

Anoxic Brain Injury

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16 September 2020

RAD 4001 Diagnostic Radiology

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Clinical History

49yo male with history of quadriplegia, several c-spine injuries 2/2 MVC in 1/2020 (s/p fusion, laminectomy), neurogenic bladder (foley at baseline) admitted with chief complaint of “indwelling catheter is not having output since last night.”

- Found to have UTI, foley exchanged, treated with ceftriaxone
- Began AMS workup on day 5
 - Likely not metabolic, seizure
 - Infection w/u ongoing, including LP
 - Thought to be 2/2 to baclofen withdrawal

Clinical History

Day 9 – unresponsive after returning from LP

- Found to have PEA, code blue called
- ROSC after 7 minutes

Clinical History

- Vitals: hr 85, RR 20, SpO2 98 (intubated)
Tmax 93.7 (Tmax 100.9), bp 87/59
- General: sedated, on hypothermia protocol
- Neck: decreased ROM
- Chest: intubated, chest tube in place
- CV: tachycardic, normotensive on pressors
- Abd: soft, nondistended
- Skin: no rashes
- Neuro
 - Mentation: sedated, not following commands
 - CN: 3mm PERRLA, dysconjugate gaze, not tracking, flattening of L nasolabial fold
 - Motor: thin bulk, spasticity throughout, no mvmt of U/Les
 - Sensation: grossly intact to light touch
 - Coordination: could not assess
 - Gait: deferred

Clinical History

144	106	29	224	14.2	266
3.0	24	1.05			

16.0	1.27
33.8	

Ph 8.2
 Ca 10.5
 Mg 2.0
 NH3 30.0
 Lactic Acid 9.8
 TSH 4.27

- Day 9 CSF (before event, not sedated): Glc 50, Ptn 68, RBC 4, WBC 3, OP 31, negative GS
- EEG with slowing, no epileptiform discharges
- Day 5 CTH: no acute abnormality
- Day 9 MRI (before event): no acute abnormality; chronic R cerebellar hemorrhagic infarct

