AMSER Case of the Month: June 2020

20-year-old female with confusion, headache, nausea, and vomiting

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Patient Presentation

- A 20-year-old female presented to the emergency department complaining of holocephalic headache, neck pain, confusion, dizziness, nausea, and vomiting.
- Per the patient's mother, she had experienced worsening frontal headache and nausea for 3 days, progressing to severe head and neck pain, confusion, and vomiting. At this point, she was taken to the ED.
- PMHx: s/p C-section 2 months prior for preeclampsia, migraines, depression
- Med: Norelgestromin-ethinyl estradiol transdermal contraceptive patch, Escitalopram
- SHx: Weekly alcohol use, non-smoker, no illicit drugs
- FHx: Negative for CVA/TIAs, cerebral aneurysms, or coagulopathies

Physical Exam and Pertinent Labs

- Vitals: BP 164/101; HR 64; RR 17; T 98.8; SPO_2 100%; BMI 39 kg/m^2
- Notable physical exam findings: (Patient's mental status precluded a full exam)
  - Obtunded with confusion
  - Neurological exam revealed no focal deficits, cranial nerves were grossly intact
  - Neck was supple with no meningismus
  - Fundoscopy was not possible
  - Heart: RRR; Chest: Clear to auscultation; Abdomen was non-tender
- Notable lab results:
  - PT/INR: 9.9/0.9
  - aPTT: 30.6
  - WBC: 13.4 [Elevated]
  - BUN/Cr: 9/0.86; No proteinuria

What Imaging Should We Order?

Select the applicable ACR Appropriateness Criteria

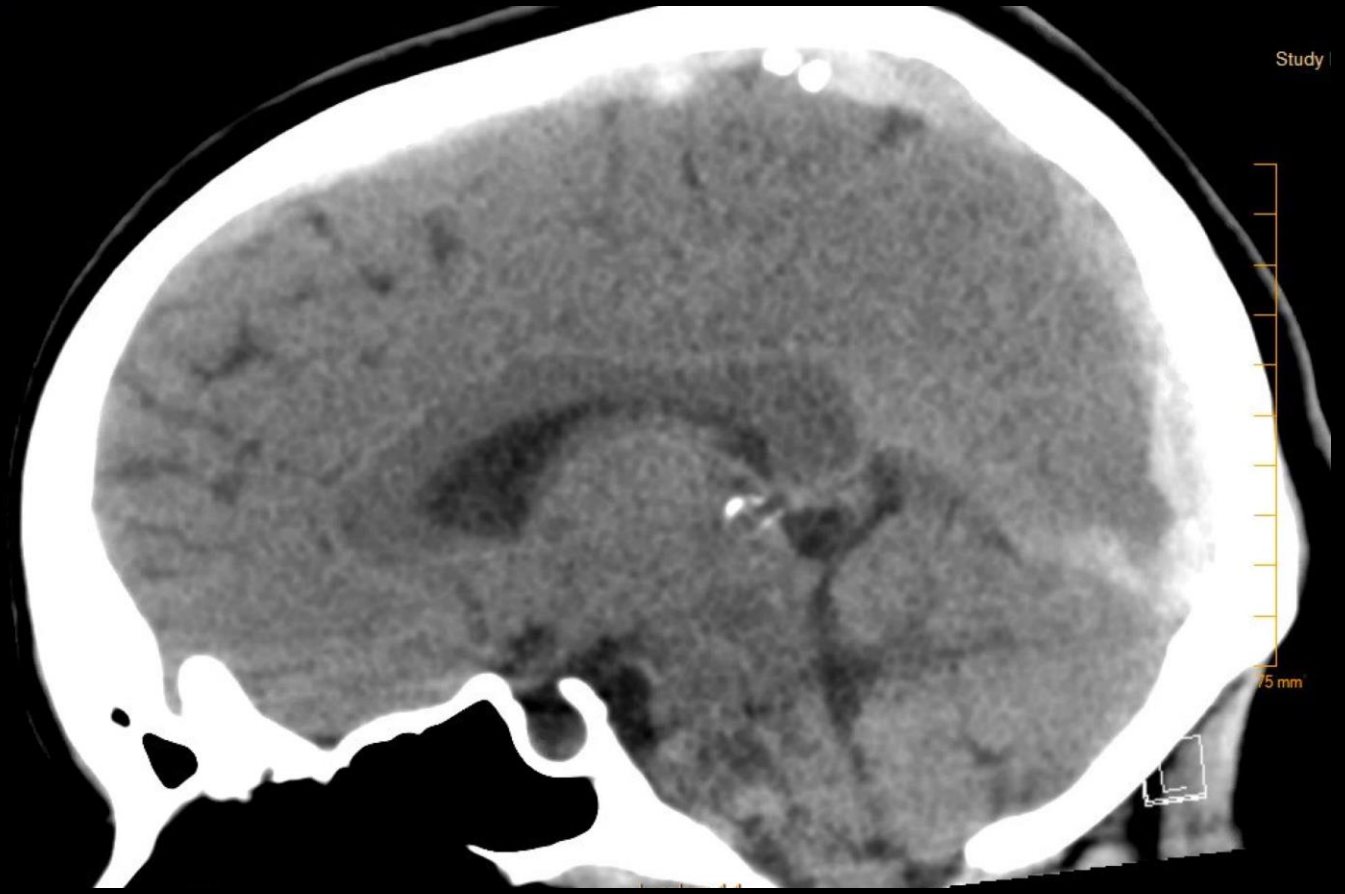
American College of Radiology
ACR Appropriateness Criteria®
Acute Mental Status Change, Delirium, and New Onset Psychosis

