Radiological Manifestations of Neurofibromatosis

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Overview

• What is Neurofibromatosis?
• Diagnostic Criteria for NF
• Radiology and NF Management
• Natural History / Sequelae of NF
Patient L.R

- 17 y.o. female
- P/W nausea and headache
- History of NF-1
- NF-1 Dx at 4 months, asymptomatic until 2002

Courtesy Mustafa Sahin, M. D., Children’s Hospital
Differential Dx

• Medulloblastoma
• Brainstem Glioma
• Pilocytic Astrocytoma
• Ependymoma
• Metastasis
Phakomatoses
(phakos - “mother spot”)

Neurofibromatosis 1 and 2
Tuberous Sclerosis Complex
Von Hippel Lindau Syndrome
Sturge Weber Syndrome

• Hereditary Transmission
• Hamartoma Formation
• Slowly Progressive
• Predisposition towards Malignancy
Mechanism of Disease

Neurofibromatosis

- RAS
- GDP
- RAS
- GTP

NF1

Tuberous Sclerosis Complex

- Rheb
- GDP
- Rheb
- GTP

TSC1
TSC2

Gene Expression
(Anti-apoptosis, Cell Cycle Progression)
Neurofibromatosis I

• Von Recklinghausen’s Disease
• Loss-of-Fxn BUT Autosomal Dominant
• 1:3000, M=F, all races equally affected
• 50% inherited, 50% spontaneous
• Neurofibromas
• 100% Penetrant/ Variable Expressivity
Diagnosis of Neurofibromatosis

- >5 Café-au-Lait Spots
- Neurofibromas
  - 2 Cutaneous OR
  - 2 Subcutaneous OR
  - 2 Nodular OR
  - 1 Plexiform Neurofibroma
- Axillary/Inguinal Freckling
- Optic Glioma
- 2 Lisch Nodules
- Bony Lesions
- First-degree relative with NF
Diagnosis:
Café-au-Lait Spots /
Cutaneous Neurofibroma

Diagnosis:
Subcutaneous Neurofibroma

Ultrasound, Transverse Axis, Forearm

- Delimited
- Relatively Hypoechoic
- Collagen Deposition

Diagnosis: Subcutaneous Neurofibroma

• Fibroblasts cause collagen deposition focally in neurofibromas

• Collagen Deposition is BRIGHT on T2 Weighted MRI - assists in diagnosis of NF
Diagnosis:
Subcutaneous Neurofibroma

Ultrasound, Longitudinal Axis, Forearm

Median Nerve

Diagnosis: Nodular Neurofibroma

MRI, T2-weighted, Coronal C-spine

- Involve Nerve Roots and Nerves
- Impinge upon Spine
- DDX limited to NF with multiple masses

Thakkar et al, Neurorad. 41:625 (1999)
Diagnosis:
Diffuse Plexiform Neurofibroma

PA Chest Film

MRI, Gad contrast, Coronal, Thoracic spine


Ibid.
Diagnosis:
Diffuse Plexiform Neurofibroma

- DPNs consist of tortuous cords of Schwann Cells
- Thought to be Congenital
- Involve Multiple Nerve Roots
- Overlying Hypertrichosis/Hyperpigmentation
- Frequently associated with adjacent scoliosis
**Diagnosis:**

**Optic Pathway Glioma**

- MRI head, axial inversion recovery

- **15% of children < 6**
- Anywhere along visual pathway
- Can cause sellar compression
- Can cause visual acuity loss, proptosis

Diagnosis: Bony Abnormalities

Leg Film

- Thinning of Cortical Bone
- Bowing of Tibia/Forearm
- Male Predominance
- Pseudoarthrosis (most common cause)
- Sphenoid Dysplasia

Courtesy Bruce Korf, M. D.
Diagnosis: Bony Abnormalities

DDX of Tibial Bowing
• Neurofibromatosis I
• Osteogenesis Imperfecta
• Pagets Dz
• Osteomalacia
• Fibrous Dysplasia
Role of Radiology in NF1

- Annual MRI/CT used to be standard of care.
- Now image per symptoms.

Plains films/CT:
- Modeling changes in long bones/ribs
- Concerns re: bony erosion from NFs
- Scoliosis
- Bone Pain

MRI:
- Δs in head size, hormones, neuro sx, visual status
- Concerns re: deep NFs
Sequelae of NF1

• Clinical Syndromes
  MR, Szs, Altered hormonal status

• Spectrum of Disease
  CNS: Dysplasia, Harmartomas, Neoplasms
  Ocular: Bupthalmos
  Osseus: Kyphoscoliosis, Tibial bowing
  GI: Carcinoid Tumor
  Endocrine: Pheochromocytoma
  GU: Wilm’s Tumor
  Pulmonary: Interstitial Fibrosis
Sequelae of NF1: Dural Ectasia

- Dilatation of dural sac
- Unknown cause — possibly congenital
- Also in Marfans
- Dura erodes adjacent bone

Courtesy Steve Reddy, M. D., BIDMC
Sequelae of NF1: Unidentified Bright Object

Axial MRI

- On T2, no enhancement
- No mass effect
- Thought to be Hamartomas
- Correlate with MR
- Often resolve
- Not seen on CT

www.emedicine.com
Sequelae of NF1: Astrocytoma

- Astrocytomas when young (p/w hydrocephalus)
- Optic glioma increase risk
- Also NF gets other cancers: Brainstem glioma, Leukemia, Pheochromocytoma, Neurofibrosarcoma (MPNSTs)

Patient L.R

- MPNST
- Occur in 5% of pts with Plexiform NFs
- Present in adolescence
- Aggressive, often fatal

Courtesy Mustafa Sahin, M. D., Children’s Hospital
Patient L.R

CT chest

Courtesy Mustafa Sahin, M. D., Children’s Hospital
Patient L.R c/o neck pain 4.5 mos prior.

CT revealed mediastinal mass deviating trachea.

Bx revealed MPNST.
Quiz

3D CT Reconstruction

• Pt is Joseph Merrick, “The Elephant Man”
• Elephant Man Disease - Proteus Syndrome not Neurofibromatosis
• Proteus Syndrome - rare (<100 cases ever), bony overgrowth, hemihypertrophy.
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References