

AMSER Case of the Month

August 2020

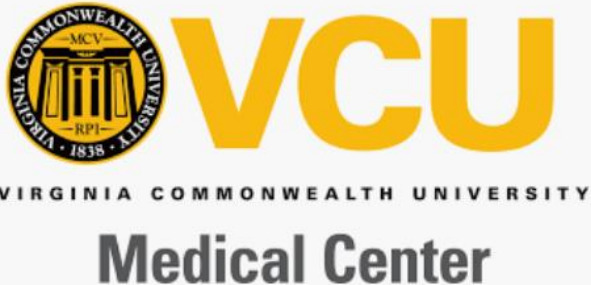
2-year-old with Neurofibromatosis type I with Headache

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VCU Health



Patient Presentation

- HPI: A 2 year old girl with **NF type I** confirmed by genetic testing presents to the neurology clinic with a h/o of HA for 9 months. **HA can wake her up from sleep**. Onset varies. No modifying factors. No vomiting, photophobia, phonophobia.
- PMHx: NF type 1, + genetic testing.
- PSHx- bilateral ear tubes
- Fam Hx: Paternal Grandfather with DM, Twin brother healthy

Exam

- Gen – well appearing child
- Head and Neck- atraumatic, normocephalic, neck supple
- Eye- VA Fixes and Follows
 - Left eye polar cataract outside of visual axis
- CV- nl S1, S2, no murmurs
- Lungs- CTAB
- GI-Soft NT, ND
- Skin- **café au lait spots**, no axillary/inguinal freckling, no fibromas
- Neuro-CN 2-12 grossly intact, normal gait, DTR 2+, no abnormal movements

- What Imaging Should We Order?

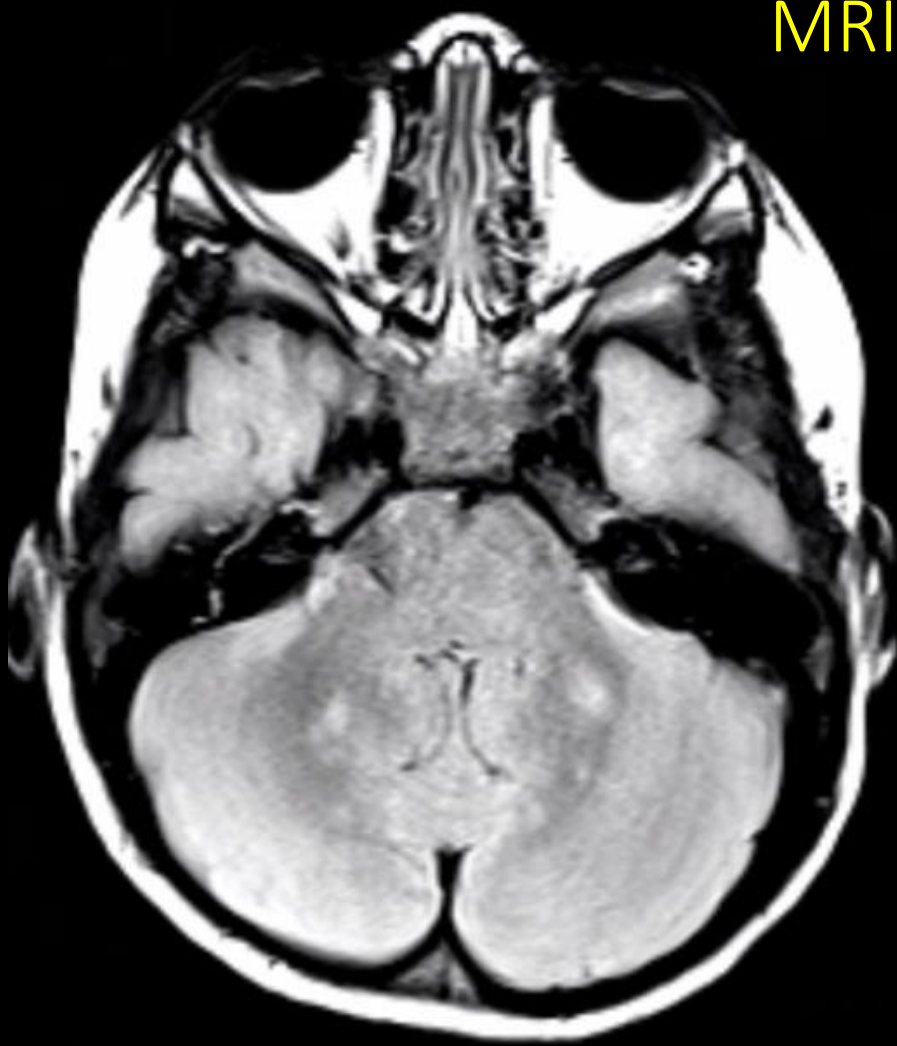
ACR Appropriateness Criteria

Variant 2: Child. Secondary headache. Initial imaging.		
Procedure	Appropriateness Category	Relative Radiation Level
MRI head without IV contrast	Usually Appropriate	0
MRI head without and with IV contrast	Usually Appropriate	0
CT head without IV contrast	May Be Appropriate	☼☼☼
MR venography head without IV contrast	May Be Appropriate	0
MRA head without IV contrast	May Be Appropriate	0
CT venography head with IV contrast	May Be Appropriate	☼☼☼☼
CTA head with IV contrast	May Be Appropriate	☼☼☼☼
MR venography head with IV contrast	Usually Not Appropriate	0
Arteriography cerebral	Usually Not Appropriate	☼☼☼☼
CT head with IV contrast	Usually Not Appropriate	☼☼☼
CT head without and with IV contrast	Usually Not Appropriate	☼☼☼☼
X-ray skull	Usually Not Appropriate	☼☼

