

Brain Death Diagnosis From CTA

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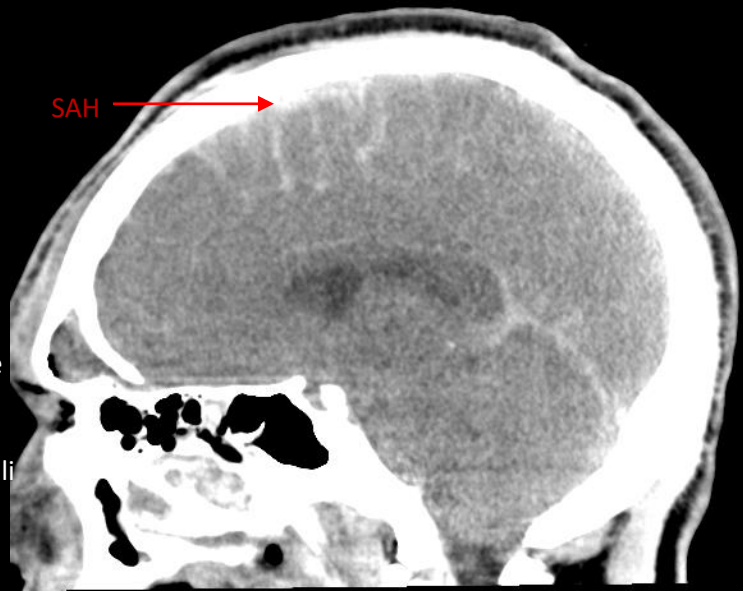
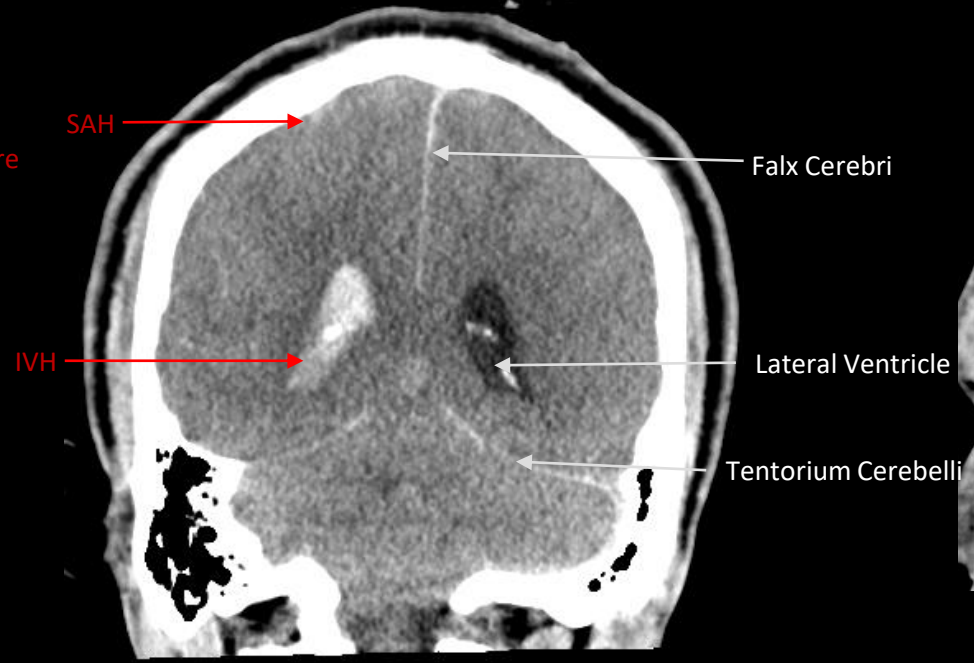
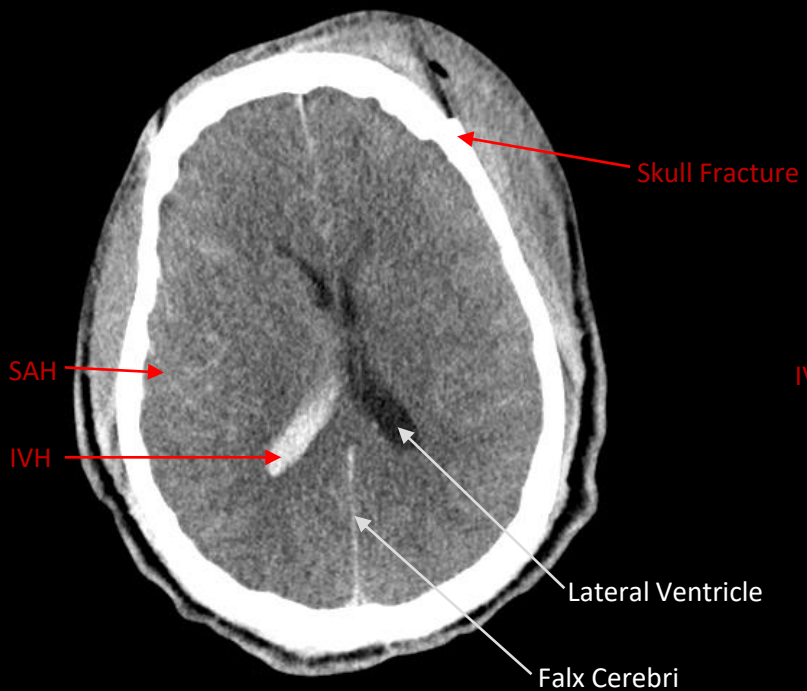
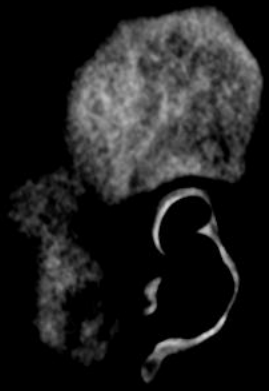
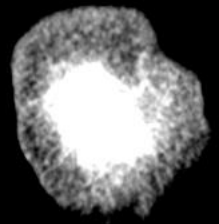
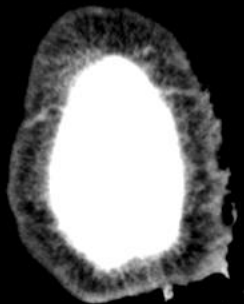
RAD 4013 (Emergency Radiology)

