Tuberculosis: CNS and Respiratory

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JS- Clinical Presentation

37 y.o. female who presents with a history of transient homonymous hemianopsia and headache.

- While 6mths pregnant, JS awoke from sleep with a HA focused on the left side of her head. She tried to read and noted that she couldn’t read the right half of the words on the page. However she could read the left half. This spontaneously resolved after 30 minutes.

- Work up for preeclampsia negative. No further f/u
Her prepartum period was difficult and include an intense coughing spell at 4 months GA that lasted a month and culminated in chorioamnionitis and C-section at full term.

s/p delivery she was well for three months, at which point she noted a repeat episode of transient right homonymous hemianopsia. This was accompanied by “flecks” in her right visual field bilaterally, that would last for a minute, and occurred 3-4 times during the day. She also noted a headache 2-3/10 on the left side which became worse 5-10 over a few days.

PCP told her to go to ED where she had a non-focal neurological exam and non-contributory PE, not HIV +.
Mechanism Homonymous Hemianopsia.

http://www.dwp.gov.uk/medical/med_conditions/images/visual.stroke.jpg
What studies???

MRI and CT
Magnetic Resonance Imaging of the Brain

- **Studies**
  - T2, FLAIR
  - T1 DWI
  - Contrast enhancement

- **Advantages:**
  - Increased contrast resolution, no ionizing radiation, can produce primary images in the, axial, coronal, sagittal, or oblique planes.

- **Limitations:**
  - long acquisition time, Claustrophobic pts, expensive incompatible with pacemakers, some aneurysm clips.

Courtesy of Kasuga Huang http://en.wikipedia.org/wiki/Image:Modern_3T_MRI.JPG
MRI: Normal Brain Anatomy

- Genu of CC
- Head caudate
- Putamen
- Third ventricle
- Trigone of lateral vent.
- Med. P. + O lobes
- Interhemispheric fissure
- Frontal horn of Lat. Vent
- Septum pellucidum
- Thalamus
- Pineal gland

Our patient: T1 MRI Ring Enhancing Lesion on MRI
Our patient MRI Ring Enhancing Lesion on MRI

Axial T2 FLAIR MRI

PACS, BIDMC
Our Patient: Alternative view of lesion

Sagittal MRI T2 FLAIR +GAD
Differential Diagnosis of a Ring-Enhancing Lesion

- Tumor, trauma, infection, infarction

**Common**
- **Tumor**: Glioblastoma multiforme, Metastatic brain tumor, Necrotic lymphoma in immunocompromised pts.
- **Infection**: Cystercercosis cyst, Abscess - bacteria, fungal, parasitic (toxoplasmosis), Granulomatous dx, AIDS and associated conditions.
- **Infarction**: Resolving subdural hematoma
- **Misc**: Demyelinating dx.

**Uncommon**
- Astrocytoma grade 2, Craniopharyngioma, Meningioma, Aneurysms, Subdural hematoma, Cerebral infarct, Radiation necrosis, AV malformation.

*Gamuts in Radiology 4th ed. Reeder 2004*
Helpful Mnemonic

“MAGICAL DR”
Mets, Abscess, Gbm, Infarct, Contusion, AIDS [toxo], Lymphoma, Demyelination (Active), Resolving Hematoma, Radiation necrosis
MRI Diffusion Weighted Imaging and Apparent Diffusion Coefficient

DWI: Based on the movement of water molecules. Water in biological tissues has “apparent diffusion”. Diffusion directly correlates to attenuation. Pair of strong gradients pulses are added to the pulse sequence. The first pulse dephases the spins and the second rephases the spins if no net movement occurs. If net movement of spins occurs between the gradient pulses signal attenuation occurs.

ADC: Image map from multiple diffusion weightings. A low ADC corresponds with low signal, high ADC has high signal.