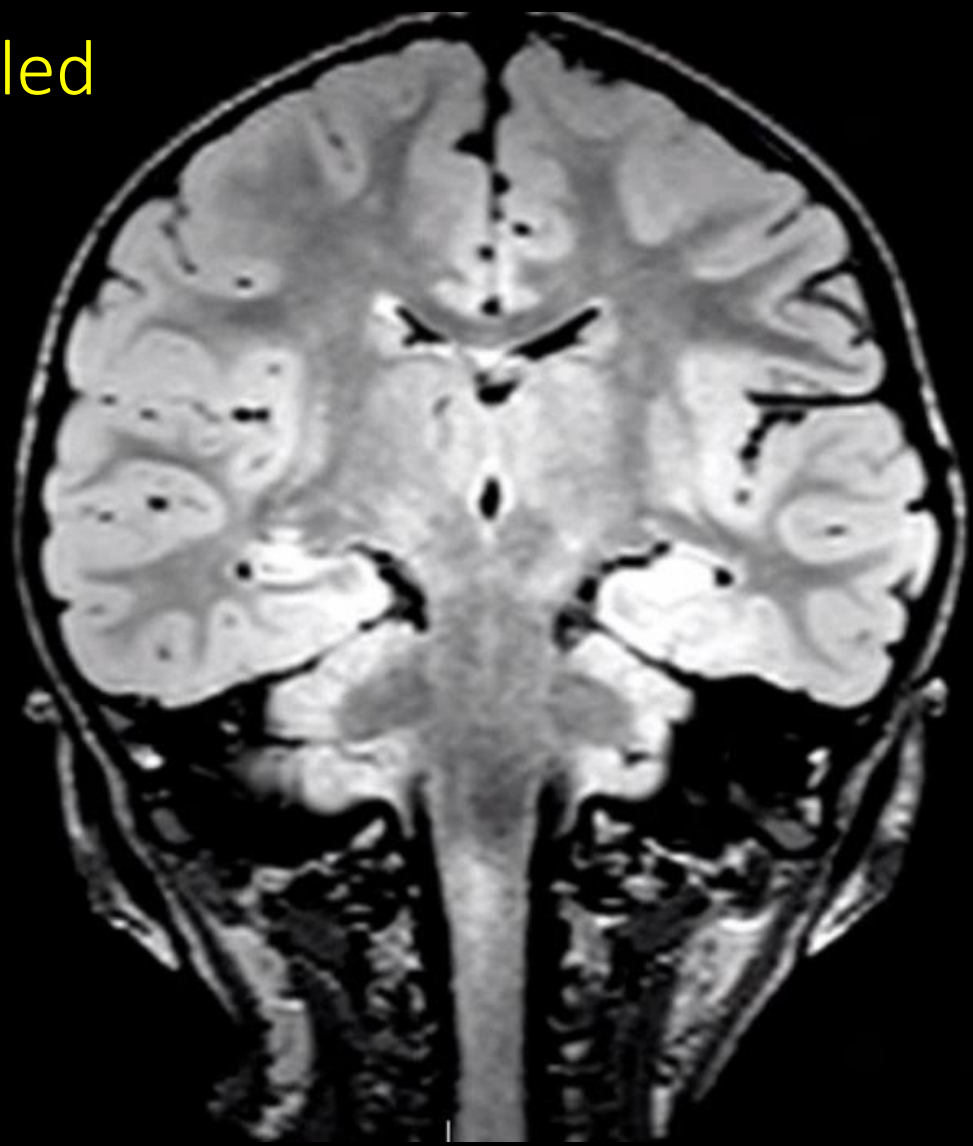
← Ordered by neurologist

MRI Brain Unlabeled

2.5 yrs. old



Axial T2/FLAIR



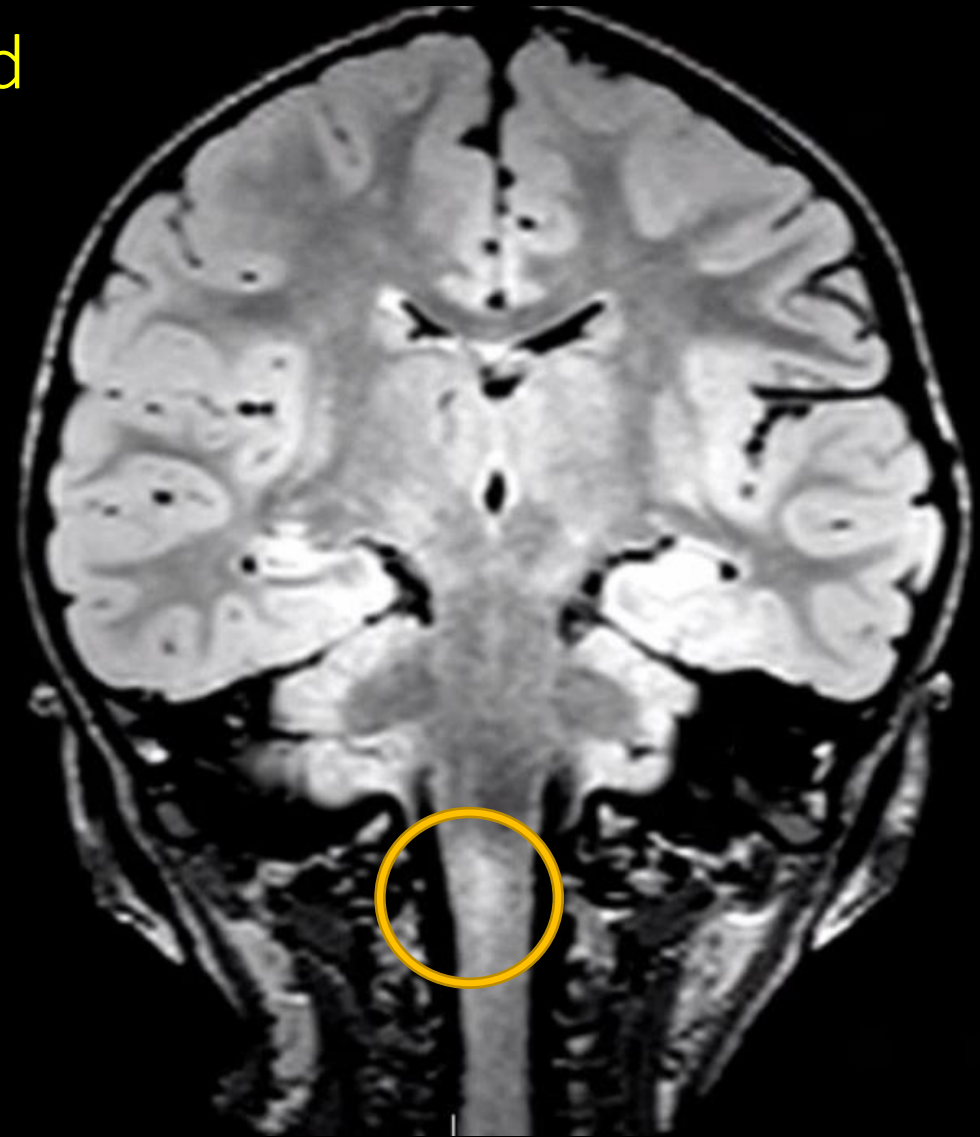
Coronal T2/FLAIR

MRI Brain Labeled

2.5 yrs. old



Axial T2/FLAIR: Non-enhancing foci of inc signal in the cerebellar white matter



Coronal T2/FLAIR: Inc signal in the right inf. aspect of medulla/cervical cord, appears expansile → attention on follow-up imaging