Dr. Ronald Bilow

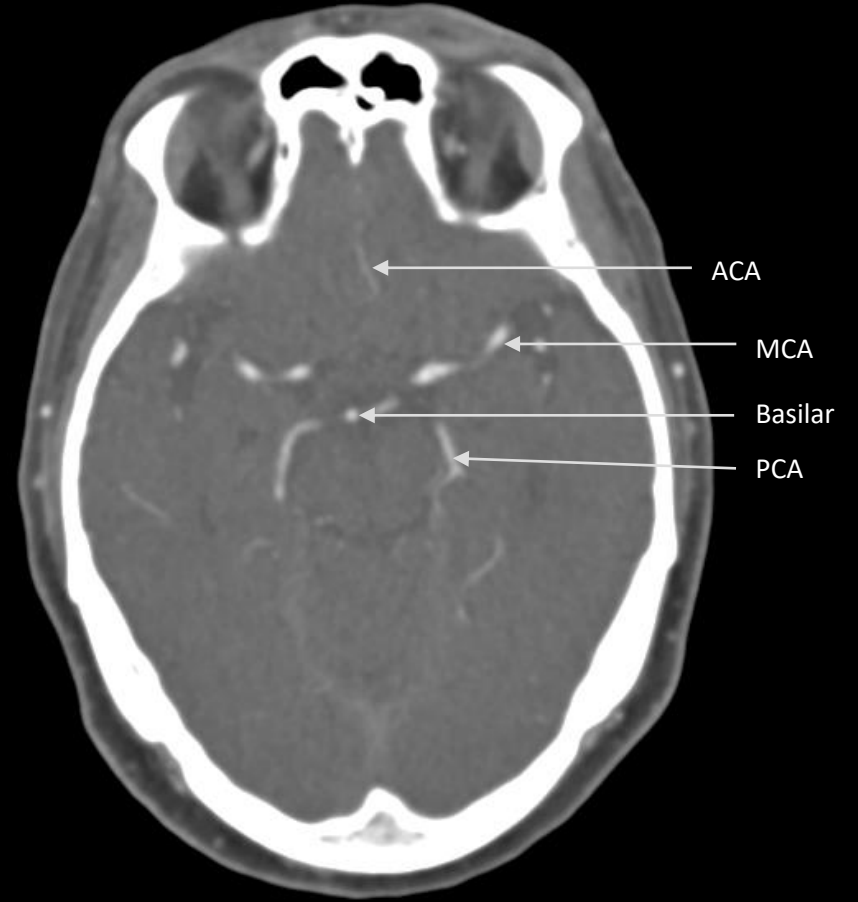
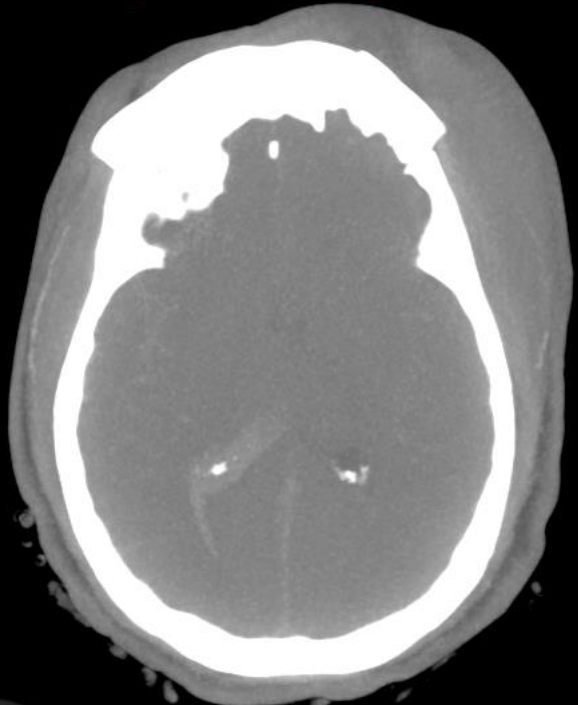
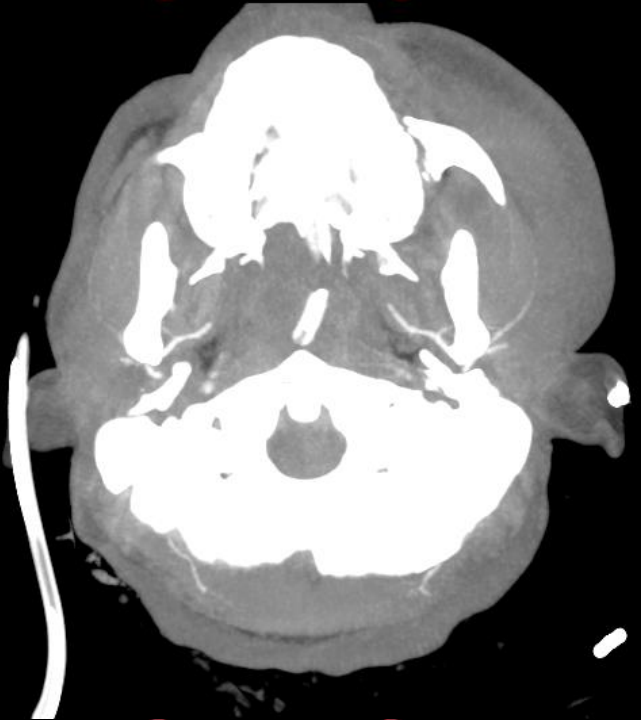


Clinical History

- 26yoM with unknown PMHx presented as level 1 after MCC
 - GCS3, intubated, given 1 unit blood in field, 2 in ED. FAST+ per LF, indeterminate in ED
- V/S: HR 150-160s, SBPs 50-60s
 - Pupils fixed & dilated. Lacerations to forehead, BUE, RLE. Left thigh avulsion.
 - CXR wnl, pelvic xray with multiple fractures
- Due to persistent HypoTN, pt taken emergently to OR for exlap
 - Pre-peritoneal packing, bilat chest tubes, left thigh washout
 - Taken to CT afterwards, followed by STICU



CT Brain w/o Contrast



