

“Mommy, my head hurts”: Pediatric Neurologic Emergencies

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6 yr old boy with altered LOC

- 6 yr old boy with no past medical history
- 12 days ago fever x 4days up to 103 with V/D
- Fevers persisted but became low grade,
- Saw PMD yesterday (+strep test) >> Augmentin >> sent to OSH for dehydration. Given IVF's and sent home
- That evening became lethargic, difficult to arouse, incontinent of urine >> to PMD >>sent to OSH ED
- Performed LP, moderate WBC's in CSF >> meningitic doses of antibiotics, Acyclovir given
- Protecting his airway without respiratory distress, + gag and cough
- HR=59-72, B/P= 85/44 (87/31), Afebrile
- Neuro: PERRL, GCS=9-10, opening eyes to painful stim, localizing pain, confused. Giving one word answers.

Differential Diagnoses

- Meningitis ?
- Toxicology (ingestion) ?
- Trauma ?
- Brain Tumor ?
- Brain Abscess ?
- Intracranial Hemorrhage (bleeding or ruptured AVM) ?
- Encephalitis / Encephalopathy ?

...On Transport

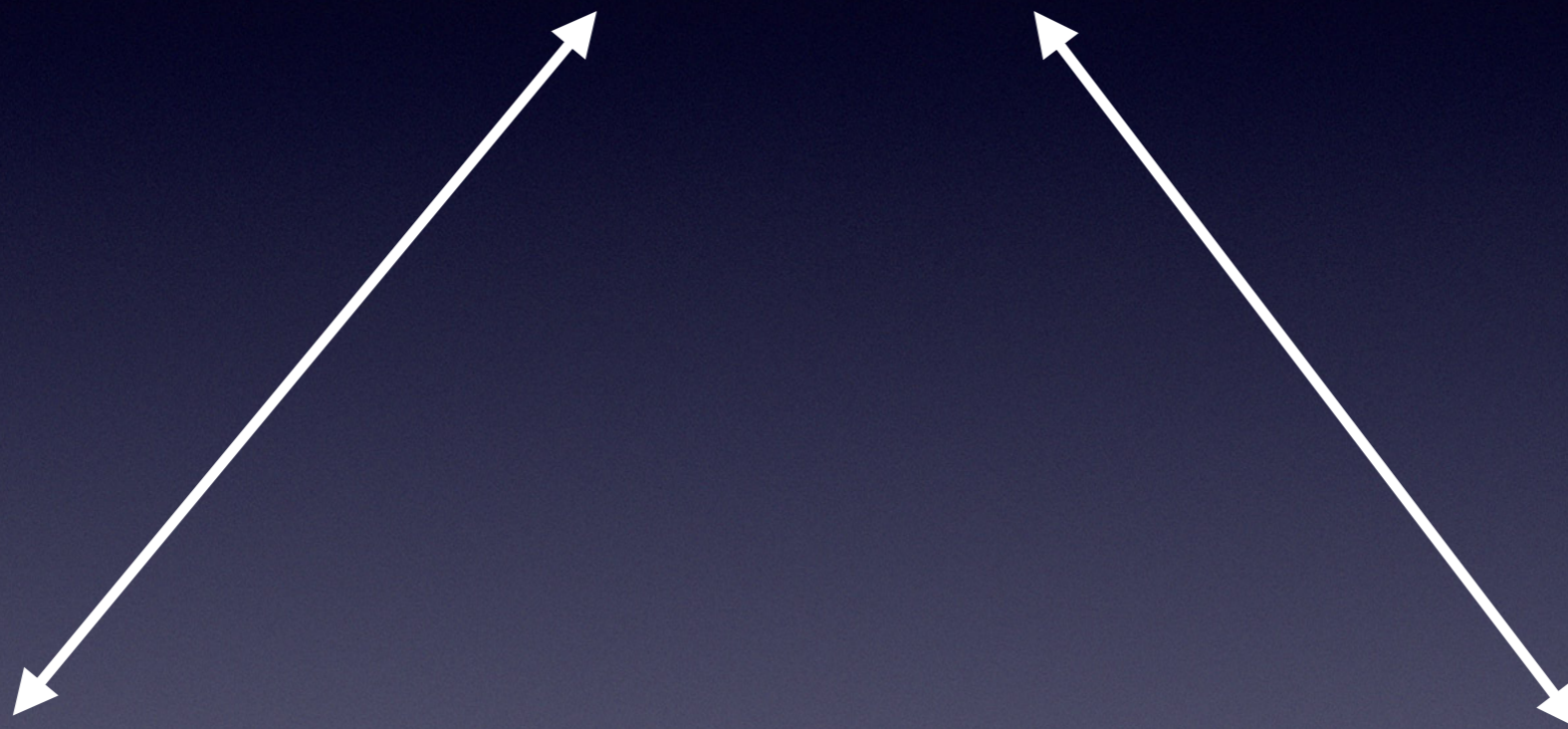
- Upon arrival: opening eyes to voice and gentle touch (still lethargic)
- Purposeful movements but non-verbal. Occasional moaning
- Withdrew to painful stimuli
- 20ml/kg 0.9NS being completed
- VS's: HR= 83, RR =28, B/P= 97/43, SAT = 100% on R/A
- GCS =11, PERRL