ACR Appropriateness Criteria

Variant 4: **Soft-tissue mass. Nondiagnostic initial evaluation. Presenting with spontaneous hemorrhage or suspicion of vascular mass. Next imaging study.**

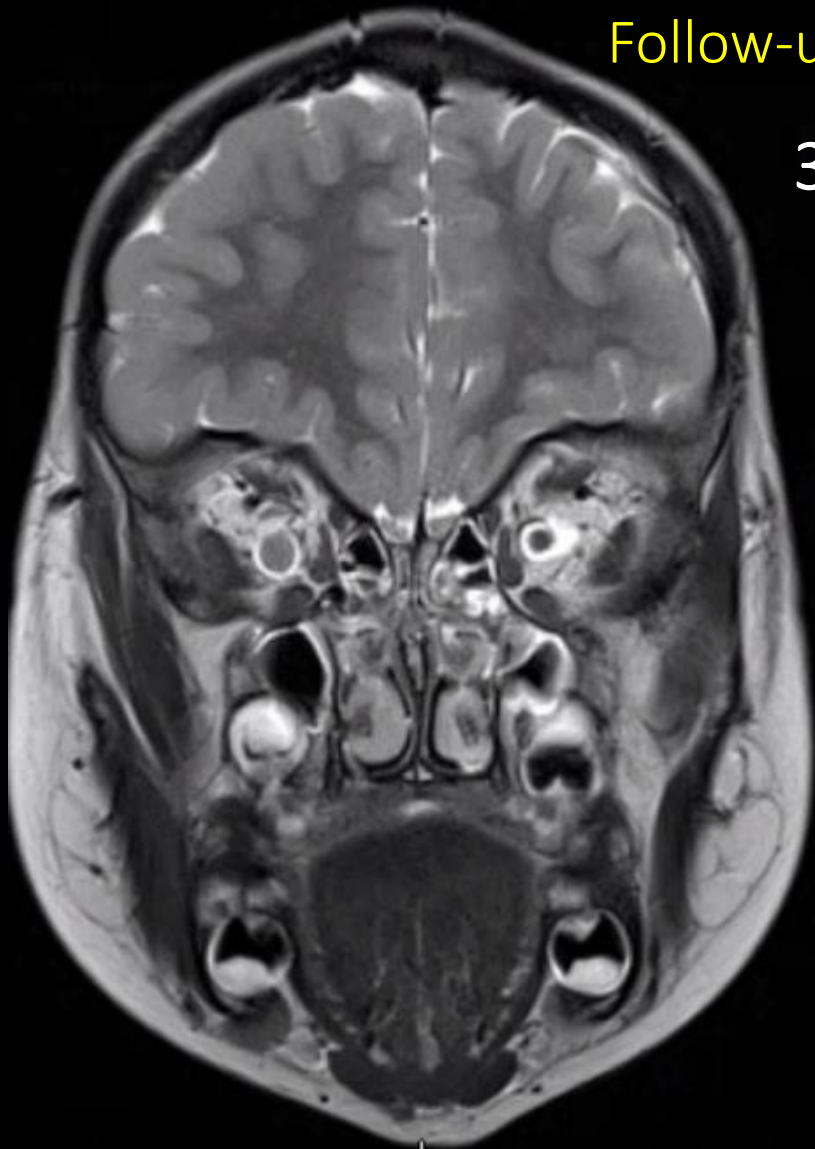
Procedure	Appropriateness Category	Relative Radiation Level
MRI area of interest without and with IV contrast	Usually Appropriate	○
CT area of interest without and with IV contrast	Usually Appropriate	Varies
CTA area of interest with IV contrast	May Be Appropriate	Varies
MRA area of interest with IV contrast	May Be Appropriate	○
MRI area of interest without IV contrast	May Be Appropriate (Disagreement)	○
CT area of interest with IV contrast	May Be Appropriate	Varies
CT area of interest without IV contrast	May Be Appropriate	Varies
FDG-PET/CT area of interest	May Be Appropriate	⊗⊗⊗⊗
US area of interest	Usually Not Appropriate	○

