

AMSER Case of the Month

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11yo F presenting with headache and neck pain

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Patient Presentation

- 11yo F without significant PMHx presents to the ED c/o headache, fever ($>100^{\circ}\text{F}$), fatigue, vomiting, and neck pain over past week
 - Difficulty walking due to weakness in legs, leading to recent falls
 - Drooping of L face and bulging of R forehead
 - No sick contacts, up-to-date on all immunizations
- **Vitals:** BP 128/87, Pulse 81, Temp 98.2 F (36.8°C), Resp 26, SpO2 97%
- **Physical Exam:**
 - **HENT:** diffuse neck tenderness, pain with neck movement
 - **Neuro:** lethargic, sensation equal and intact in all 4 extremities, 4/5 strength throughout, L eyelid droop, L pupil sluggish and minimally reactive, protruding R frontal forehead, ecchymosis over R eyebrow

Pertinent Labs

- WBC 23.4 (H)
- Neutrophils 90.5 (H)
- Lymphocytes 3.7 (L)
- Eosinophil 0.0 (L)
- Glucose 121 (H)
- Carbon Dioxide 19 (L)
- Creatinine 0.31 (L)
- Lipase 5 (L)

What Imaging Should We Order?

ACR Appropriateness Criteria¹

Variant 3: Child. Sinusitis with clinical concern of orbital or intracranial complications. Initial imaging.

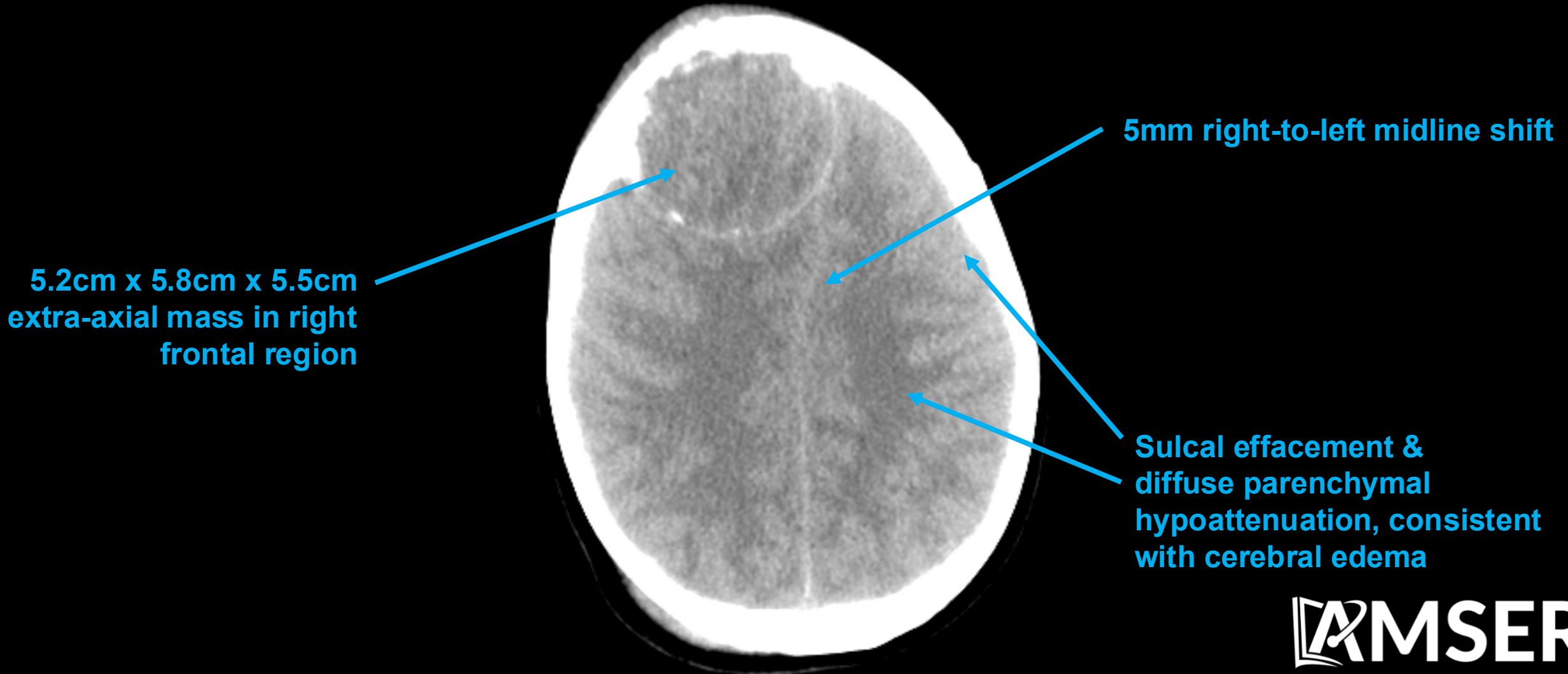
Procedure	Appropriateness Category	SOE	Adult RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
CT head and paranasal sinuses with IV contrast	Usually appropriate	Limited References		☼☼☼ 0.3-3 mSv [ped]	9	9	0	0	0	0	0				
MRI head and paranasal sinuses without and with IV contrast	Usually appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	8	8	0	0	1	0	2	0	1		
MRA head with IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	4	4	2	2	0	7	7	1	0		
MRA head without IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	5	5	1	0	1	3	13	1	0		
MRV head with IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	6	6	0	0	0	1	8	5	2	2	0
MRV head without and with IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	5	5	2	0	1	2	9	4	1	0	0
MRV head without IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	5	5	2	0	1	3	9	3	1	0	0
CTA head with IV contrast	May be appropriate	Limited References	☼☼☼ 1-10 mSv	☼☼☼☼ 3-10 mSv [ped]	5	5	1	0	0	3	13	2	0	0	0
CTV head with IV contrast	May be appropriate	Limited References	☼☼☼ 1-10 mSv	☼☼☼☼ 3-10 mSv [ped]	5	5	0	0	0	2	8	3	5	0	0
Radiography paranasal sinuses	Usually not appropriate	Expert Consensus	☼ <0.1 mSv	☼ <0.03 mSv [ped]	1	1	16	2	0	0	0	0	0	0	0
CT head and paranasal sinuses without and with IV contrast	Usually not appropriate	Limited References		☼☼☼☼ 3-10 mSv [ped]	1	1	10	2	4	2	0				
CT head and paranasal sinuses without IV contrast	Usually not appropriate	Limited References		☼☼☼ 0.3-3 mSv [ped]	3	3	3	5	5	1	2				
MRI head and paranasal sinuses without IV contrast	Usually not appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	3	3	3	2	7	4	3				

