C34 – Pseudoprogression vs. True Progression in Glioblastoma: MRI
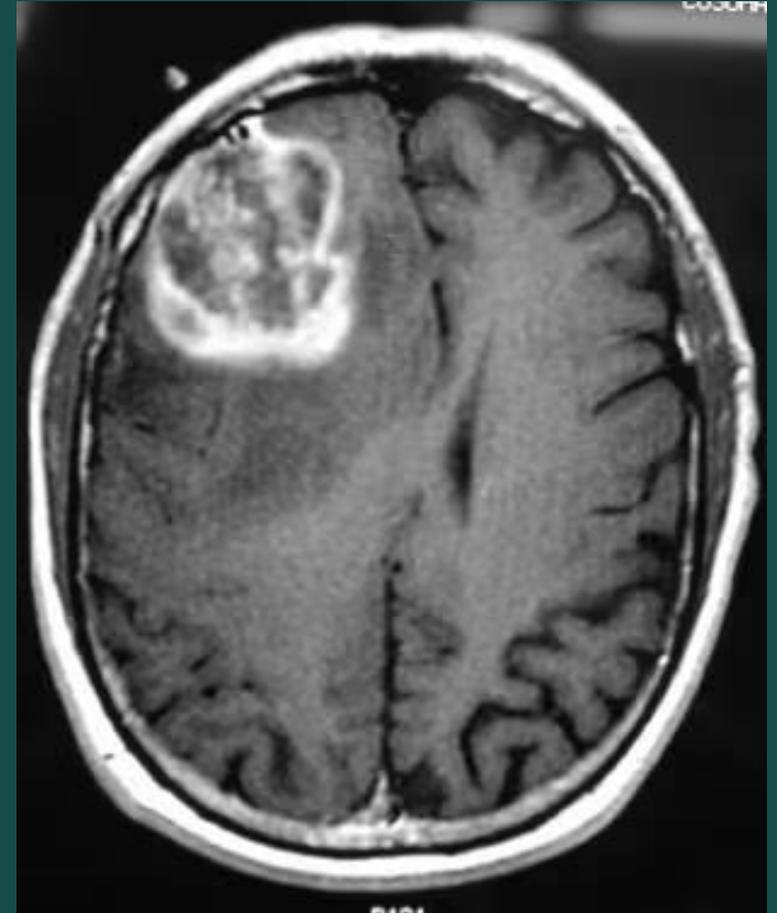
Objectives

- Define Glioblastoma and understand how MRI is used to diagnose.

- Compare true tumor reoccurrence to pseudo progression caused by treatment.

- Understand advanced imaging options to help differentiate.

- Recognize symptoms caused by Glioblastoma.

Thesis

- Using MRI to diagnose a Glioblastoma, conventional techniques can have a difficult time distinguishing actual tumor progression from pseudoprogression that can be a side effect from certain treatments. Using advanced imaging techniques such as perfusion-weighted imaging and spectroscopies are crucial in making an accurate diagnosis and a better outcome for the patient.

Glioblastoma

- Brain tumor

- Originates from glial cells that support and protect the neurons in the brain

- Most common and aggressive type of brain tumor in adults

- Glioblastoma is the most common malignant primary brain tumor, and many refer to it as the "emperor of all cancers." This is because it is a very difficult disease to treat, and the highly invasive nature of this disease causes significant morbidity and mortality (Lobera, 2024).

https://emedicine.medscape.com/article/340870-overview

Common Symptoms of Glioblastoma

Glioblastoma
(most frequent sites where glioblastoma is localized and the estimated percentages)

32% — Frontal lobe
23% — Parietal lobe
7% — Occipital lobe
33% — Temporal lobe
0,4% — Cerebellum

https://www.mayoclinic.org/diseases-conditions/glioblastoma/symptoms-causes/syc-20569077