Abnormality in upper cervical cord on Brain MRI → Follow-up Cervical Spine MRI

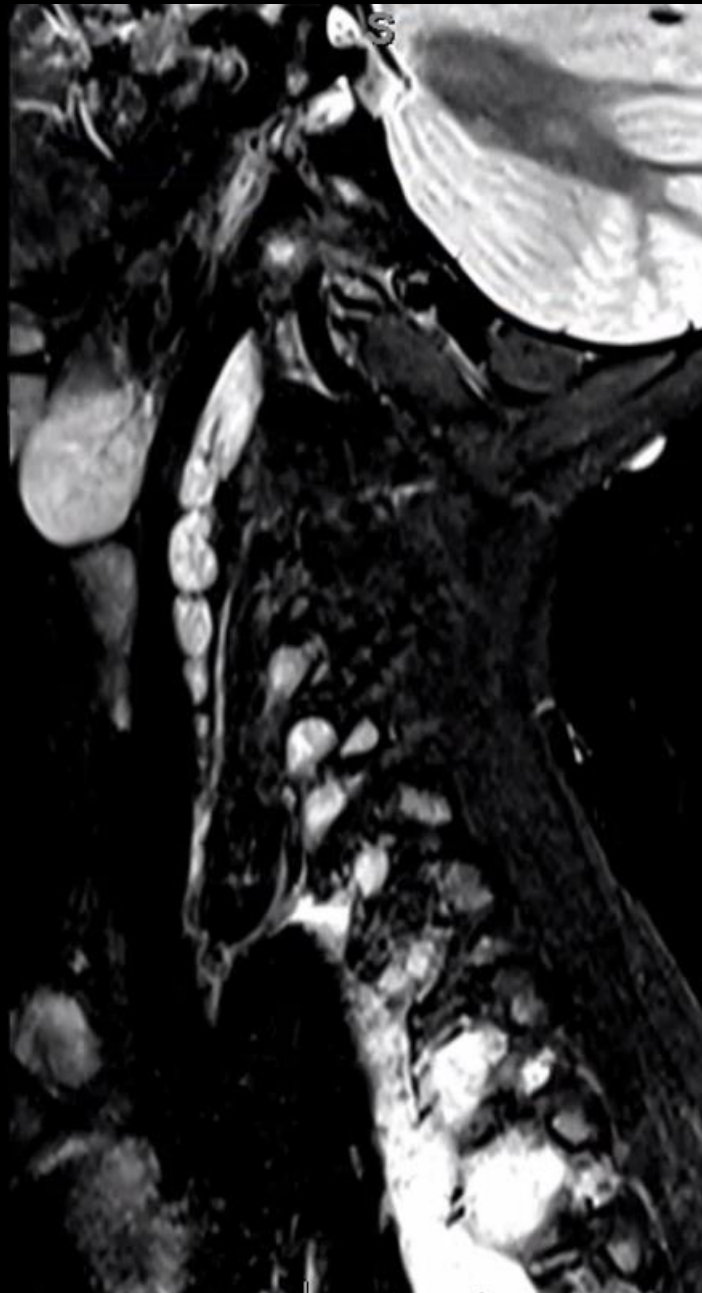
← Ordered by neurologist

Follow-up MRI Brain and C-Spine Unlabeled

3 yrs old



Coronal T2



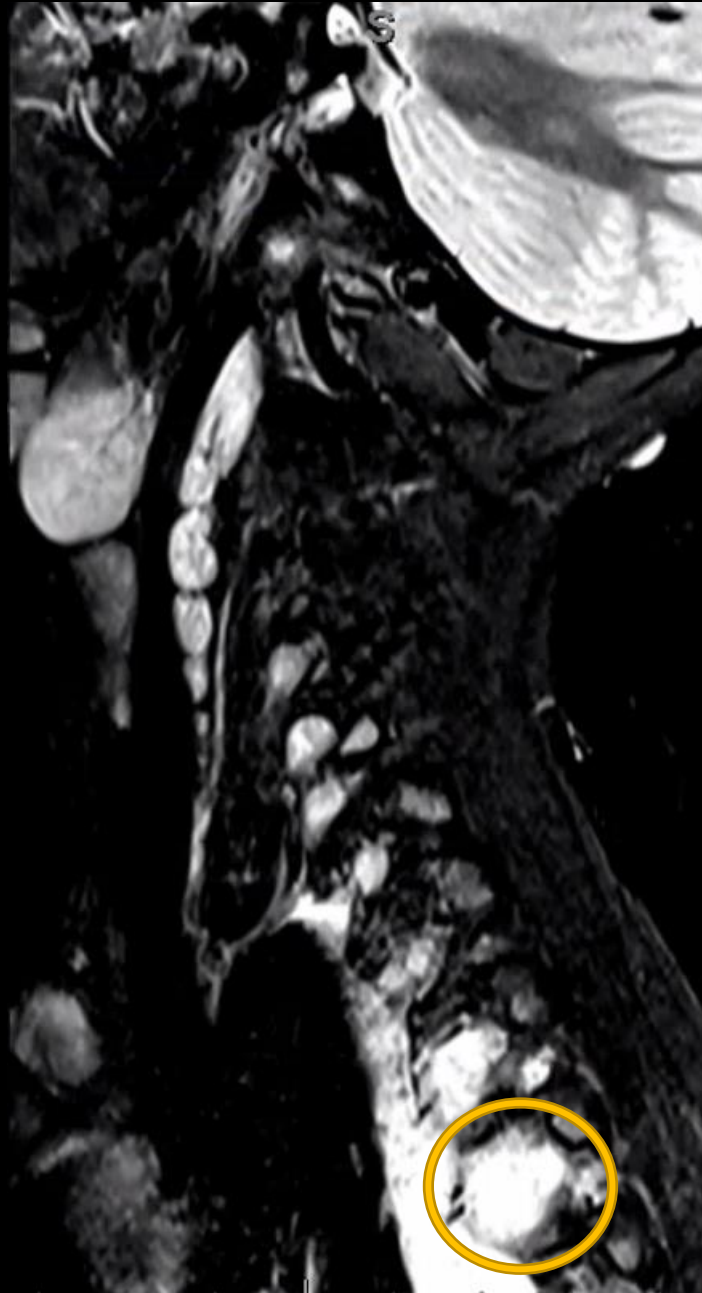
Sagittal Cervical Spine T2 Stir

Follow-up MRI Brain and C-Spine Labeled

3 yrs old



Coronal T2: Focal enlargement of R optic nerve - 6 mm diameter = **SMALL OPTIC NERVE GLIOMA**



Sagittal Cervical Spine T2 Stir :
Partially visualized paraspinal masses- likely **PLEXIFORM NEUROFIBROMAS**

Vision Problems?

Eye Exam:

- VA 20/30 OU with glasses
- Visual Field testing Full
- Optic Disc: sharp, pink, normal cup
- Left anterior polar cataract—not in visual axis
- No Lisch Nodules

ACR Appropriateness Criteria

Optic Nerve Glioma →
Follow up Orbital MRI

Variant 6: Visual loss. Intraocular mass, optic nerve, or pre-chiasm symptoms. Initial imaging.

Procedure	Appropriateness Category	RRL
MRI orbits without and with IV contrast	Usually Appropriate	0
CT orbits with IV contrast	Usually Appropriate	☼ ☼ ☼
MRI orbits without IV contrast	Usually Appropriate	0
CT orbits without IV contrast	May Be Appropriate	☼ ☼ ☼
MRI head without and with IV contrast	May Be Appropriate	0
CT head with IV contrast	May Be Appropriate	☼ ☼ ☼
MRI head without IV contrast	May Be Appropriate	0
CT head without IV contrast	May Be Appropriate	☼ ☼ ☼
CTA head and neck with IV contrast	May Be Appropriate	☼ ☼ ☼
MRA head and neck without and with IV contrast	May Be Appropriate	0
MRA head and neck without IV contrast	May Be Appropriate	0
Arteriography cervicocerebral	Usually Not Appropriate	☼ ☼ ☼
CT head without and with IV contrast	Usually Not Appropriate	☼ ☼ ☼
CT orbits without and with IV contrast	Usually Not Appropriate	☼ ☼ ☼
X-ray orbit	Usually Not Appropriate	☼