Cushing's Triad

Hypertension
widening pulse pressure

Bradycardia

Hypoventilation
Irregular breathing
pattern



MRI with contrast



Encephalitis

- **Encephalitis:** Inflammation of the brain parenchyma
- **Encephalitis:** the presence of an inflammatory process of the brain in association with clinical evidence of **neurological dysfunction**.
Encephalitis is due to either direct invasion of the central nervous system (CNS) or indirect involvement of the CNS The Infectious Disease Society of America
- **Encephalopathy:** Disruption of normal brain function

Presentation

- Initial Signs and Symptoms similar to bacterial meningitis?
- How to distinguish: **The presence or absence of normal brain function**
 - **Meningitis**: fever, meningeal signs, CSF pleocytosis (increase WBC), without neurologic dysfunction
 - **Encephalitis**: fever, focal neurologic signs, cranial nerve involvement, motor deficits, sensory deficits,

Presentation / Symptoms

- Highly variable presentation
- Fever, headache, irritability, malaise, nausea, possible nuchal rigidity or neck pain.
- Decreased LOC, confusion, ataxia, **seizures**, aphasia, visual disturbances, focal motor / sensory deficits. Personality changes. Increased ICP (**ACUTE CEREBRAL EDEMA**)
- Children vs Adults
 - Children: more neurologic symptoms
 - Adults / young adults: psychiatric symptoms

Mildred A Iro Dominic F Kelly, Management and outcome of

encephalitis in children, PAEDIATRICS AND CHILD HEALTH 25:11 2015

Encephalitis

- Cause of Encephalitis
 - Infectious
 - Statistics:
 - virus is the most common cause of encephalitis
 - 1400 deaths annually (highest < 1 year)
 - Post Infectious
 - Immune mediated inflammatory process

Most common causes (Viral Agents)

- Most common cause:
 - Herpes Simplex Virus
 - Enterovirus
- Epstein-Barr Virus
- Influenza
- Arbovirus