Variant 1: **Acute mental status change. Increased risk for intracranial bleeding (ie, anticoagulant use, coagulopathy), hypertensive emergency, or clinical suspicion for intracranial infection, mass, or elevated intracranial pressure. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☢ ☢ ☢
MRI head without IV contrast	Usually Appropriate	O
MRI head without and with IV contrast	May Be Appropriate	O
CT head without and with IV contrast	May Be Appropriate	☢ ☢ ☢
CT head with IV contrast	Usually Not Appropriate	☢ ☢ ☢

This imaging modality was ordered by the ER physician

Findings (unlabeled)



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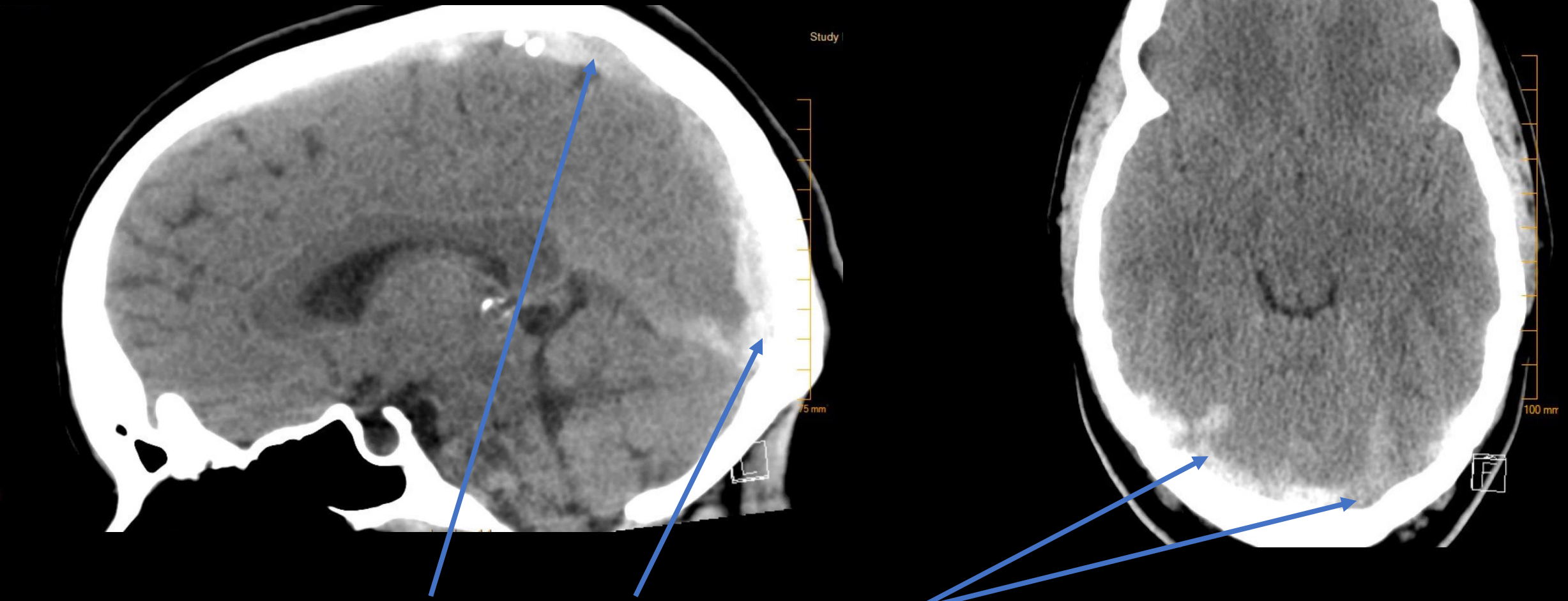
Findings (labeled)