← Ordered by neurologist



Follow-up MRI Orbits Unlabeled

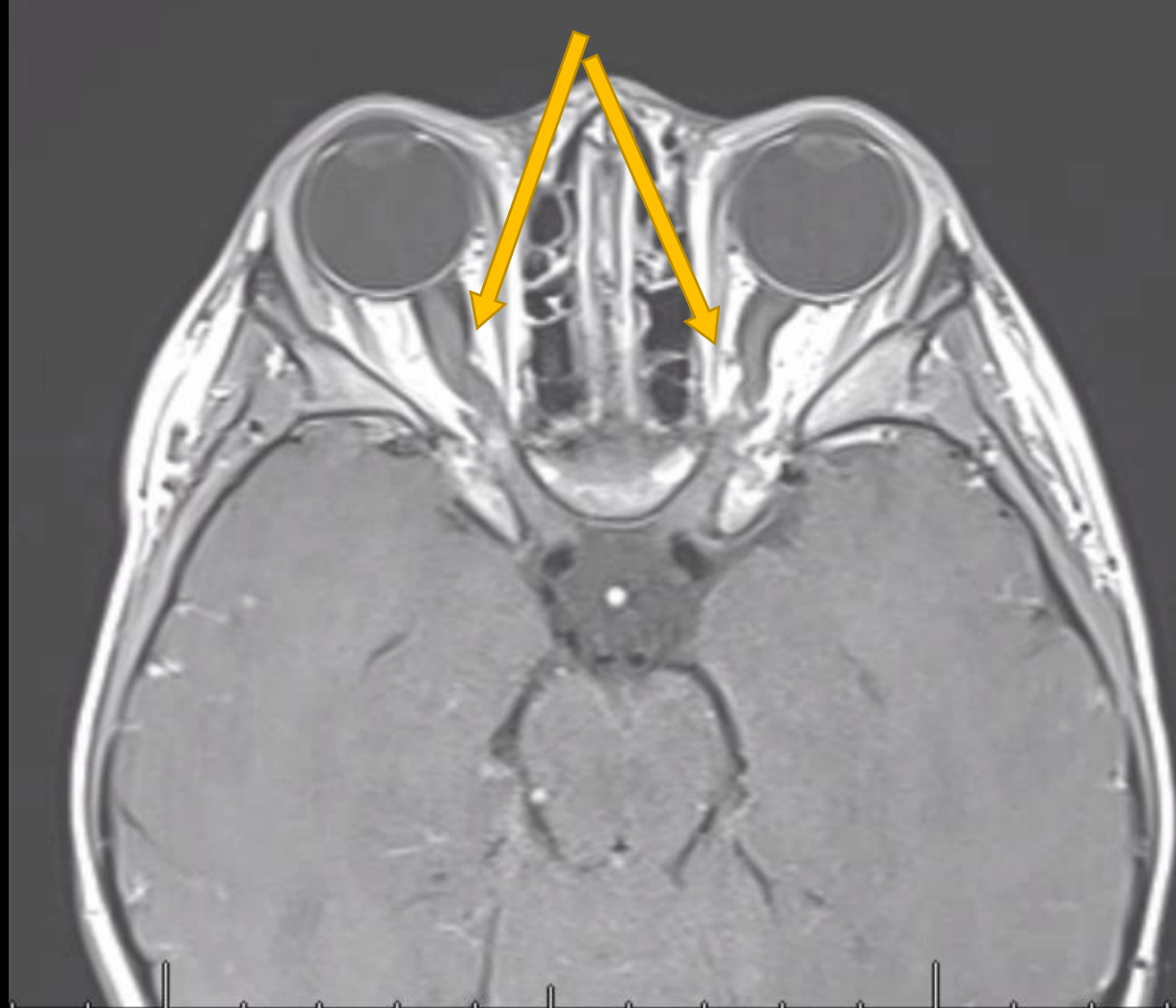
4 yrs old



Axial T1 POST GAD

Follow-up MRI Orbits labeled

4 yrs old



Axial T1 Post Gad: R optic nerve larger than L without discrete enh mass. Tortuosity of both optic nerves seen.

ACR Appropriateness Criteria

Plexiform neurofibromas only partially visualized on C-spine MRI
 → Follow Up Thoracic spine MRI

Variant 4: **Soft-tissue mass. Nondiagnostic initial evaluation. Presenting with spontaneous hemorrhage or suspicion of vascular mass. Next imaging study.**