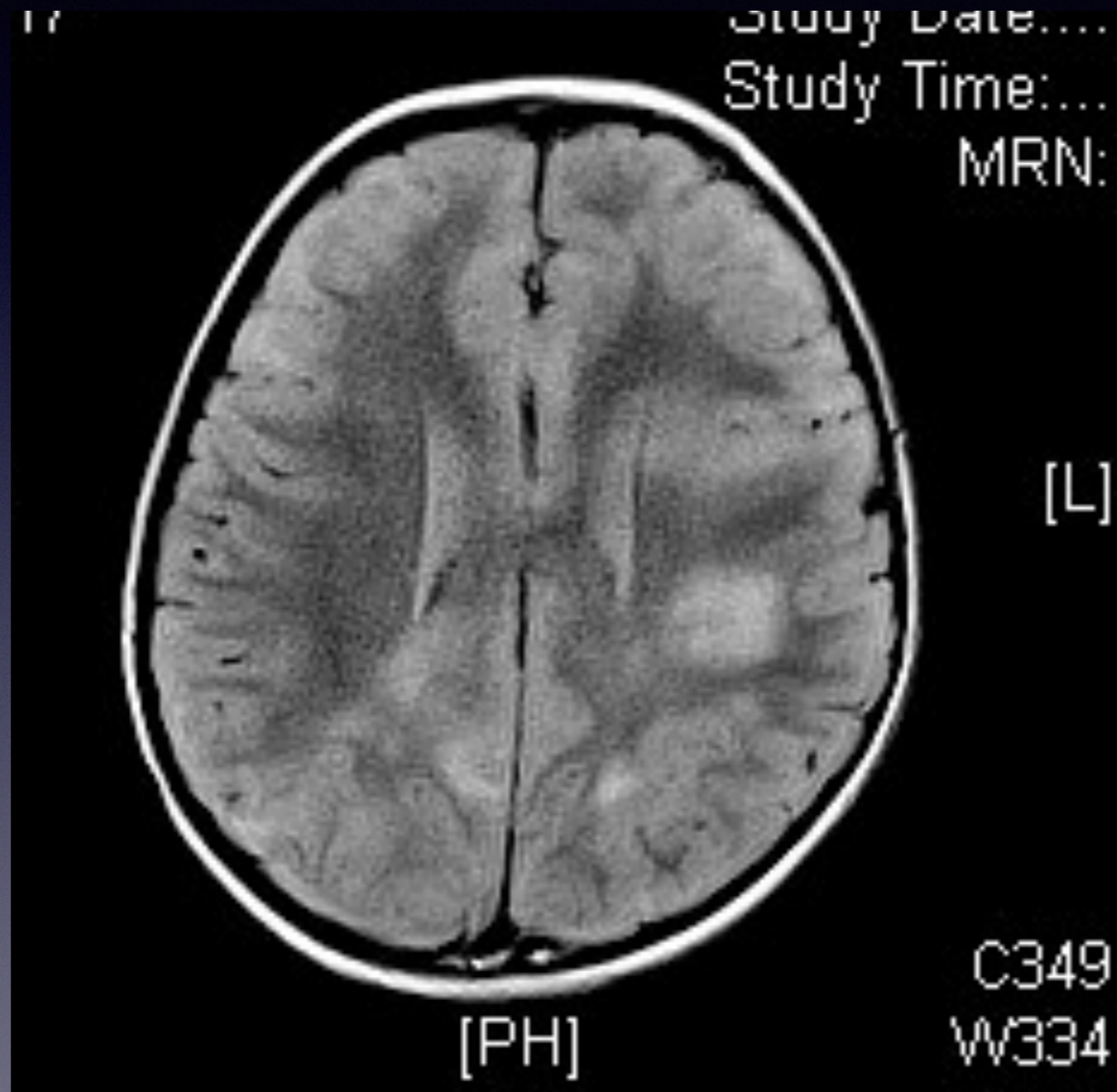
Post Infectious (Auto immune encephalitis)

- **ADEM: Acute disseminated Encephalomyelitis**
- **Immune mediated**
 - Post infectious process
 - 70-77% report pre viral event 1-3 weeks ago.
 - Recent vaccine
 - Seasonal
 - Most present without fever: *Post Infectious*
 - Seizures: 80% of patients (90-100% Abnormal EEG)
 - Diagnosis based on clinical or radiologic findings (**MRI**)

Acute Management

- Protect the airway
- Control seizures
- ICP precautions
- IV hydration / fluid resuscitation
- Labs: CBC with diff, CMP, Toxicology screen
- **Imaging (before LP) !!!**
- Antibiotic and Antiviral therapy
- Monitor for signs of Increased ICP
- **History should include:**
 - vaccination status
 - immunocompromised
 - mosquito or tick bites
 - travel history
 - neonates: maternal HSV

MRI with contrast 6yr old



Outcomes: Infectious Encephalitis

- Mortality: up to 29%
- Vary in relation to pathogen and initial CNS injury
- Initial presentation with fulminant cerebral edema: worse outcome
- HSV: mortality up to 70%-30% (with early treatment)
- Enterovirus: less severe sequelae than HSV
 - many cases self limiting
 - most have short term morbidity