Hyperdensity within the sagittal sinus, torcula, and bilateral transverse sinuses. No hemorrhage or vasogenic edema in the brain. These findings are concerning for dural venous sinus thrombosis. ('Cord sign')

Case Progression

- With suspicion for dural venous sinus thrombosis, neurosurgery and interventional neuroradiology were consulted.
- The interventional neuroradiologist ordered a low dose of IV heparin (25,000 units), and requested that the patient be transferred to a facility with endovascular capabilities.
- The patient was transferred and admitted to the ICU out of concern for increased intracranial pressure, and the need for anticoagulation, intensive blood pressure control, and further workup.

What Imaging Should We Order?

Select the applicable ACR Appropriateness Criteria

American College of Radiology
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Cerebrovascular Disease

Variant 15: **Suspected dural venous sinus thrombosis.**

Radiologic Procedure	Rating	Comments	RRL*
MR venography head without and with IV contrast	9	Parenchymal imaging and vascular brain imaging with CT or MR should be considered. With contrast is preferred over MRV without contrast.	O
MR venography head without IV contrast	8	Parenchymal imaging and vascular brain imaging with CT or MR should be considered. Can be useful in the patient with a contraindication to contrast.	O
CT venography head with IV contrast	8	CTV can be obtained while the patient is still on the CT scan table after NCCT and can be obtained rapidly in the emergent setting. Postcontrast image timing can be optimized for evaluation of the intracranial venous structures.	☢☢☢
MR venography head and neck without and with IV contrast	8	Can be obtained in conjunction with MRI head. MRV without and with contrast is superior to MRV without contrast due to problems noncontrast MRV has with slow and turbulent flow. Neck MRV can be useful to evaluate involvement of the neck vessels.	O
CT head without and with IV contrast	7	Can be useful if there is contraindication to MRI. Head CTV with contrast provides superior evaluation of the intracranial venous structures.	☢☢☢
CT head without IV contrast	7	Useful in initial evaluation of symptoms and in follow-up.	☢☢☢
MRI head without and with IV contrast	7	Useful to evaluate for complications of CVT including infarct and hemorrhage; to visualize thrombus; to determine the age of infarct; and to evaluate for other pathologies.	O

