u>

A: Big arrow →Dense superior sagittal sinus +

Cord sign: Small arrow → Dense superficial cortical vein

B: Dense triangle sign on CT

C: Dense clots in superior sagittal sinus on CTV

D: Empty Delta Sign on CTV

Imaging credit: Up To Date

CVST: Cerebral Venous Sinus Thrombosis

* Rx: Anticoagulation (with OR without hemorrhagic transformation): Heparin or LMWH

* AHA/ASA recs on duration:
    [ ] LMWH in Rx doses through the pregnancy
    [ ] LMWH or warfarin (INR 2-3) for at least 6 months
    [ ] Total duration at least 6 months

* May need seizure and ICP management (Coming up!)

Acute ischemic stroke

Causes in pregnancy:

* Cardioembolic
* Cervical artery dissection
* CVST
* Paradoxical emboli / DVT
* APLA: Catastrophic

* Amniotic fluid embolism
* Choriocarcinoma w/ mets

* PE/E
* RCVS

Management:

* Overall, similar to non-pregnant patient.
* Activate stroke team

Investigations:

* Always look for Preeclampsia/eclampsia
* Echo w/ bubble: PP cardiomyopathy/shunt
* Imaging for CAD/CSVT

Rx:

- Pregnancy is a relative C/I to thrombolysis. Benefits treatment in the setting of moderate/severe stroke should be weighed against risks of uterine bleeding . Limited data[1]
r
- Endovascular therapy for LVO[2]

* ASA category B: Use as usual[3]

Ref 1: 33896537 Ref 2: 33896537 Ref 3: 34177249

ICH

Causes in pregnancy:

* Eclampsia +/- PRES/RCVS
* CVST

* SAH:
[ ] Basal: Suggests underlying aneurysm: Can expand/rupture[1]
[ ] Convexity: Suggests RCVS/CVST[2]

* AVMs
* Cerebral cavernous malformations (CCM)

Management:

* Overall, similar to non-pregnant pt
* Activate stroke team

Investigations:
* Don't hesitate to get CTs
* Don't hesitate to give IV CT contrast

Rx:
* Neuro IR interventions depending on cause
* ICM management/monitoring
* Post intervention antiplatelets per NSx

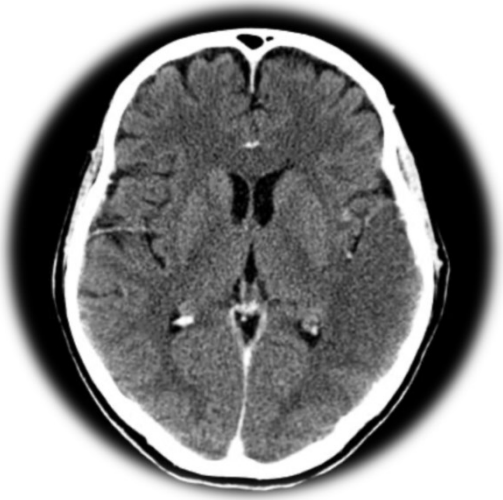
Ref 1: 33896537 Ref 2: 27741996

ICP in pregnancy

What's different in pregnancy?

* Young brain → No atrophy
* ↑ risk of edema/herniation
* Labor can ↑ ICP to 70 CMW

* Baseline respiratory alkalosis



Management:

* **Osmotic agents: Severe risks**
  [ ] Mannitol[1]: ↓ uterine and AF volume → Fetal hypoxia and acid-base issues
  [ ] Hypertonic[2]: Not studied, known 1st trimester abortifacient
  [ ] Use agents only if ABSOLUTELY NEEDED as bridge to decompression!

* Consider **early decompression**[2]

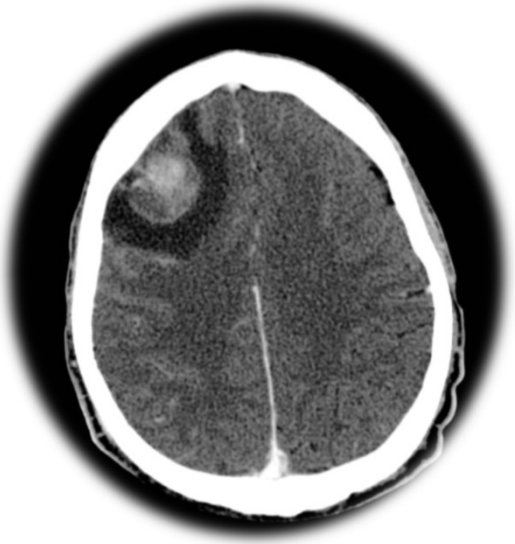
* **PaCO2** 30 – 32 mmHg regardless of ICP in ventilated patients[3]

* Consider **operative delivery.**

Ref 1: 33896537 Ref 2: 34177249 Ref 3: 32736751 Ref 4: 32736751

Metastatic Choriocarcinoma

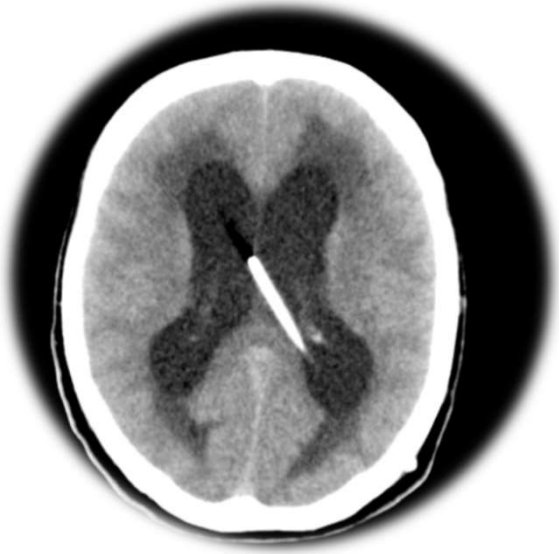
* Mets common to lungs/brain
* Brain mets invade blood vessels → hemorrhage → edema
* Very sensitive to chemo
* High cure rates even with mets!



Case courtesy of Frank Gaillard, Radiopaedia.org, rID: 12586
Reference: 33896537

Malfunctioning VP shunts

* Upto 50% shunts malfunction in pregnancy
* Esp in 3rd trimester
* P/W ↑ ICP: Headache, N/V → obtundation
  Don't miss abducens nerve palsy
* CT/MRI: worsening hydrocephalus



Case courtesy of Ian Bickle, Radiopaedia.org, rID: 55488
Reference: 32726751

Questions