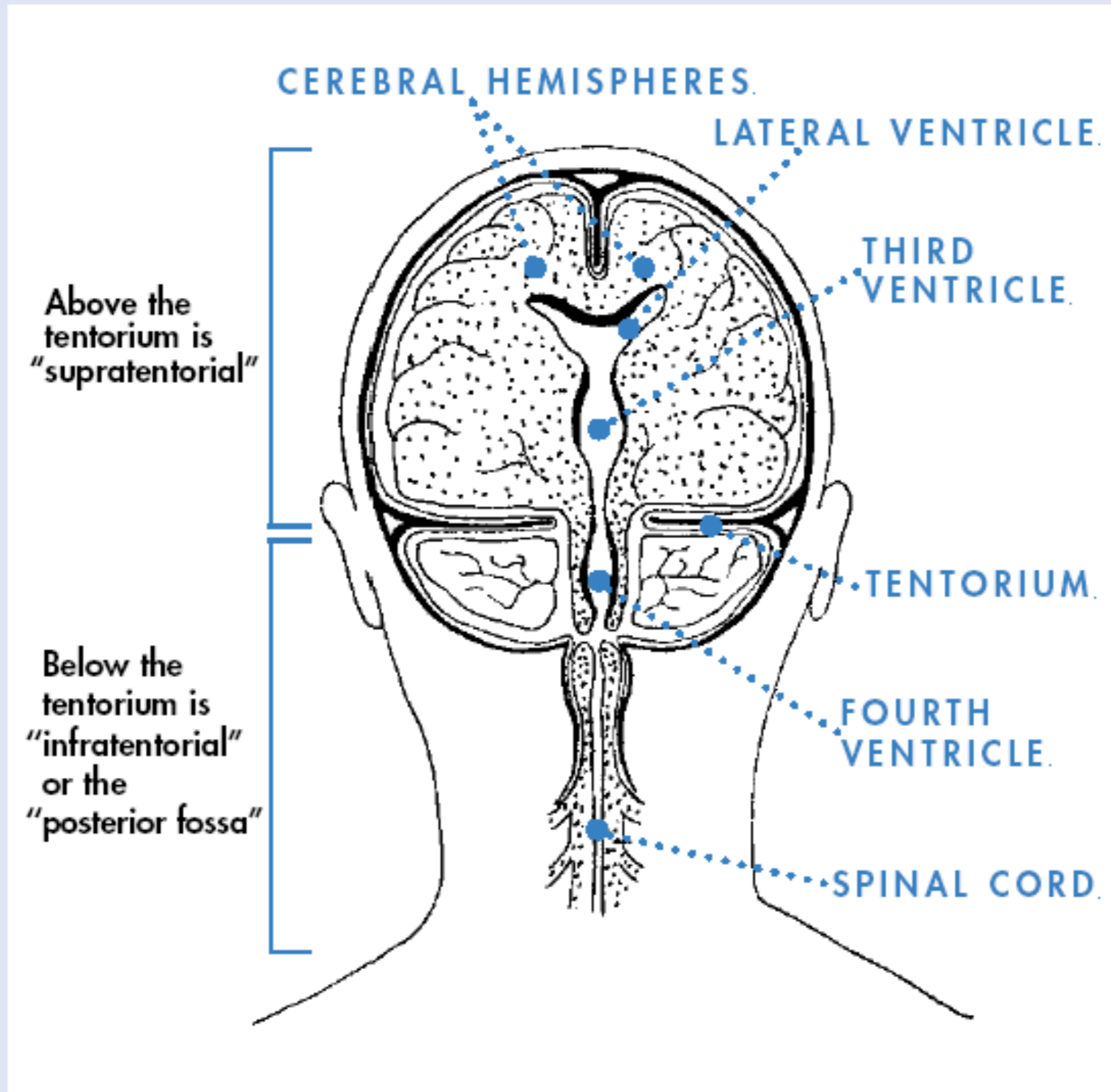
Outcomes for Autoimmune Encephalitis

- Gradual improvement over several weeks (to 1 year)
- complete recovery: 57-94% (*improved with use of high dose steroids*)
- Cognitive deficits (often subtle)
 - *Children more uncertain*
- Recovery without treatment is rare