This imaging modality was ordered by the interventional neuroradiologist

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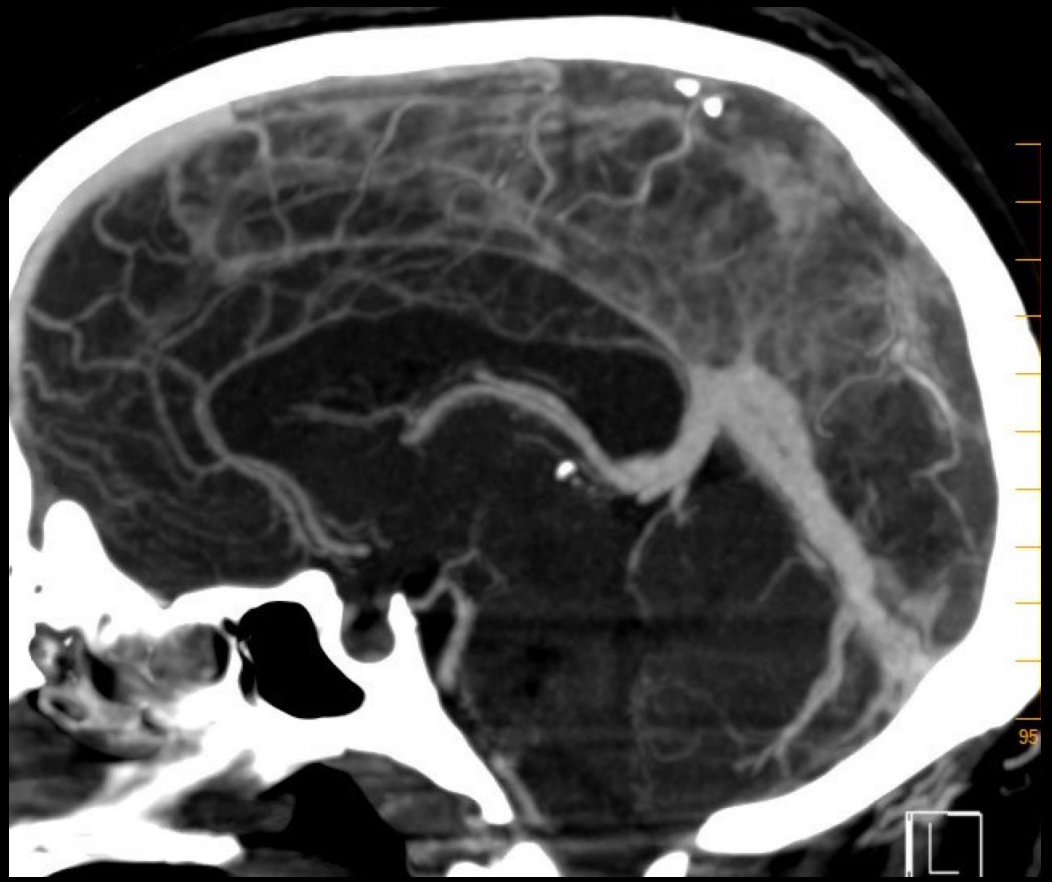
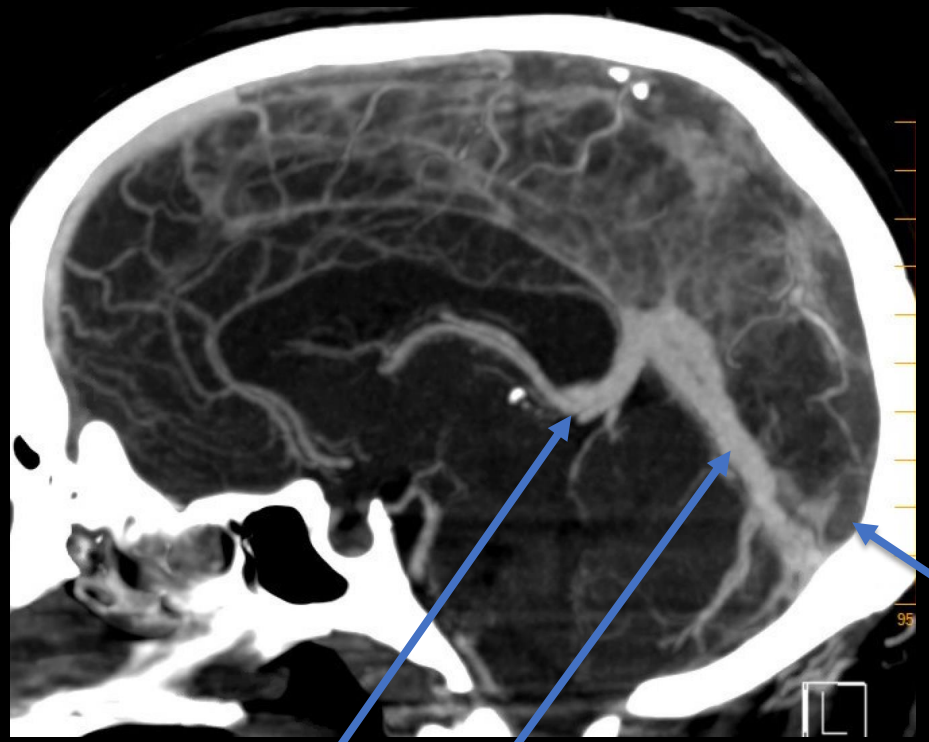
Findings (unlabeled)