This imaging modality was ordered by the ER physician

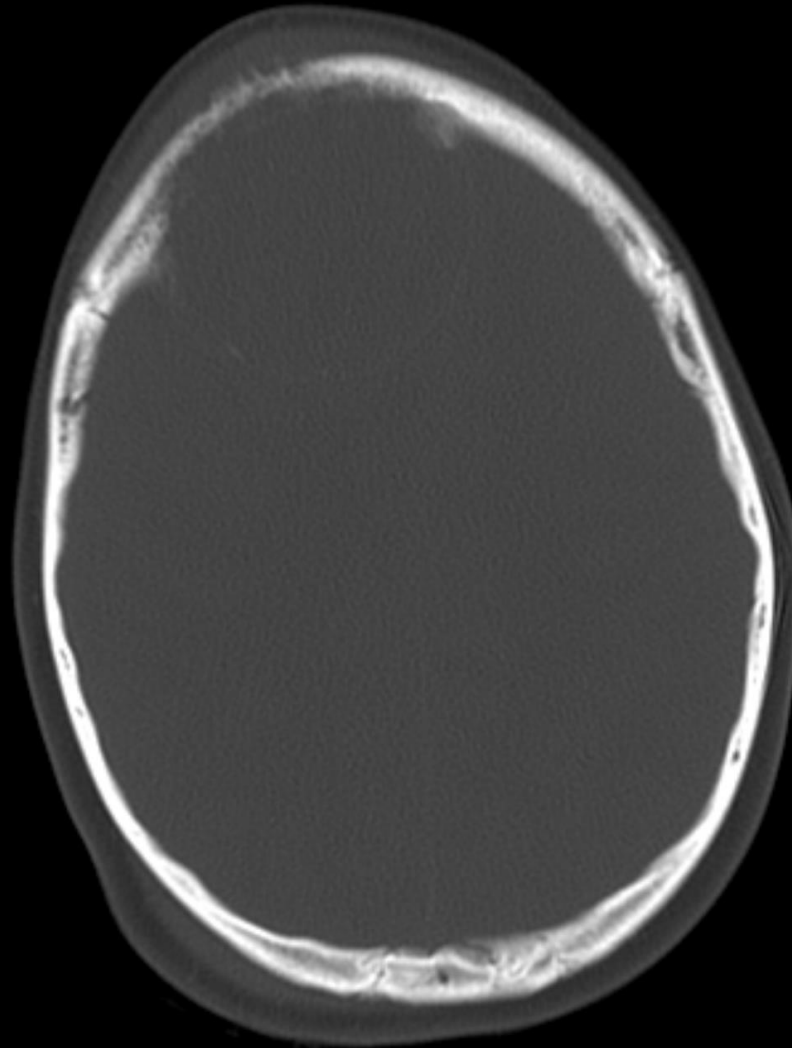
Axial CT Head w/ IV Contrast (unlabeled)