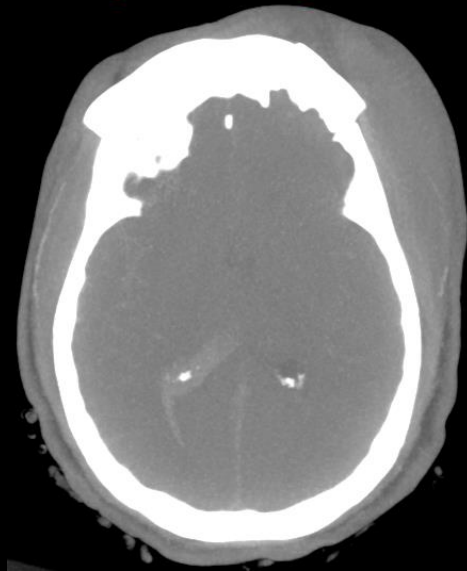
Normal Head CTA
Case courtesy of Assoc Prof Craig Hacking,
Radiopaedia.org, rID: 40801

Findings

- Brain CT w/o contrast
 - Hemorrhage: IVH, SAH, small hemorrhagic contusions of inferior left frontal lobe
 - Loss of gray/white junction, diffuse edema. Various face & skull bone fx



- Head/Neck CTA
 - Internal carotid: luminal narrowing in neck, with no opacification of intracranial ICA
 - Vertebral: No opacification of intradural vertebral arteries
 - Head: No opacification of ACA, MCA, PCA, Basilar artery
 - Compatible with brain death



Diagnosis of Brain Death from CTA

- No standardized criteria set

CTA evaluation scales in the diagnosis of BD.