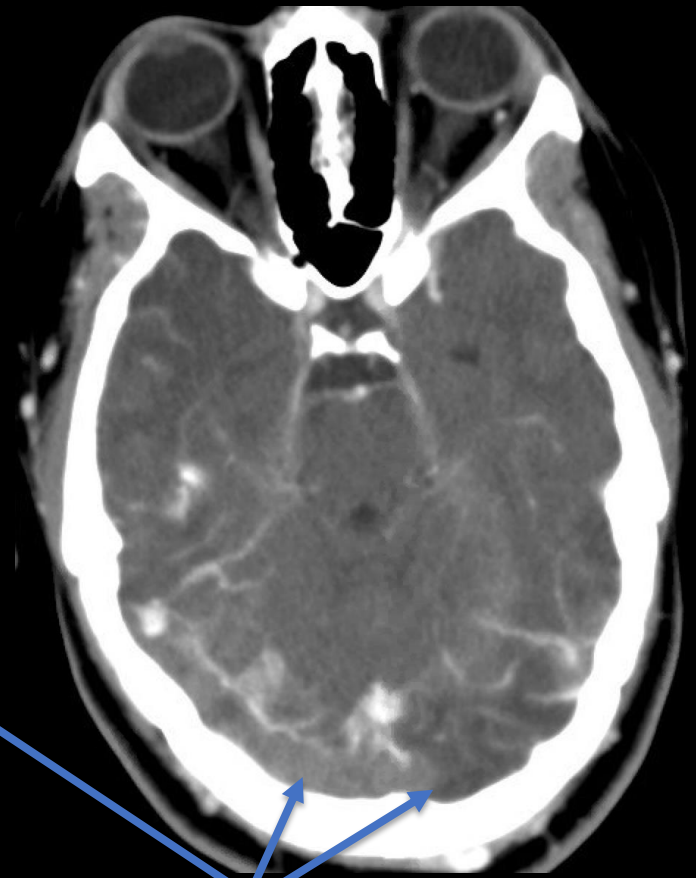


Findings (labeled)

Filling defect in posterior portion of the superior sagittal sinus.
('Empty delta sign')



The vein of Galen, straight sinus and internal cerebral veins are patent and engorged, as are the small cortical venous structures.



Filling defect of the transverse sinuses

Extensive central filling defects within the mid and posterior portion of the superior sagittal sinus and within the bilateral transverse and sigmoid sinuses suggesting extensive dural venous sinus thrombosis.

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Final Dx:

Dural Venous Sinus Thrombosis

Case Discussion

- The brain parenchyma is drained of blood by a network of veins that eventually empty into a series of major sinuses (veins with no valves) formed by reflections in the dura mater. These dural sinuses meet at the torcula in the posterior fossa and drain blood down through the transverse and sigmoid sinuses into the internal jugular veins.
- Dural venous sinus thrombosis is the occlusion of a large dural venous sinus by a blood clot.
- A thrombus in the dural venous sinus impairs drainage from the more proximal veins. This causes venous congestion and increased intracranial pressure. It can also prevent arterial filling, leading to a venous infarct or even a venous hemorrhage. Rarely, it may result in pulmonary emboli.
- It is an uncommon condition, occurring more often in women and generally at an age <40. Most cases involve a risk factor predisposing them to thrombus formation including:
  -Estrogen-containing contraceptives (as in our patient) or hormone replacement
  -Pregnancy or in the postpartum period (our patient was 8 weeks postpartum)
  -Any prothrombotic hematologic condition (Factor V Leiden, Protein C & S deficiency, etc.)
  -Active malignancy
  -Systemic inflammatory or collagen vascular disorders (such as SLE)
  -Mechanical compression (meningioma)
  -Local skull trauma (as happened to then Secretary of State Hillary Clinton in 2012)