6 yr old girl with headaches

- 6 year old girl presents to ED with intermittent headaches for 2 months (mostly on R side)
- Seen by PMD, work up for “The Flu”. Eye exam = “normal”
- parents recently reported “incoordination” (recently walked into a wall few times)
- More recently he has had nausea and vomiting in AM and symptoms lessen during the day.
- Has also recently been tilting head to one side
- Last few days feeling weak
- “Passed out” today while fishing
- Taken to local ED, CT obtained
- VSS: Afebrile, HR =82, RR=16, B/P 138/78, Sat's= 96% (r/a)

THE TENTORIUM



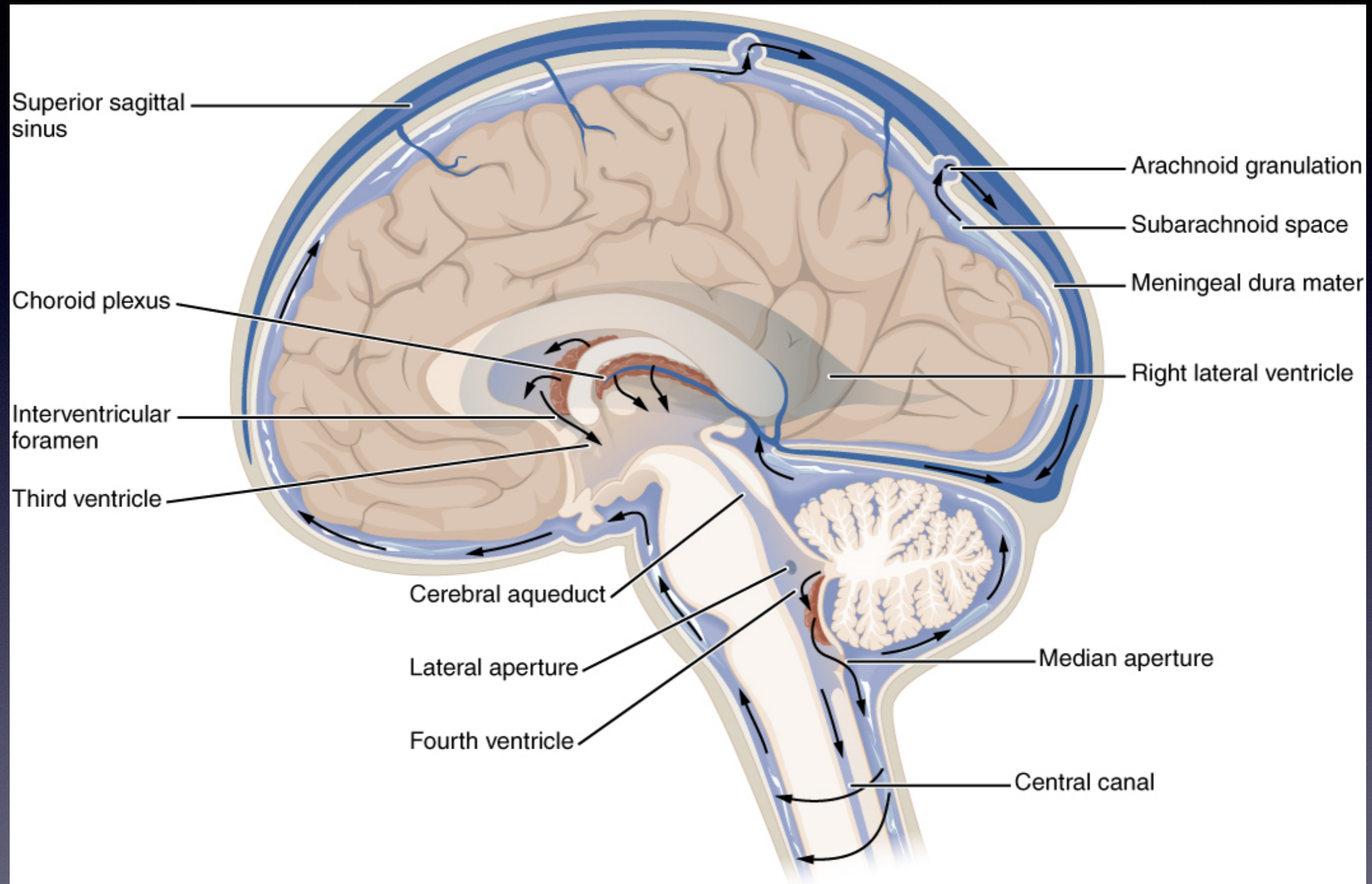
MRI



Pediatric Brain Tumors

- Most common solid tumor in children
- Second most common childhood Cancer
- 3500-3700 new diagnosis / year in the U.S.
- >2000 are malignant
- Medulloblastoma: most common malignant brain tumor in children
- Brain tumors are the leading cause of cancer related deaths in children < 20years (ABTA)