Axial CT Head w/ IV Contrast (labeled)

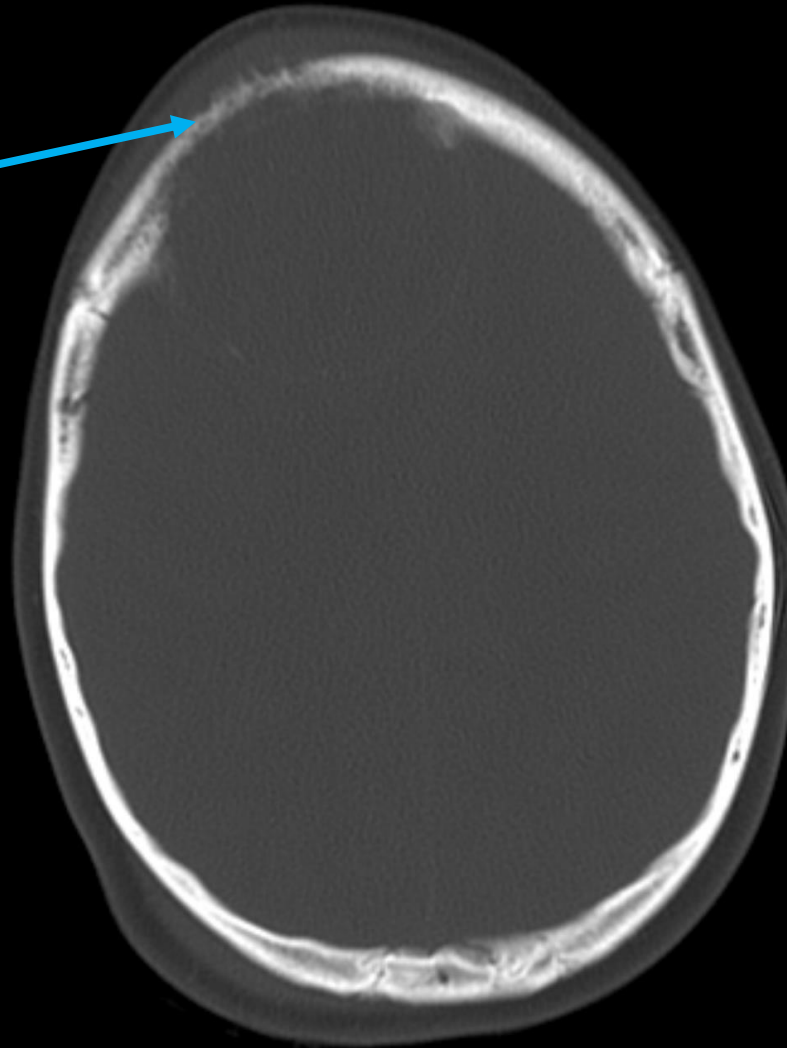


Axial CT Head w/ IV Contrast, bone window (unlabeled)



Axial CT Head w/ IV Contrast, bone window (labeled)