Criteria	Lack of opacification of
Intracranial non-filling	<ul style="list-style-type: none"> • ICA beyond the level of the anterior clinoid process • VA beyond their dural penetration • ICV, GCV and the straight sinus
10-point*	<ul style="list-style-type: none"> • BA • Right and left PCA-P2 • Right and left ACA-A3 (pericallosal artery) • Right and left MCA-M4 • Right and left ICV • GCV
7-point*	<ul style="list-style-type: none"> • Right and left ACA-A3 (pericallosal artery) • Right and left MCA-M4 • Right and left ICV • GCV
4-point*	<ul style="list-style-type: none"> • Right and left MCA-M4** • Right and left ICV

*One point is noted for each nonopacified vessel in the late phase. Cerebral circulatory arrest is diagnosed with the score of 10, 7, or 4 points, accordingly;

** according to the 4-point scale, opacification of 1 or 2 cortical branches of MCA on the same side does not exclude the diagnosis of cerebral circulatory arrest provided there is no opacification of ICVs.

$$\text{Cerebral Blood Flow} = \frac{\text{Cerebral Perfusion Pressure}}{\text{Cerebrovascular Resistance}} = \frac{(\text{MAP} - \text{ICP})}{\text{CVR}}$$

- Brain death leads to elevated ICP from edema
 - When $\text{ICP} > \text{MAP}$, cerebral arteries close
- Sensitivity based on lack of opacification of:
 - Internal cerebral veins & vein of Galen 98-100%
 - Middle cerebral artery cortical branches 86-100%
 - Basilar artery 83-94%
 - Posterior cerebral artery cortical branches 79%
 - Anterior cerebral artery cortical branches 64%
- Limitations
 - Opacification can be altered by uneven ICP (decompressions, fontanelles, skull fx, etc)
 - Infratentorial area has higher ICP than supratentorial

Diagnosis

- Brain death likely due to:
 - Hemorrhagic shock
 - TBI
 - Intra-cranial hemorrhage

Discussion

- Brain death is usually diagnosed clinically
 - Absent cerebral motor function, pupillary light reflex, corneal reflex, oculovestibular reflex, jaw jerk, gag reflex, cough, sucking reflex.
 - Must be in coma, and fail apnea test
 - Observation period is not required for adults
- Indication for ancillary tests
 - Use tests for cerebral blood flow like CTA, MRA, TCD, Angiography, Nuclear Medicine (most common)
 - Lack of cerebral blood flow is consistent with whole brain death
 - Used when clinical criteria are insufficient for diagnosis
 - CNs can't be tested, heavily sedated, shorten observation period, other confounders

ACR appropriateness Criteria

Cost for imaging

Variant 1: Major blunt trauma. Hemodynamically unstable. Initial imaging.		
Procedure	Appropriateness Category	Relative Radiation Level
Radiography trauma series	Usually Appropriate	☼☼☼
US FAST scan chest abdomen pelvis	Usually Appropriate	0
CT whole body with IV contrast	May Be Appropriate	☼☼☼☼
CT whole body without IV contrast	May Be Appropriate	☼☼☼☼
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	0
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	0

- Pt had FAST and plain films prior to surgery, and whole body CT afterwards

- Chest X-Ray - \$683
- Pelvis X-Ray - \$719
- CT Brain w/o contrast - \$3157
- CT Face w/o contrast - \$4409
- CT C-Spine w/o contrast - \$5651
- CT Chest w/ contrast - \$3936
- CT Abd/pelvis w/ contrast - \$7998
- CTA Head+Neck - \$4460 + \$2666
- Total = \$33,679

References

- Sawicki, Marcin et al. "CT Angiography in the Diagnosis of Brain Death." *Polish journal of radiology* vol. 79 417-21. 15 Nov. 2014, doi:10.12659/PJR.891114
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- Young, Bryan. "Diagnosis of Brain Death." UpToDate, 8 Mar. 2018, www.uptodate.com/contents/diagnosis-of-brain-death?search=brain%2Bdeath&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1.



Questions?