KEY



Symptoms of CNS Tumors related to hydrocephalus

- **Common**
 - Headache: never alone !!
 - Nausea and Vomiting
- **Emergent:**
 - Cushing's Triad
 - lethargic / obtunded
- **Localizing Symptoms**
 - Seizures (15-25%) **less likely with PF tumors**
 - Coordination and Motor

Brain Stem Tumors

- “The most dreaded cancer in pediatric oncology”
- Worse prognosis of all Pediatric Brain tumors: most will die within the first year of diagnosis
- Pontine Gliomas
 - ataxia, cranial nerve palsies, extremity weakness, diplopia (most common for this tumor)
 - peak incidence: 6-9 year old
 - rapidly growing / rapid progression
- Symptoms >>> herniation > Death

Interventions

- HOB elevated
- Steroids: Dexamethasone preferred
(dose: 0.5mg-1mg/kg/day divided doses)
- Secure airway
- Mannitol / hypertonic 3% Saline
- ETCO₂ = 30-35
- Imaging before LP !!!
- Avoid Narcotics if possible

Case Presentation 3

- 11yr old boy wrestling with brother, hit head
- Possible seizure, became “sleepy”, unable to arouse
- 911 called
- Intubated in referring hospital ED (20 min away by ground)
- CT scan obtained: reported subarachnoid hemorrhage
- Transport Team Called: dispatched in 10min.

On Transport

- Received child intubated on vent
- Pupils fixed and dilated
- Not withdrawing to painful stim.
- Mannitol given (1Gm/kg)
- VSS: HR=72, RR=16 (on vent), B/P 143/61, Sat's = 100%, ETCO₂ =28-30
- Occasional spontaneous breaths
- Gave sedation (morphine and versed)

Arteriovenous Malformation

- “Lesions of the cerebral vasculature develop” such that blood flows directly from the arterial system to the venous system without passing through a capillary system. An arteriovenous (AV) shunt is formed.” Medscape ref. 1/12 Altschul, Wyler et al.

AVMs

- Venous system: abnormally high pressure
- Congenital lesions
- Most dangerous congenital vascular malformations
- Incidence: in US: 140 /100,000 persons

Pediatric AVM stats

- Brain AVMs: most common cause of spontaneous ICH (Intracranial hemorrhage) <18yr
- account for 50% of pediatric hemorrhagic strokes
- AVM rupture: highest morbidity / mortality
 - Children > Adults
- Children vs Adults: children more likely present with ICH.
- Unruptured lesions: ICH prevented with treatment
- ICH 50-80% of presentation.

Presentation and Symptoms

- Presentation between ages 10-40yr
- Acute Onset of severe headache (34%)
- Seizures (46%) larger lesions
- Hemorrhage (53%)
 - Children more likely to present with hemorrhage
- Progressive Neurologic Deficit (21%)
- Size and location determine clinical presentation
- Location: in children can occur anywhere more prevalent in posterior fossa

Initial Treatment and Stabilization

- Protect Airway (ICP precautions)
- Head of bed elevated
- Give Mannitol (suspected or impending herniation)
- Maintain normotensive
- Obtain imaging if possible
- Lumbar Puncture after imaging
- Sedate (morphine and versed)
- Control Seizures
- Transport to Tertiary Care Facility
- Gold standard for diagnosis ANGIOGRAPHY

Outcomes

- Outcomes vary depending on:
 - Size of lesion
 - Location of lesion
- 10% mortality associated with bleed
- Surgical vs nonsurgical intervention vary dramatically
- **Children:** more aggressive treatment plan
- Overall attempts should be made to eradicate the lesion. (may include combination of treatments)
- “Neural plasticity” in children allows for faster post-surgical recovery

In Summary

- Encephalitis / Encephalopathy
- Brain Tumors
- AVM

Thank you for your attention!

QUESTIONS?

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