Ill-defined, permeative
lytic lesion on calvarium



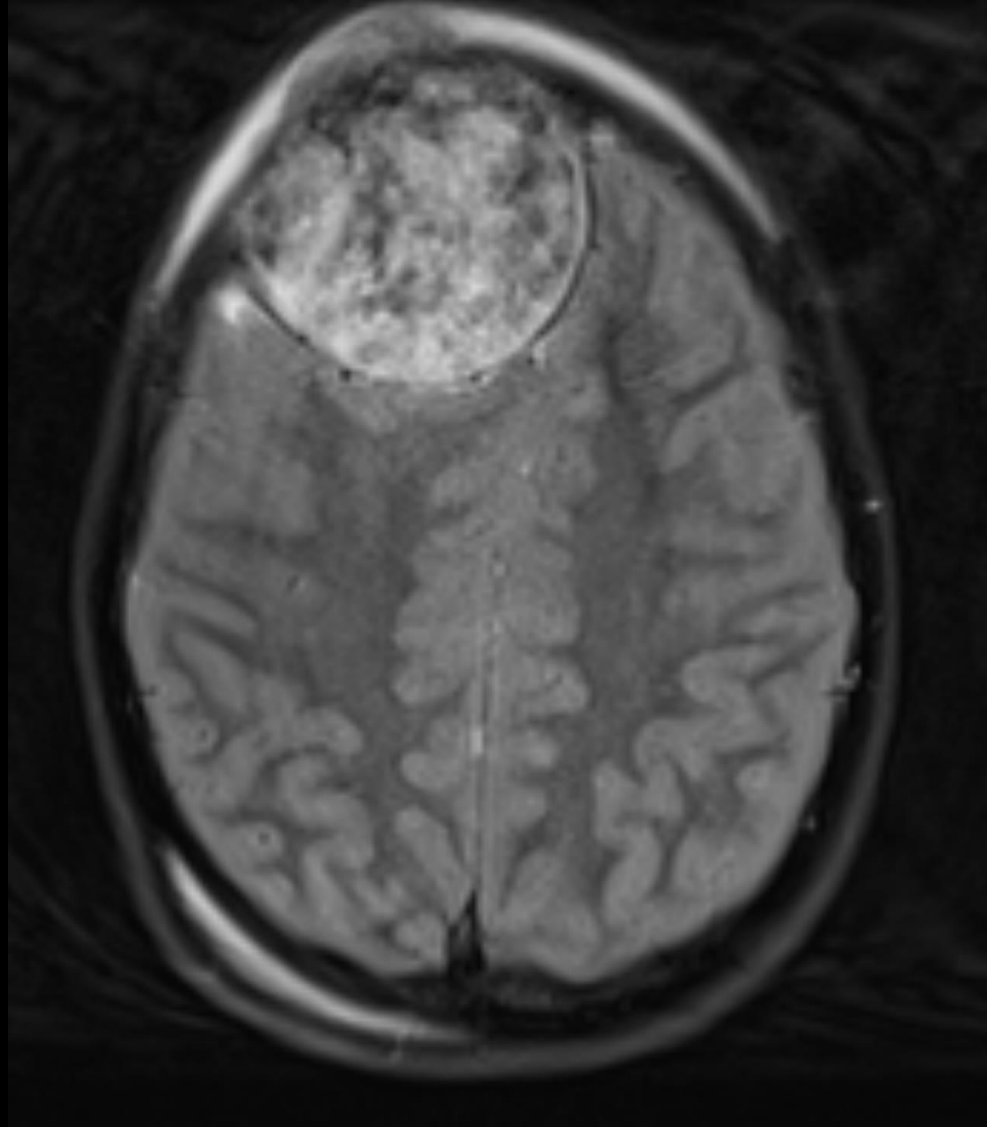
ACR Appropriateness Criteria for Subsequent Imaging¹

Variant 4: Adult. Suspected extra-axial brain tumor on prior imaging. Pretreatment evaluation.