Clinical History

Transferred to CCU

Pressors as needed

CXR: R tension pneumothorax, chest tube placed

Empiric antibiotics for possible meningitis

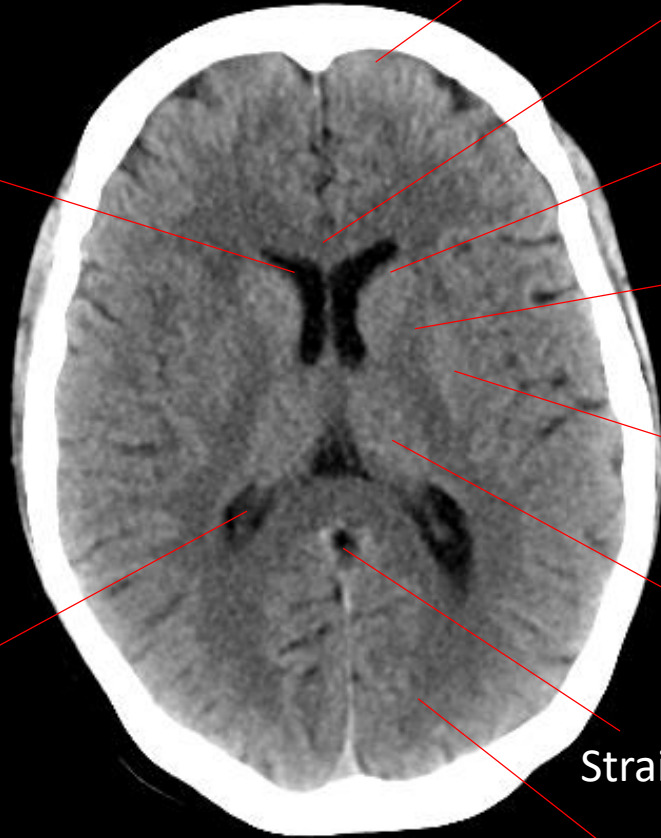
Hypothermia protocol initiated

Stat CT brain without contrast

Warning: Not for diagnostic use

Anterior
horn of
lateral
ventricle

Posterior
horn of
lateral
ventricle



Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 37008

Frontal lobe

Genu of corpus
callosum

Caudate
nucleus

Anterior limb of
internal capsule

Lenticulate
nucleus

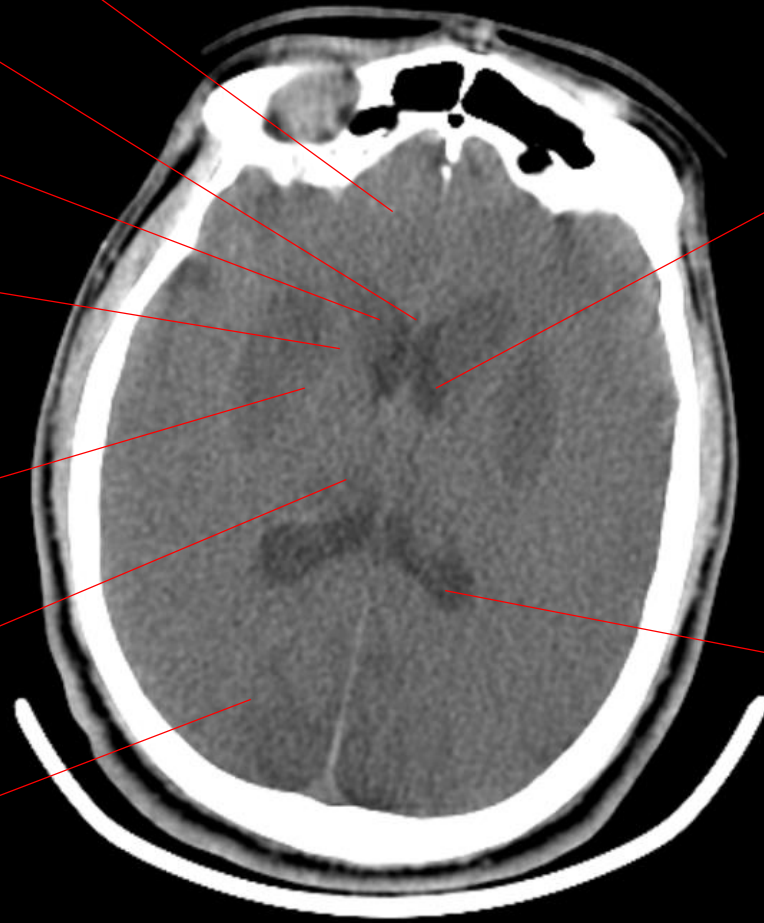
Thalamus

Straight sinus

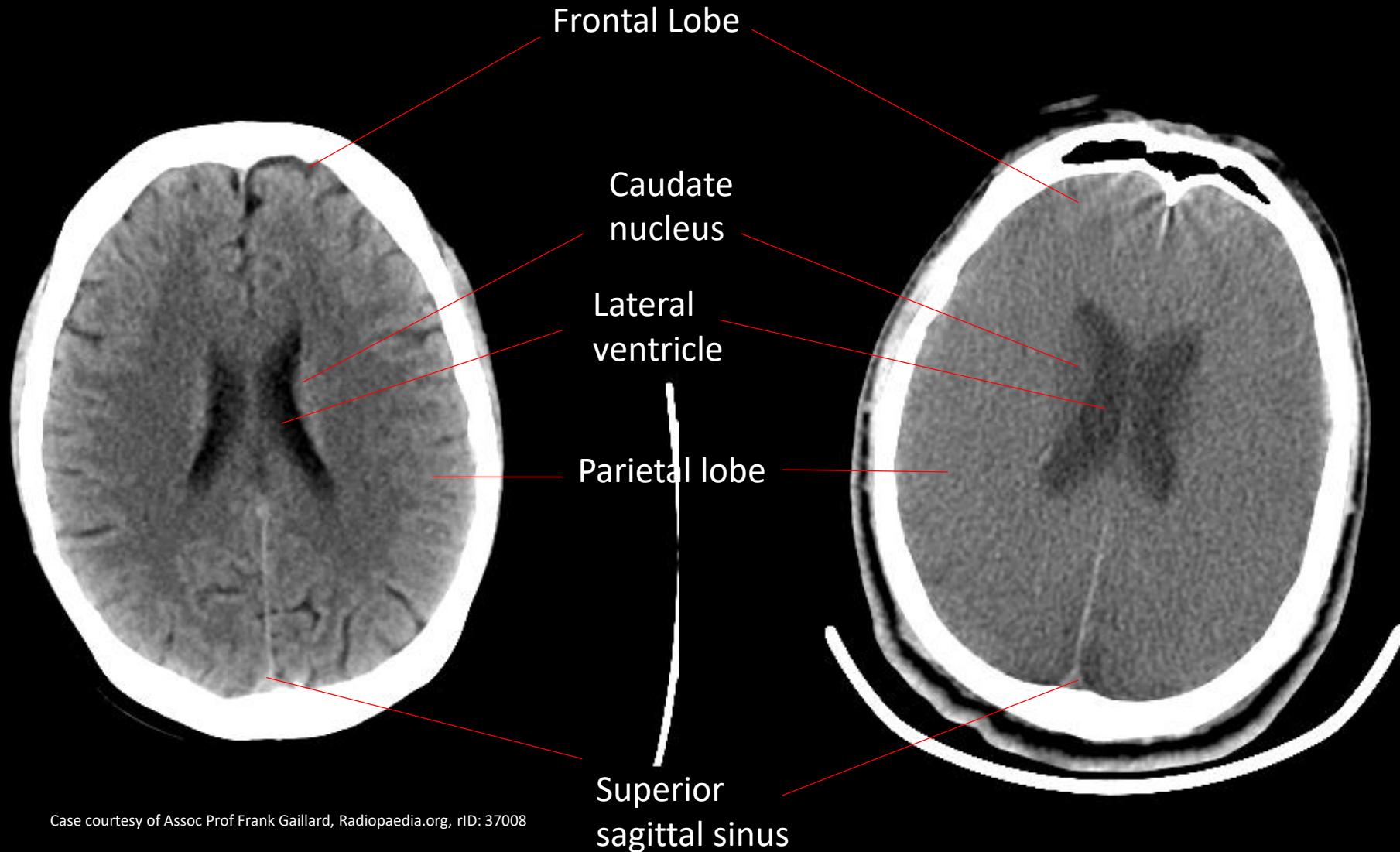
Occipital