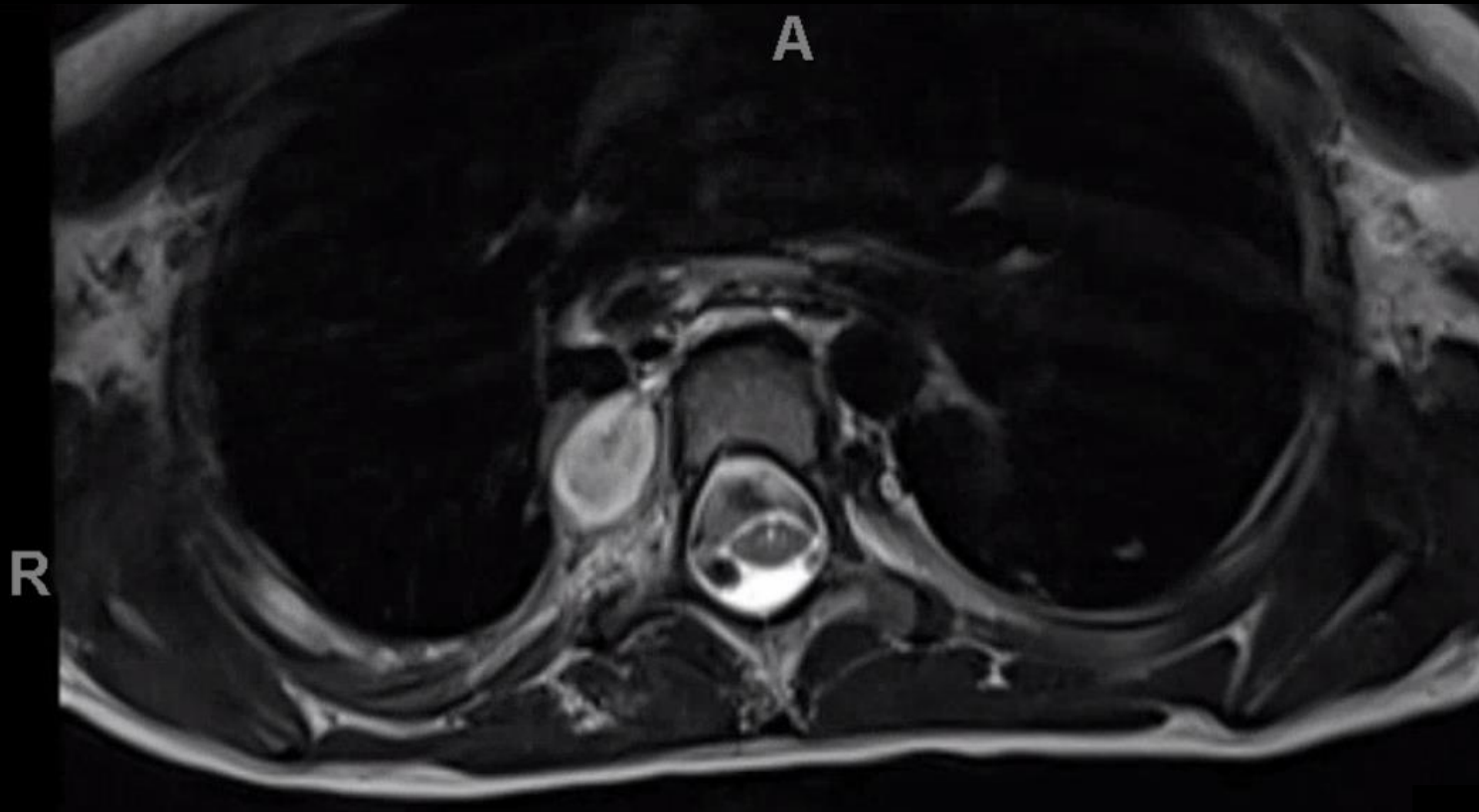
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CT area of interest without and with IV contrast	Usually Appropriate	Varies
CTA area of interest with IV contrast	May Be Appropriate	Varies
MRA area of interest with IV contrast	May Be Appropriate	○
MRI area of interest without IV contrast	May Be Appropriate (Disagreement)	○
CT area of interest with IV contrast	May Be Appropriate	Varies
CT area of interest without IV contrast	May Be Appropriate	Varies
FDG-PET/CT area of interest	May Be Appropriate	⊕⊕⊕⊕
US area of interest	Usually Not Appropriate	○