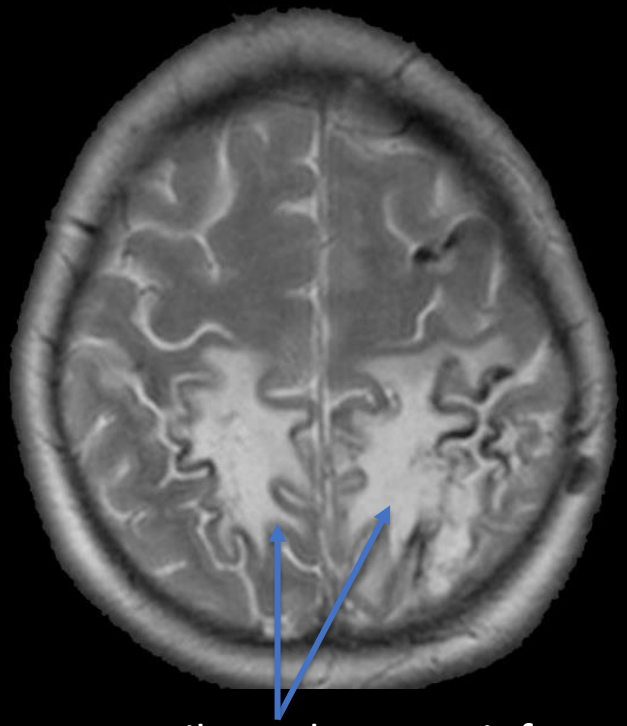
Case Discussion

- Symptoms are the result of increased intracranial pressure or parenchymal damage and can occur gradually or acutely:
  - -Headache is the most common symptom (~90%)
  - -Visual changes or vision loss
  - -Nausea and vomiting
  - -Seizures (~40-45%)
  - -Altered consciousness
  - -Death is uncommon, and usually results from herniation due to intracranial hypertension.
- Findings on physical exam include:
  - -Papilledema
  - -Focal neurologic deficits can be present, especially if the thrombus is isolated
  - -Encephalopathy ranging from mild confusion to coma
  - -Cranial nerve palsies
- Diagnosis is based on neuroimaging (discussed on the next slide), and ruling out other possible diagnoses.
- Treatment:
  - -Acute treatment is anticoagulation with heparin, LMWH, or dabigatran. Warfarin can be bridged with LMWH if desired.
  - -Severe intracranial hypertension can be treated with elevation of the head of the bed, hypertonic saline, or hyperventilation. Rarely, a ventricular drain or craniotomy may be required.
  - -Endovascular thrombectomy has also shown some limited benefit.
  - -The patient may also require seizure prophylaxis with antiepileptics.
  - -Long term treatment is anticoagulation for 3 to 6 months, and treatment or modification of risk factors if possible. Patients at greater risk for recurrence may continue anticoagulation indefinitely.
- Outcomes are typically good, with studies showing complete recovery in ~80% of cases. However, up to 5% of patients die in the acute phase, and another 13-14% die or have poor outcomes in the long term.

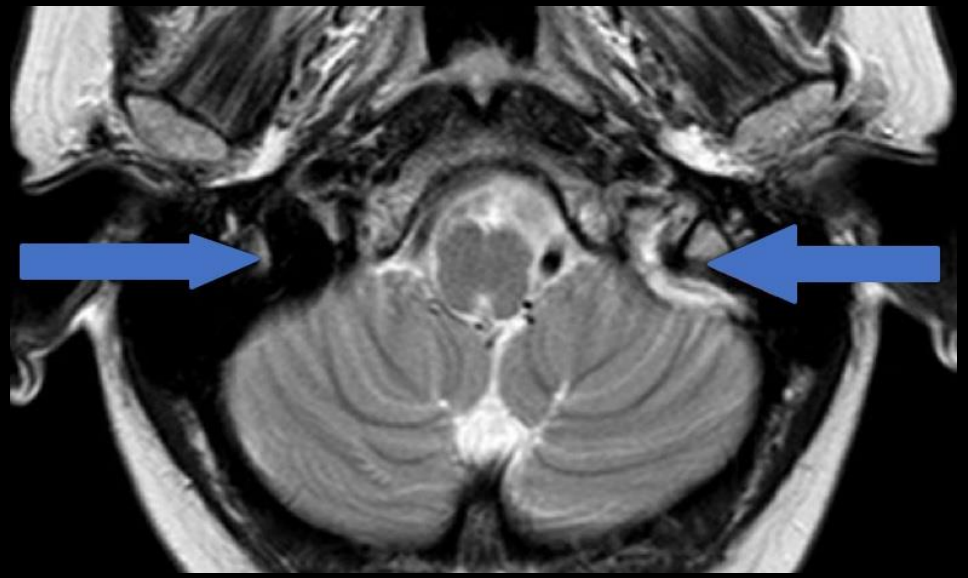
Dural Thrombus on Imaging

- Non-contrast CT: Often the first study ordered.
  - Hyperdense or hyperattenuated dural sinus may be the only finding
  - The ‘Cord sign’: A cord-like hyperdensity of clot lying over the cortex
  - Non-contrast CT can also show significant cerebral edema or hemorrhage
- CT Venogram (CTV): Venous-phase contrast enhancement
  - Filling defects in the affected dural sinus
  - Classic ‘Empty-delta sign’: Triangular filling defect of the posterior sagittal sinus when viewed in the axial plane
  - May also show engorgement of more proximal veins
- MRI
  - T1: Iso- to Hyperintense with an absence of the normal flow void
  - T2: Hypo- to Hyperintense thrombus, Hyperintense venous infarct can also be seen
- MRI Venogram (MRV): MRV combined with MRI is the most sensitive test
  - Absence of, or decreased, normal flow related signal in the dural venous sinuses. (Incidentally, this may be seen in a hypoplastic sinus, which is a benign finding)

Findings on Imaging
(Not seen in our patient)



MRI: Bilateral venous infarct from a superior sagittal sinus thrombus. Note that this does not correspond to an arterial territory.