lobe

Anterior
horn of
lateral
ventricle

Posterior
horn of
lateral
ventricle

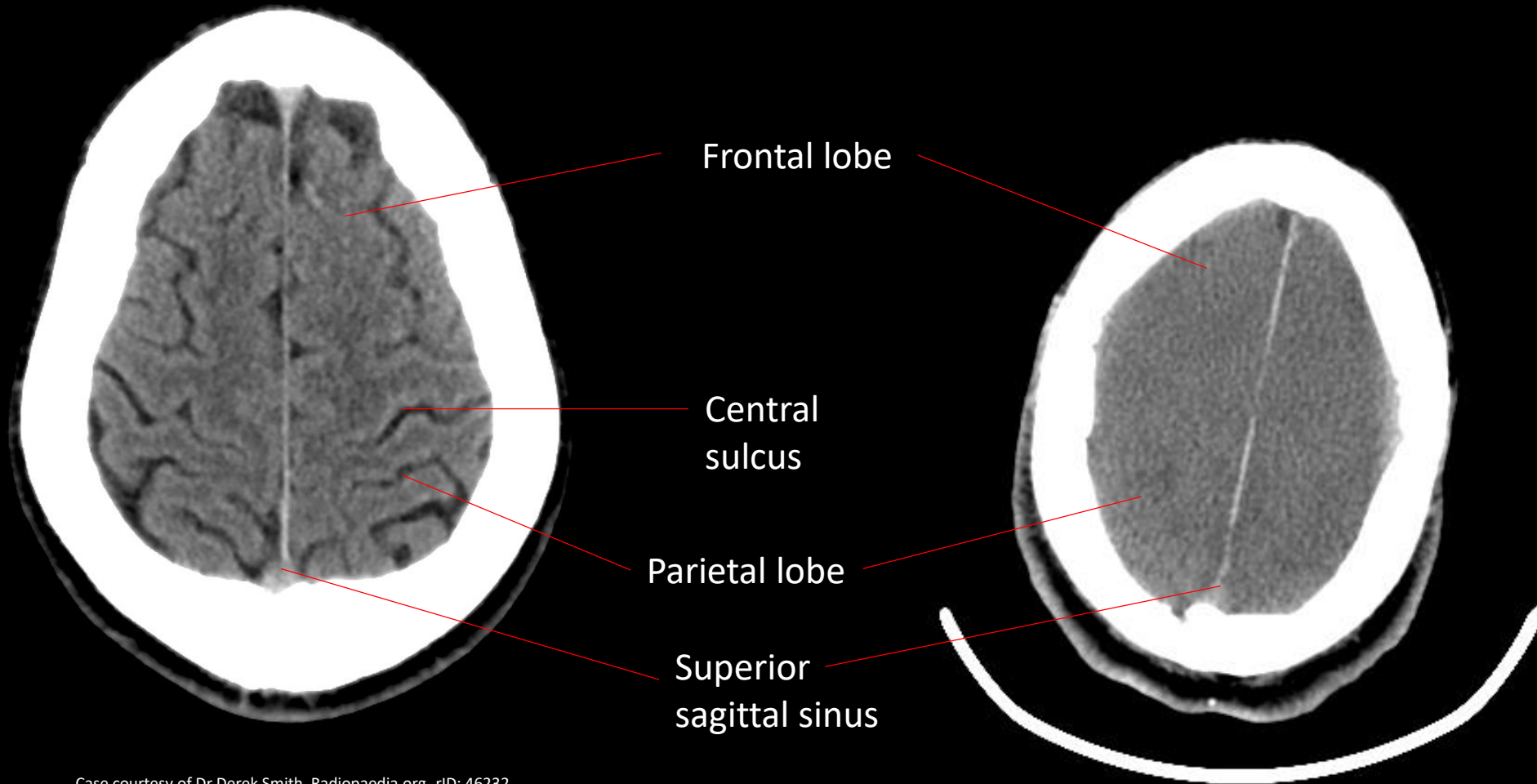


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Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 37008

Warning: Not for diagnostic use



Case courtesy of Dr Derek Smith, Radiopaedia.org, rID: 46232

Summary of imaging findings

- Loss of gray/white matter interface in both cerebral hemispheres
- Symmetric hypodensity in basal ganglia and thalami bilaterally
- Cerebral edema, effacement of cisterns, sulci

Differential Diagnosis

- Anoxic Brain Injury
- Ischemic Stroke
- Traumatic Brain Injury

Discussion