← Ordered by neurologist

Follow-up MRI Thoracic spine Unlabeled

4 yrs old

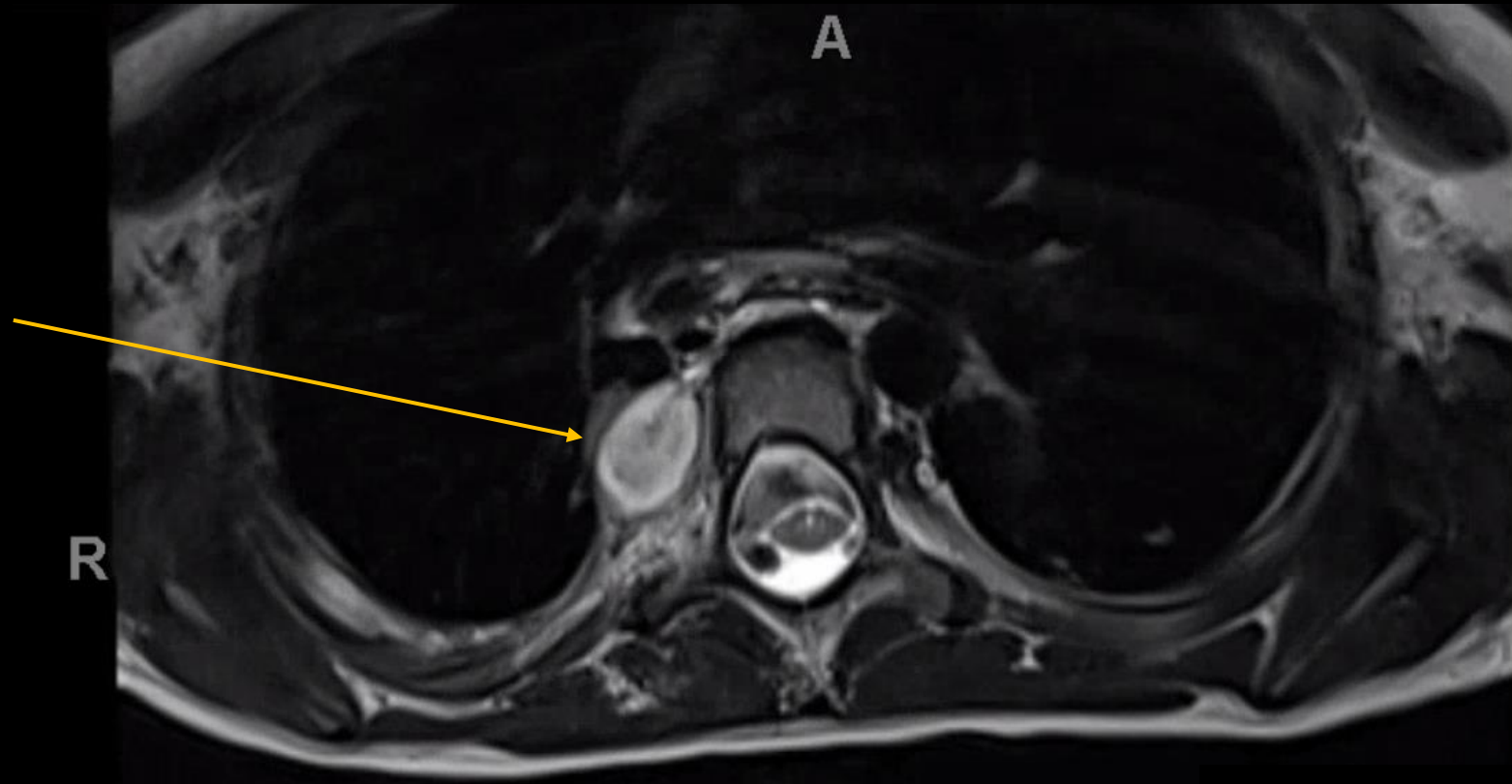
Axial T2



Follow-up MRI Thoracic spine labeled

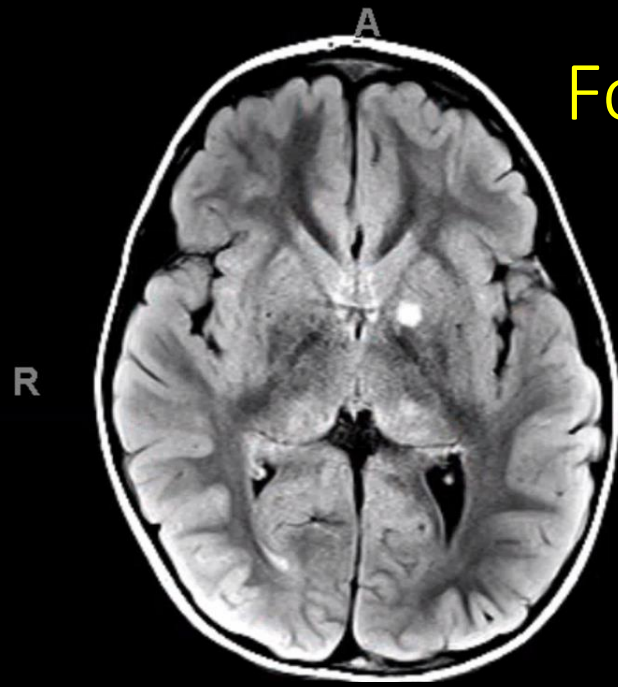
4 yrs old

Axial T2: Fully visualized right
paraspinal mass = Plexiform
neurofibroma

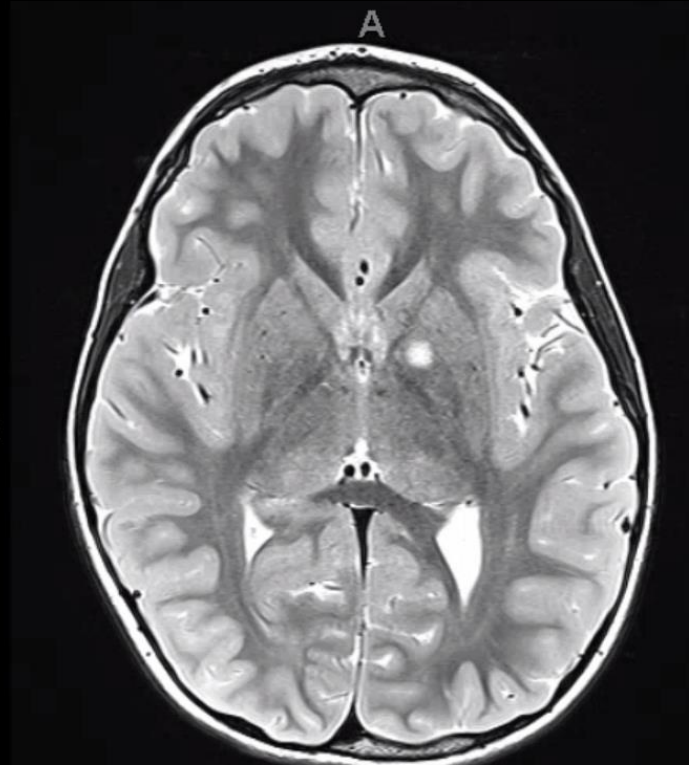


Follow-up Brain MRI Unlabeled

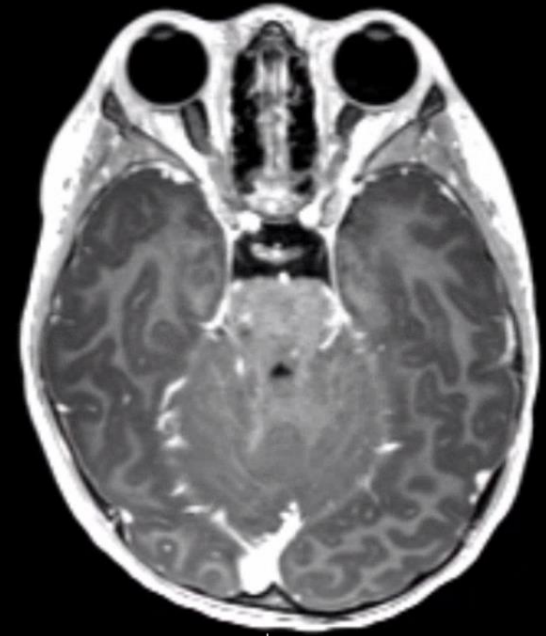
4 yrs old



Axial T2 flair



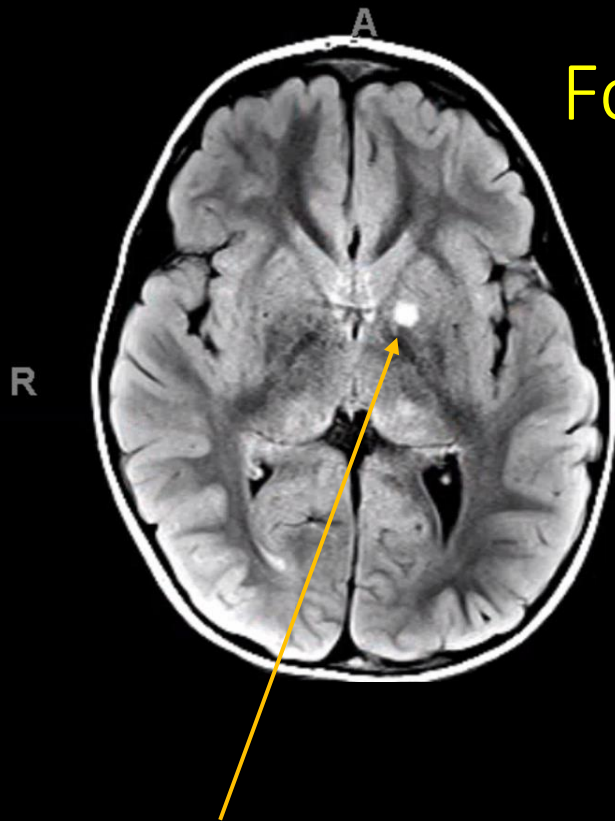
Axial T2



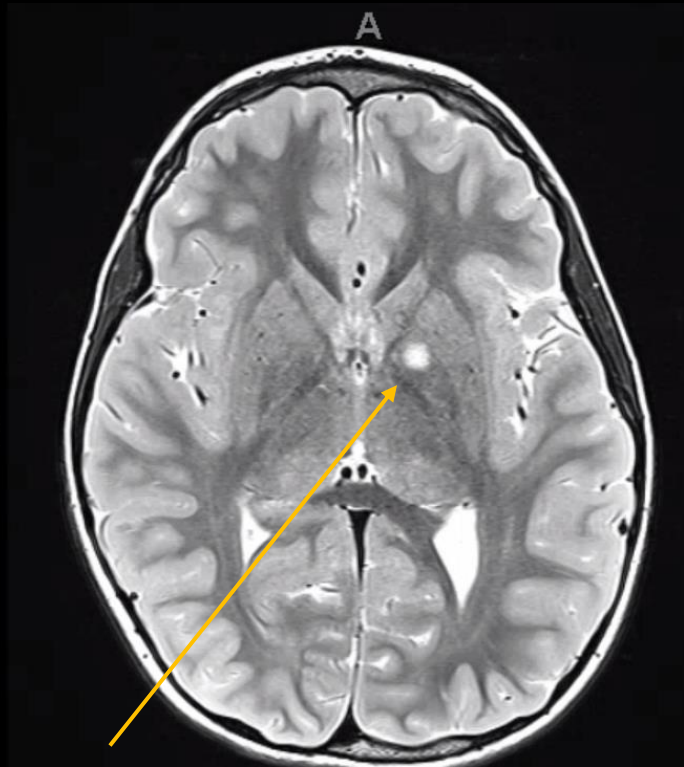
Axial T1 Post Gad

Follow-up Brain MRI Labeled

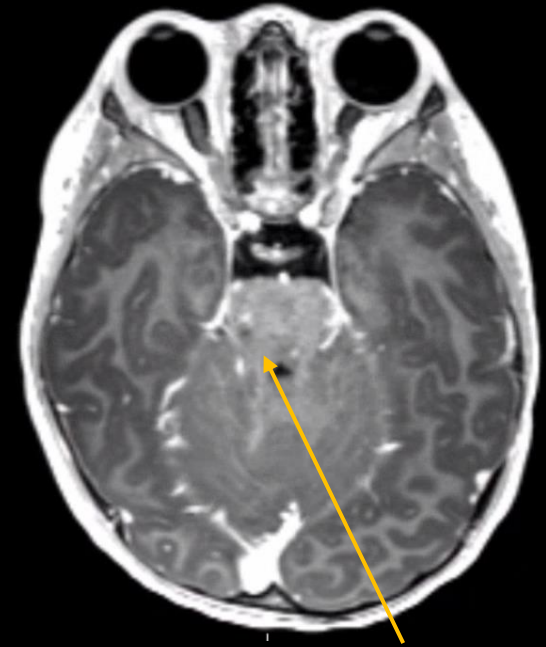
4 yrs old



Axial T2 flair: large focus of inc signal in L globus pallidus



Axial T2: large focus of inc signal in L globus pallidus



Axial T1 Post Gad: non-enhancing focus in R superior cerebellar peduncle

Multiple new foci of spongiform and vacuolar changes consistent with NF1

Case Timeline Summary

- 2.5 yo child with NF1 with secondary HA → **Brain MRI**
 - **FASI** (focal areas of signal intensity) found in cerebellum and inf medulla/cervical cord
- 3 yo-Known brain lesions and nondiagnostic cervical lesion → **Follow up Brain and Cervical MRI**
 - NEW **Optic nerve glioma**
 - NEW **Plexiform neurofibromas** that are incompletely characterized
- 4 yo Known Brain lesions, orbital tumor, and paraspinal masses → **Follow up Brain, Orbital, Thoracic MRI**
 - **Optic nerve glioma** unchanged
 - **Plexiform neurofibromas** unchanged
 - NEW **FASI** lesions involving globus pallidus and cerebellar peduncle

Diagnosis

- Sequelae of Neurofibromatosis type I
 - Optic nerve glioma
 - Spongiform and vacuolar changes in brain
 - Plexiform neurofibromas in the spine

Radiographic Findings for NF1

- **FASI**- focal areas of signal intensity
 - Most common finding in NF1
 - Areas of inc T2 signal commonly in basal ganglia (often **globus pallidus**), thalamus, brainstem, **cerebellum**