MRI: Loss of normal flow void in thrombosed left sigmoid sinus, compared to normal right sigmoid sinus.

CT: Venous hemorrhagic infarct

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Case Resolution

- Our patient remained in the ICU where she received IV heparin with a goal PTT of 60-80, and was bridged to warfarin with a goal INR of 2-3.
- She also received IV antihypertensives with a target systolic <140.
- During her admission, she did not require any surgical or interventional procedures. Nor did she require thrombolysis with tPa.
- She was discharged after 7 days demonstrating normal mental status as well as improved headache and nausea. She was prescribed amlodipine, enoxaparin, and warfarin, along with medication for nausea and pain.
- Additionally, she was instructed to stop using her birth control patch, and to follow up with the interventional neuroradiologist.

References:

1. ACR Appropriateness Criteria 2020. ACR.org. Published 2020. Accessed May 9, 2020. Available at: www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria.
2. Canedo-Antelo M, Baleato-González S, Mosqueira A et al. Radiologic Clues to Cerebral Venous Thrombosis. *RadioGraphics*. 2019;39(6):1611-1628. doi:10.1148/rg.2019190015. Available at: pubs.rsna.org/doi/full/10.1148/rg.2019190015.
3. Diaz J, Schiffman J, Urban E, Maccario M. Superior sagittal sinus thrombosis and pulmonary embolism: a syndrome rediscovered. *Acta Neurol Scand*. 1992;86(4):390-396. doi:10.1111/j.1600-0404.1992.tb05106.x. Available at: onlinelibrary.wiley.com/doi/abs/10.1111/j.1600-0404.1992.tb05106.x.
4. Ferro J, Canhão P, Stam J, Bousser M, Barinagarrementeria F. Prognosis of Cerebral Vein and Dural Sinus Thrombosis. *Stroke*. 2004;35(3):664-670. doi:10.1161/01.str.0000117571.76197.26. Available at: www.ahajournals.org/doi/10.1161/01.STR.0000117571.76197.26.
5. Jick S, Kaye J, Russmann S, Jick H. Risk of nonfatal venous thromboembolism in women using a contraceptive transdermal patch and oral contraceptives containing norgestimate and 35 µg of ethinyl estradiol. *Contraception*. 2006;73(3):223-228. doi:10.1016/j.contraception.2006.01.001. Available at: www.contraceptionjournal.org/article/S0010-7824(06)00008-4/.
6. Lu A, Shen PY, Dahlin BC, Nidecker AE, Nundkumar A, Lee PS. Cerebral venous thrombosis and infarct: Review of imaging manifestations. *Appl Radiol.* 2016;45(3):9-17. Available at: www.appliedradiology.com/communities/ct-imaging/cerebral-venous-thrombosis-and-infarct-review-of-imaging-manifestations.
7. Simons B, Lycklama a Nijeholt G, Smithuis R. The Radiology Assistant : Cerebral Venous Thrombosis. Radiology Assistant. Published 2020. Accessed May 9, 2020. Available at: radiologyassistant.nl/neuroradiology/cerebral-venous-thrombosis.
8. Siddiqui F, Dandapat S, Banerjee C et al. Mechanical Thrombectomy in Cerebral Venous Thrombosis. Stroke. 2015;46(5):1263-1268. doi:10.1161/strokeaha.114.007465 Available at: pubmed.ncbi.nlm.nih.gov/25899238/.
9. Singh A, Prenovitz I. How to Spot and Treat Cerebral Venous Sinus Thrombosis. ACEP Now. Published 2017. Accessed May 9, 2020. Avaialble at: www.acepnow.com/article/spot-treat-cerebral-venous-sinus-thrombosis.
10. Warner R, D'Souza D. Dural venous sinus thrombosis | Radiology Reference Article | Radiopaedia.org. Radiopaedia. Published 2020. Accessed May 9, 2020.Available at: radiopaedia.org/articles/dural-venous-sinus-thrombosis?lang=us.

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