- Specific to region impacted by tumor
- Occipital lobe- vision problems, blurriness or loss of vision
- Cerebellum/brainstem- balance issues, dizziness, and coordination problems
- Temporal lobe- Memory, speech, and hearing
- Frontal lobe- personality changes or weakness on one side of body
- *Glioblastomas are most commonly found in the frontal or temporal lobes but they can occur in any part of the brain or spinal cord (Pruthi, 2024).
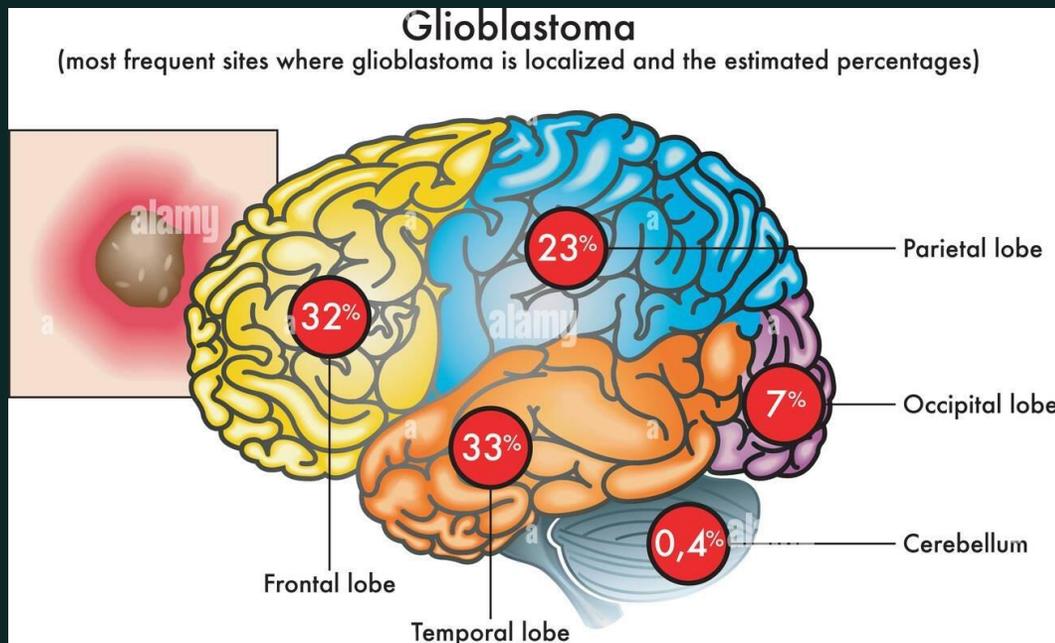
Diagnosis using MRI

MRI is the gold standard- can locate and evaluate the size, characteristics, and extent of tumor.

Uses contrast to show "ring enhancement" with a necrotic center and surrounding edema- this indicates a breakdown of the blood-brain barrier

Conventional MRI used for initial diagnosis, surgical planning, and monitoring the tumor's response to treatment (Kalpathy, 2014).

Standard Sequences

T1 Weighted- Provide anatomical detail
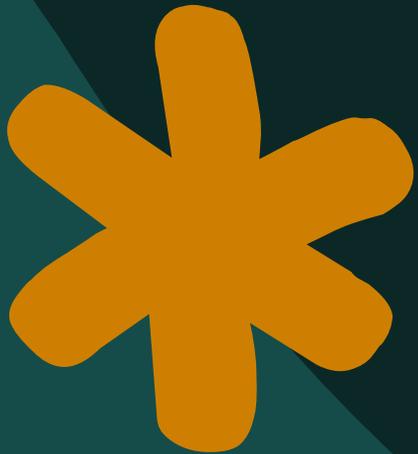
T2 Weighted- Can show edema (bright) surrounding the tumor

FLAIR- Suppresses CSF- allows edema and tumor to appear better

T1 Post Contrast- Using contrast reveals enhancing areas of the tumor where the blood-brain barrier is disrupted

Pseudoprogression

- After having chemotherapy or radiation therapy, the brain tissue surrounding the actual tumor will often become inflamed and can represent tumor growth but is just a side effect from the treatment (Kwatra, 2024).

- Standard treatment typically involves a six-week radiation therapy schedule. The difficulty with determining outcomes for the patient is that with pseduoprogression, they are usually forced to wait until after treatment to see if the tumor is reducing or growing in size. Doing this eliminates the risk of a patient being treated for a progressing disease when it is actually pseudoprogression.

Case Study

- Images obtained of a 59 year old male with a glioblastoma undergoing radiation therapy.

- One month after treatment, there is a false impression of growth within the tumor and surrounding tissue in the temporal lobe.

- In follow up images within the months after, it shows the tumor is actually shrinking (Cruz, 2011).