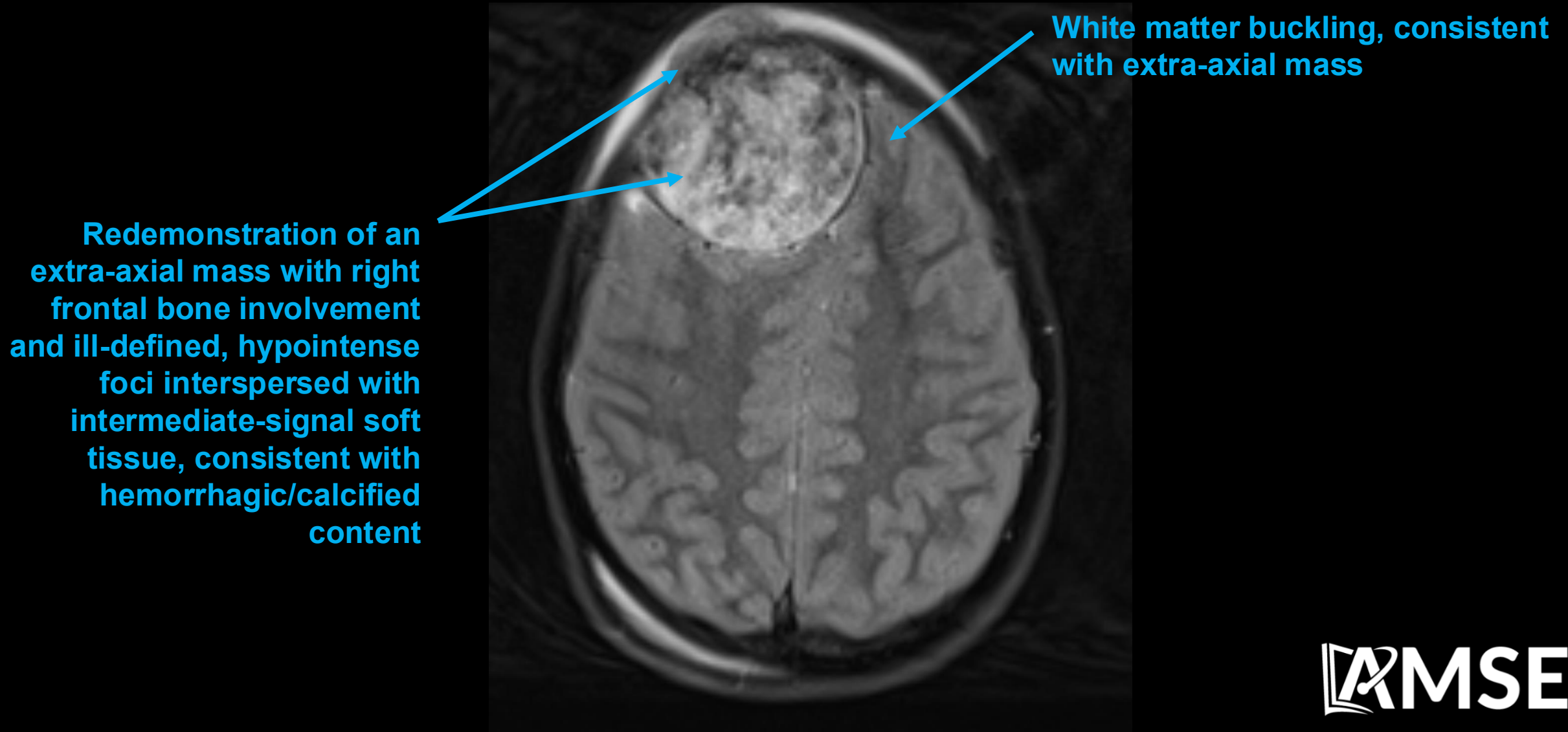
Procedure	Appropriateness Category	SOE	Adult RRL	Peds RRL	Rating	Median	Final Tabulations								
							1	2	3	4	5	6	7	8	9
MRI head without and with IV contrast	Usually appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	9	9	0	0	1	0	0	0	0	0	0
MRI complete spine without and with IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	5	5	0	1	1	1	7	6	0	0	0
MRI functional (fMRI) head without IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	4	4	3	1	2	4	4	1	0	0	0
MRI head without IV contrast	May be appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	5	5	0	1	0	1	14	0	0	0	0
DOTATATE PET/CT brain	May be appropriate	Strong References	☼☼☼ 1-10 mSv		6	6	0	0	1	1	4	6	3	1	0
DOTATATE PET/MRI brain	May be appropriate	Strong References	☼☼☼ 1-10 mSv		6	6	0	0	1	1	5	5	3	1	0
MR spectroscopy head without IV contrast	Usually not appropriate	Expert Consensus	O 0 mSv	O 0 mSv [ped]	1	1	12	1	1	0	2	0	0	0	0
MRI complete spine with IV contrast	Usually not appropriate	Expert Consensus	O 0 mSv	O 0 mSv [ped]	1	1	11	1	1	1	1	0	0	0	1
MRI complete spine without IV contrast	Usually not appropriate	Expert Consensus	O 0 mSv	O 0 mSv [ped]	1	1	12	1	2	0	1	0	0	0	0
MRI head perfusion with IV contrast	Usually not appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	3	3	5	1	3	1	6	0	0	0	0
MRI head perfusion without IV contrast	Usually not appropriate	Limited References	O 0 mSv	O 0 mSv [ped]	3	3	5	1	4	0	0	0	0	0	0
MRI head with IV contrast	Usually not appropriate	Expert Consensus	O 0 mSv	O 0 mSv [ped]	1	1	14	1	1	0	0	0	0	0	0