- Pathophysiology of Anoxic Brain injury
 - Primary injury: neuronal death due to ischemia
 - Secondary injury: neuronal death due to imbalance of cerebral oxygen delivery and use – metabolically active tissue hit hardest (e.g. basal ganglia)
- Common sequela of cardiac arrest
- Management is supportive

Discussion

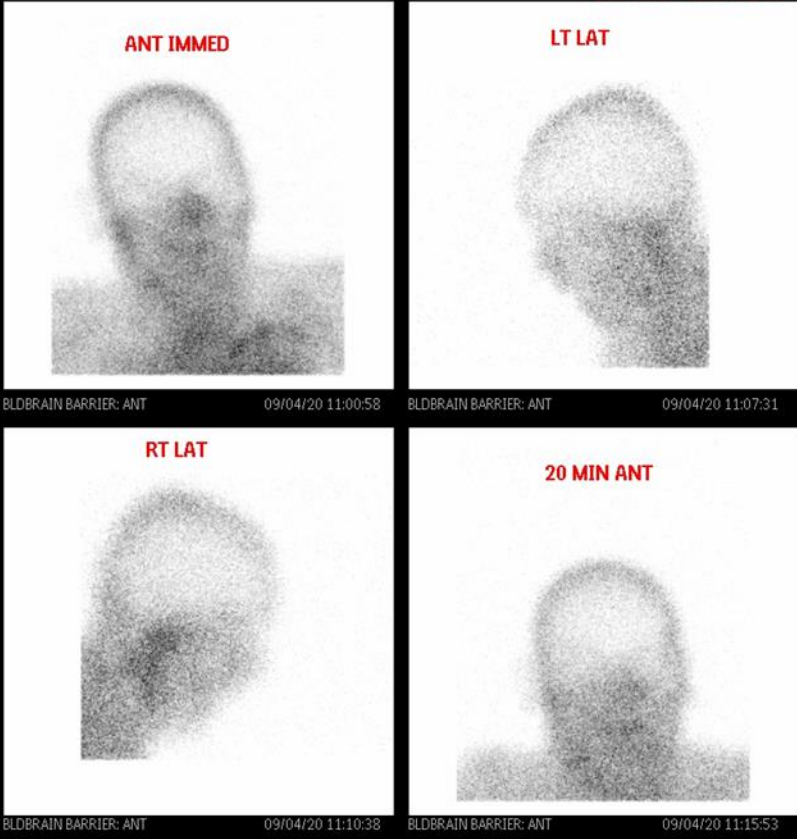
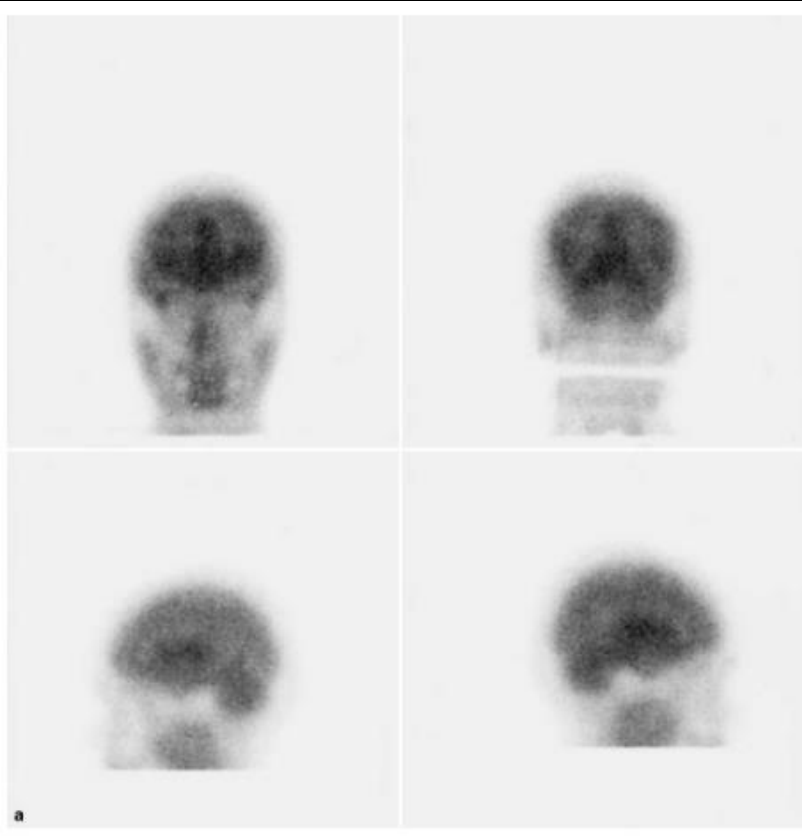
- Cerebral metabolism is reduced by 5-10% / 1°C decrease
- Hypothermia → decreased metabolic demand
 - → decreased CO₂ production
 - → decreased O₂ consumption
 - → decreased lactate production
 - → mitigates inflammation, apoptosis
- Goal temperature: 32-34°C, 24-48hrs