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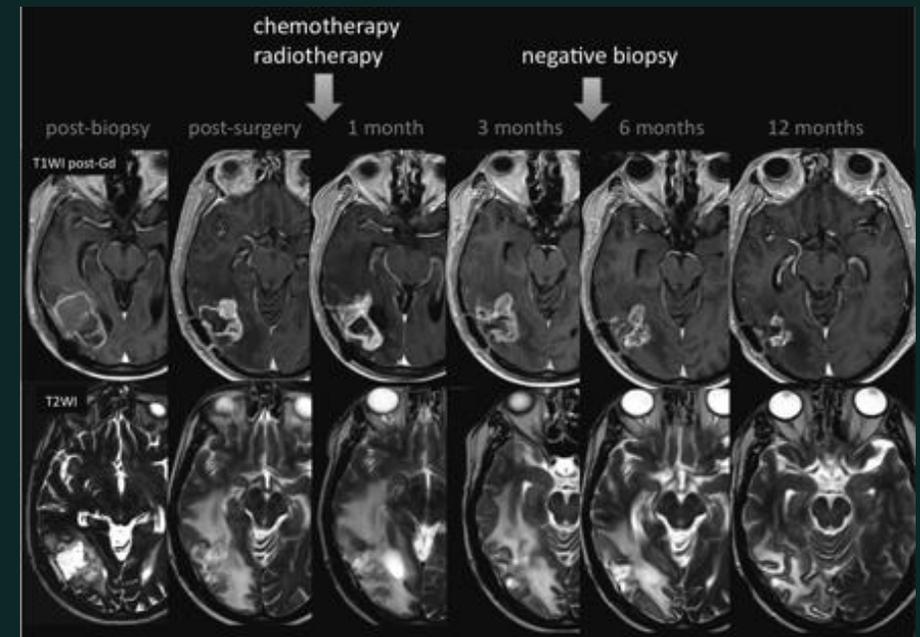
Advanced Imaging Options- Perfusion-weighted imaging

- Assesses blood flow and blood volume in the brain, neovascularization in the tumor- they require high vascularity to grow.
- Distinguish tumor progression from post-treatment effects like pseudo progression and high-grade from low-grade tumors.
- Perfusions create cerebral blood volume maps, which demonstrate grades of tumors- higher values of blood=higher grade of tumor (Cruz, 2011).
- If pseudoprogression is a concern, the perfusion scan can help to show if there is true increased blood flow to the area or not.