 - Pathologically spongiform myelinopathy or vacuolar change of myelin
 - Vacuoles filled with water → T2 signal hyperintensity
 - Unclear role in NF1 spectrum of disease
- **Optic Pathway Glioma**
 - Decreased vision
 - Mass effect with proptosis
 - Hypothalamus involved → polyuria, polydipsia, sexual precocity, endocrine dysfunction
- **Plexiform Neurofibromas**
 - Pathognomonic for NF1
 - Benign tumor of peripheral nerves
 - High potential for malignant transformation

Case Discussion

- Epidemiology: affects 1:2500-3000 individuals
 - 50% inherited , 50% de novo mutation
- Clinical Dx: 2 or more required (most dx by 1yr of age)
 - 6 or more café au lait spots in one year
 - 2 or more neurofibromas or one plexiform neurofibroma
 - Optic pathway glioma
 - Bony dysplasias
 - Two or more iris hamartomas (lisch nodules)
 - Axillary or inguinal freckling
 - First degree relative with NF1 with above criteria
- Loss of gene product neurofibromin on chromosome 17q11.2 → Neoplasm due to inactivation of tumor suppressor gene

Treatment and Prognosis

- Combination of supportive and surgical therapies. NO single treatment exists
- Overall life expectancy half of non-affected individuals
- Optic nerve gliomas require resection → loss of vision in affected eye

Resources

- Mukonoweshuro W et al: Neurofibromatosis type 1: the role of neuroradiology. Neuropediatrics. 30(3):111-9, 1999
- Nguyen R et al: Characterization of spinal findings in children and adults with neurofibromatosis type 1 enrolled in a natural history study using magnetic resonance imaging. J Neurooncol. ePub, 2014
- Jett K et al: Clinical and genetic aspects of neurofibromatosis 1. Genet Med. 12(1):1-11, 2010
- <https://radiopaedia.org/articles/focal-areas-of-signal-intensity-brain-1?lang=us>
- <https://radiopaedia.org/articles/optic-pathway-glioma?lang=us>
- <https://radiopaedia.org/articles/plexiform-neurofibroma?lang=us>