This imaging modality was ordered by the PICU physician

Axial T2 MRI (unlabeled)



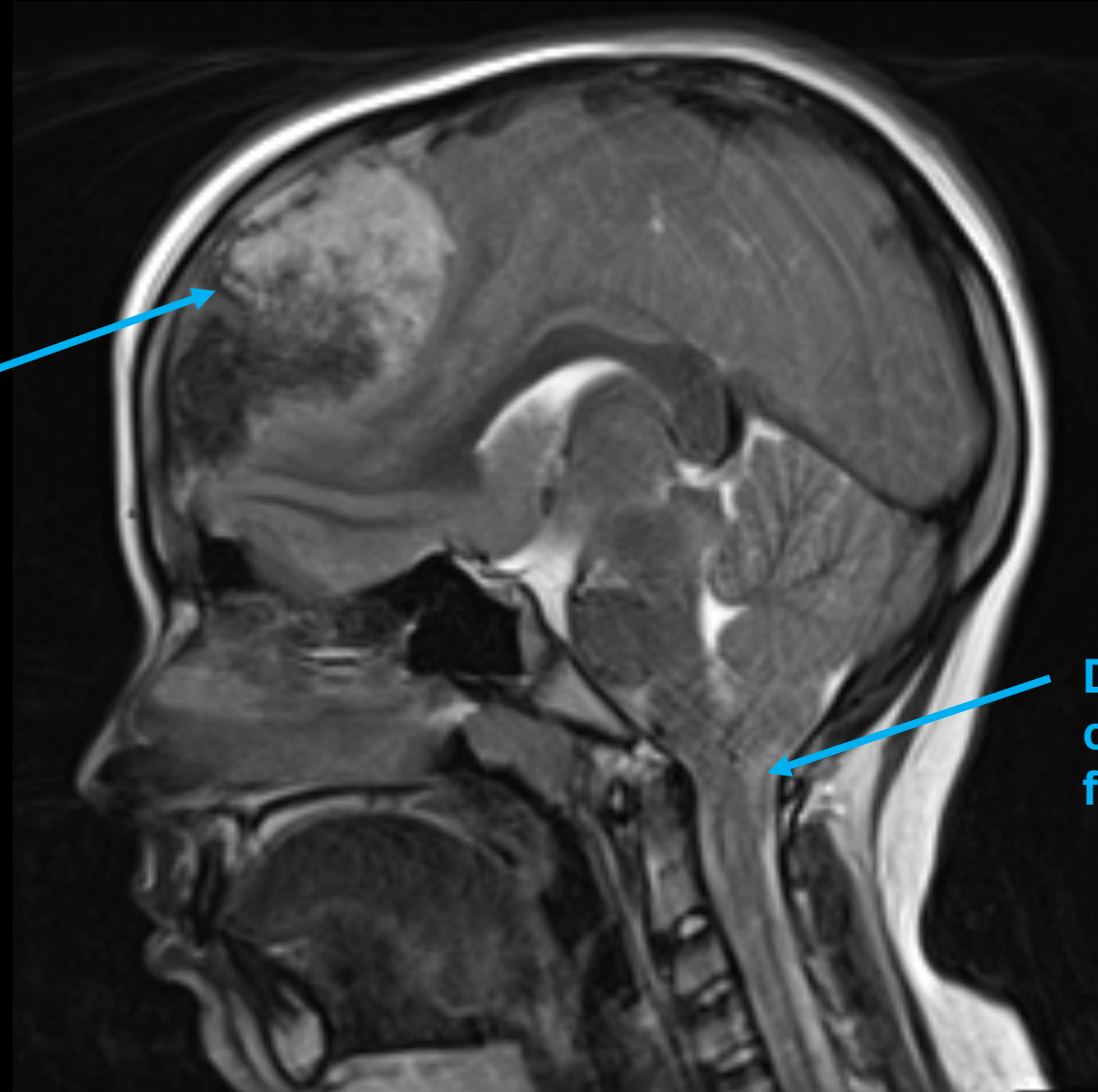
Axial T2 MRI (labeled)