Outcome

- Patient's neurologic function continued to deteriorate
- Nuclear cerebral perfusion scan performed

Warning: Not for diagnostic use

Cerebral blood f
15.0 mCi NEUROLITE
September 04, 2020



Source: Al-Shammri S, Al-Feeli M. Confirmation of Brain Death Using Brain Radionuclide Perfusion Imaging Technique. Med Princ Pract. 2004; 13:267-272.

Final Diagnosis

- Anoxic brain injury
- Brain Death

Imaging modalities and cost

- Modalities of choice: CT brain w/o contrast +/- MRI w/o contrast (head trauma from acute injury, with neurologic deterioration)
 - Brain death determination – clinical +/- ancillary studies (such as cerebral perfusion)
- Imaging for case: CT brain without contrast x2, Nuclear cerebral perfusion
- Estimated to be ~ \$4200
 - Parameters: without insurance, in AZ
 - CT brain without contrast = \$1213
 - Nuclear cerebral perfusion scan ~ 1800 (used heart SPECT scan as proxy)
- Source: <https://costestimator.mayoclinic.org/find/medical-services-and-procedures>

Take Home Points / Teaching points

- Anoxic brain injury is a common sequela of cardiac arrest
- Common brain CT findings include loss of gray-white matter interface and hypoattenuation of basal ganglia and thalami
- Therapeutic hypothermia can mitigate secondary injury

References

1. Al-Shammri S, Al-Feeli M. Confirmation of Brain Death Using Brain Radionuclide Perfusion Imaging Technique. *Med Princ Pract*. 2004; 13:267-272.
2. Lacerte M, Hays Shapshak A, Mesfin FB. Hypoxic Brain Injury. [Updated 2020 Aug 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK537310/>
3. Sekhon, M.S., Ainslie, P.N. & Griesdale, D.E. Clinical pathophysiology of hypoxic ischemic brain injury after cardiac arrest: a “two-hit” model. *Crit Care* **21**, 90 (2017). <https://doi.org/10.1186/s13054-017-1670-9>
4. Greer DM, Shemie SD, Lewis A, et al. Determination of Brain Death/Death by Neurologic Criteria: The World Brain Death Project. *JAMA*. 2020;324(11):1078–1097. doi:10.1001/jama.2020.11586



Questions?