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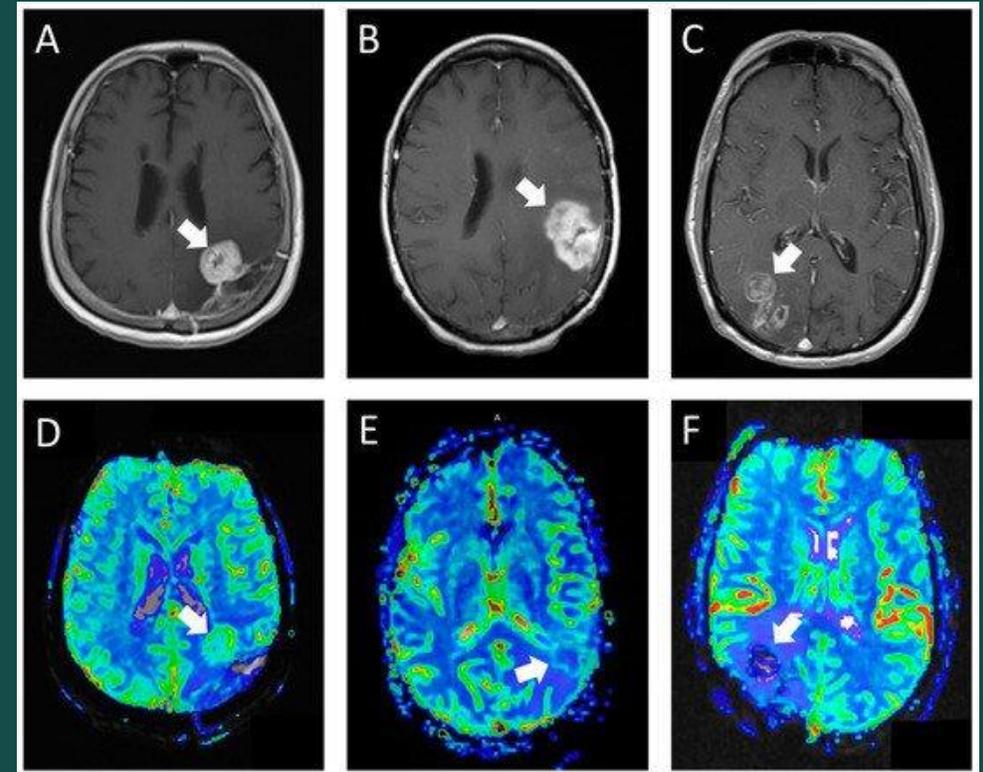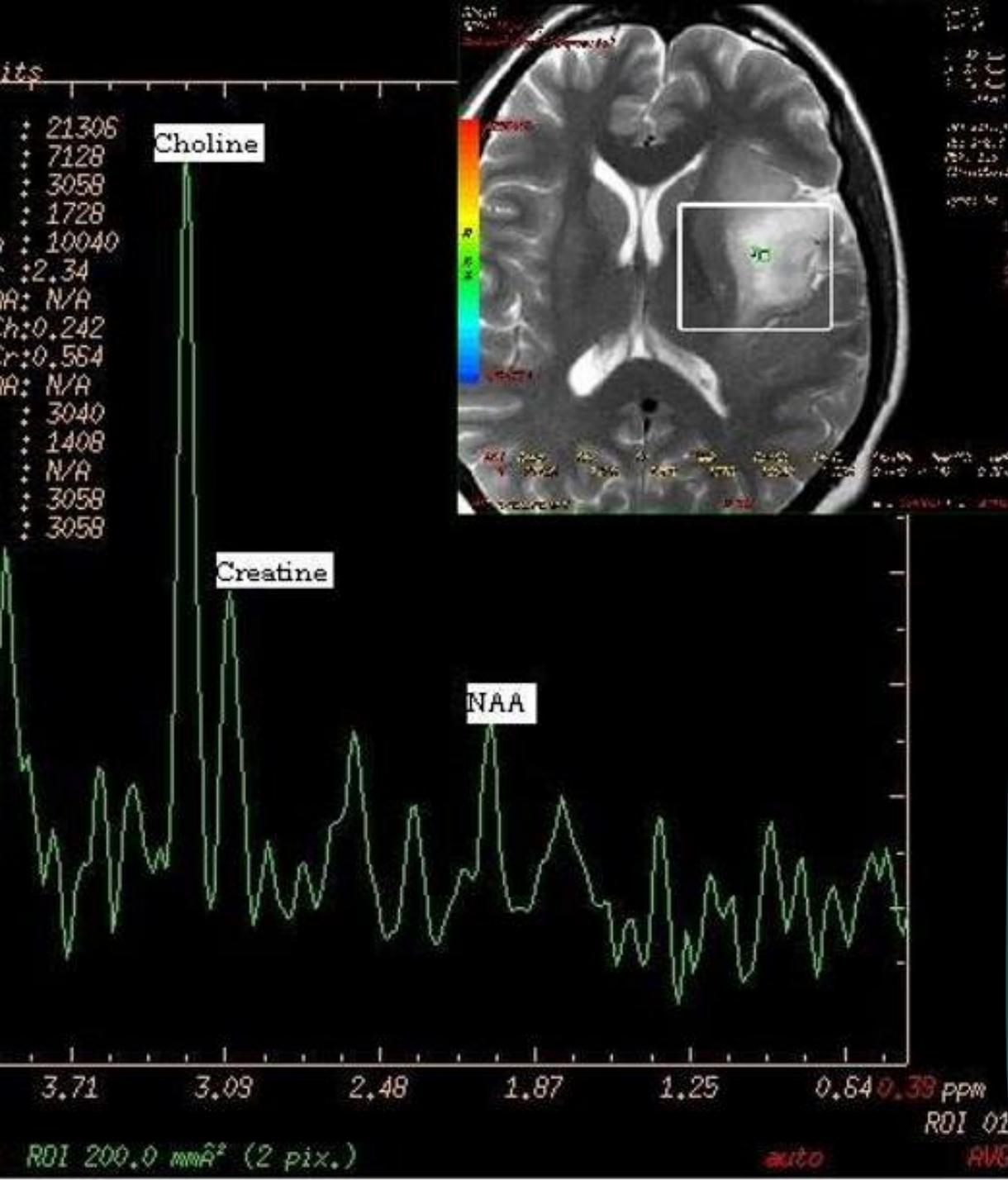
Advanced Imaging Options- Spectroscopy

- Imaging technique that focuses on a specific area, either single-voxel or multi-voxel and assess the chemical compounds of that area.

- It is able to distinguish between normal healthy brain tissue compared to areas with a tumor.

- It measures certain peaks such as choline, creatine, and lactate.

- Ex. High choline to creatine ratio is a key indicator of Glioblastoma- represents increased cell membrane turnover due to rapid cell proliferation, there would be no peak with pseudoprogression (Khana, 2025).

https://radiopaedia.org/articles/mr-spectroscopy-1

Conclusion

- Pseudoprogression is a huge concern for patients undergoing treatment for a Glioblastoma, however, using proper advanced imaging within MRI can significantly help differentiate between actual growth and pseudoprogression.

- Utilizing these techniques can save a patient from undergoing excessive treatment without waiting for their treatment course to be over.

- Spectroscopies and perfusion weighted imaging are highly successful in differing between the two and can remarkably help a patient's outcome dealing with a Glioblastoma.

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