Sagittal T2 MRI (unlabeled)



Sagittal T2 MRI (labeled)



Redemonstration of an extra-axial mass with right frontal bone involvement and ill-defined, hypointense foci interspersed with intermediate-signal soft tissue, consistent with hemorrhagic/calcified content

Downward herniation of cerebellar tonsils through foramen magnum

Differentials:

Meningioma, dural metastasis, Ewing sarcoma

With pathology, final Dx:

Ewing Sarcoma

Case Discussion

- Ewing sarcoma is the second most common bone malignancy in pediatric populations, often found in the pelvic and proximal long bones.²
 - Less than 1% of all primary Ewing sarcomas present in the skull.²
- Ewing sarcoma presents as a fast-growing malignancy.³
 - In this patient, tumor grew rapidly, leading to protruding forehead with ecchymosis and tonsillar herniation.
- Fever, fatigue, and elevated inflammatory markers can be mistaken for infectious process, but these constitutional symptoms are often seen in Ewing sarcoma.³

Case Discussion

- Differential for a child with fever, frontal forehead mass, and leukocytosis is broad.
 - Initial presentation matches that of **Pott puffy tumor**: subperiosteal abscess of the forehead with frontal bone osteomyelitis secondary to sinusitis.⁴
 - Even after imaging, meningioma, dural metastasis, osteomyelitis, and Langerhans cell histiocytosis can be difficult to distinguish from Ewing sarcoma.
- **Biopsy with NGS using molecular confirmation of EWSR1 fusion is necessary for definitive diagnosis of Ewing sarcoma.**³

Case Discussion

- CT and MRI provide complementary information to aid in management of cranial masses.
- Initial CT imaging provides rapid evaluation of the mass, mass effect, and bony involvement. Subsequent MRI demonstrates extent of invasion and potential hemorrhagic/calcified components.⁵
 - In this patient, MRI redemonstrated CT findings with greater detail, particularly tonsillar herniation secondary to mass effect, indicating the need for urgent neurosurgical evaluation.
- **If MRI is not available, head CT is adequate in assessing the need for emergent surgical intervention.**⁵

References:

¹American College of Radiology. ACR Appropriateness Criteria[®]. Available at <https://acsearch.acr.org/list>.

²Saifuddin MSAH, Ng CY, Abdullah MS. Skull Base Primary Ewing Sarcoma: A Radiological Experience of a Rare Disease in an Atypical Location. *Am J Case Rep*. 2021;22. doi:[10.12659/AJCR.930384](https://doi.org/10.12659/AJCR.930384)

³Riggi N, Suvà ML, Stamenkovic I. Ewing's Sarcoma. *New England Journal of Medicine*. 2021;384(2):154-164. doi:[10.1056/NEJMra2028910](https://doi.org/10.1056/NEJMra2028910)

⁴Daloiso A, Mondello T, Boaria F, et al. Pott's Puffy Tumor in Young Age: A Systematic Review and Our Experience. *Journal of Clinical Medicine*. 2024;13(21):6428. doi:[10.3390/jcm13216428](https://doi.org/10.3390/jcm13216428)

⁵Matcuk GR, Tivorsak T, Watterson CT, et al. Imaging of ewing sarcoma: an updated analysis including presenting features, prognostic imaging biomarkers, and treatment response assessment. *Skeletal Radiol*. 2026;55(9):2195-2217. doi:[10.1007/s00256-026-05238-8](https://doi.org/10.1007/s00256-026-05238-8)