Use these together to differentiate true restricted diffusion from T2 Shine-through.

http://spinwarp.ucsd.edu/NeuroWeb/Text/br-710dwi.htm
Our Patient: MRI Diffusion Weighted Images
Our Patient: Apparent Diffusion Coefficient
Focused Differential Diagnosis of a Ring-Enhancing Lesion

- **Tumor/ Infection**

  **Common**
  **Tumor:** Glioblastoma multiforme, Metastatic brain tumor,
  **Infection:** Granulomatous dx.
Companion Patient # 1: Glioblastoma multiforme

- Primary Brain tumor.
- Usually solitary enhancing or ring-enhancing lesion surrounded by edema.
- Detectable by CT and MR.
- Precipitating signs and symptoms of CNS dysfunction
  - New seizures, ha, ms changes, motor and sensory deficits, papilledema, stroke, migraine.
- May see mass affect.
Companion Patient # 2: Metastatic tumors

- Usually multiple lesions in the brain.
- Often found at the gray matter-white matter junction.
- Primary lesion elsewhere in the body.
Further Diagnostic testing

With this differential are any other studies warranted?

Patient had Screening Chest CT + ABDOMEN to look for primary lesion
Computed Tomography

- **Studies**
  - With and without contrast
  - Axial plane
  - Reconstruction for other planes

- **Advantages:**
  - Rapid imaging, good spatial resolution, elimination of superimposed structures with x-ray, compatible with pacemakers, better tolerated by claustrophobic patients, cheap compared to MRI.

- **Limitations:**
  - Ionizing radiation, adverse reaction to contrast, precise tissue detail less apparent than MRI.

[Image: 64_slice_scanner.JPG]
Our patient: “Roundish” opacity at right apex

Axial chest CT C+: lung window
Our Patient: “Roundish” opacity at left apex

Axial chest CT C+: lung window

PACS, BIDMC
Our patient: Right Hilar Lymphadenopathy
Our patient: Left Hilar lymphadenopathy

Axial chest CT C+: soft-tissue window

PACS, BIDMC
Our patient: Retroperitoneal Lymphadenopathy

Axial chest CT C+: soft tissue window
What’s the Next step with these new findings?

Clinical: Brain biopsy, lab tests, Lymph node Biopsy.

Are there radiological studies that can help differentiate neoplasm from infection?
Fluoro-deoxy-glucose Positron Emission Tomography Scan

- Radioactive tracer isotope bound to FDG. Tracer is taken up by cells that are avid for glucose. Undergoes beta decay and emits a positron.
- Positron collides with an electron, producing gamma photons, which move in opposite directions.
- Gamma photons detected by pet reader. Image production depends on coincident detection of the pair of photons. Photons that do not arrive in pairs are ignored.
- Limitations: high cost, careful planning of pt scheduling since radionuclide undergoes multiple half-lives of decay. Need for attenuation correction which allows significant artifact.

Patient Preparation for PET

- NPO 4-5 hours before the exam
- IDDM will need to confer with testing center about when to take medication
- Blood sugar level before exam should be 100-200mg/dL
- Weight patient
- PT will receive injection of FDG 45min – 1hr before scan.
Generally neoplasms are very avid for FDG and therefore project as areas of high uptake with high SUV on PET scan.

Infections tend to be less avid for FDG, and therefore project as areas of low uptake with a minimally increased or low SUV on PET scan.

However this is not a firm rule!
Our patient: Bilateral focal areas of uptake

Axial PET scan of the lungs
Our patient: Bilateral ground glass opacities

Axial C- CT: Lung window
Our patient: PET-CT SCAN

Axial PET-CT of the lungs
Our patient: Bilateral Hilar Lymphadenopathy

Axial C-CT: Lung window

Axial PET

Axial PET-CT scan
Our Patient: Localizing Paraesophageal Lymphadenopathy
Summary of findings for pt JS:

- Hypointense lesion with ring-enhancement on Axial T1-weighted MRI
- Abnormal area of low attenuation adjacent to the right Pulm. Art. outflow tract. Representative of a Bronchopulmonary lymph node.
- Paraspinal lymphadenopathy
- Bilateral focal areas of tracer uptake in the lung apices.
Back to the patient’s history:

- Notably JS was born in Africa, and did recall a history of exposure to TB from her nanny (who died from the infection) when she was 3 y.o. The patient also had the BCG shot when she was 7 y.o, and a positive PPD test 22 years ago, after which she did not have medication. She hasn't had a screening chest plain films in over 18 years prior to presentation.

- Labs: AFB grew in broth culture, however smear negative, Quantifier gold negative.

- She was started on INH, pyrazinamide, rifampin, ethambutol.
Tuberculosis

- Caused by Mycobacterium tuberculosis, a gram positive acid-fast aerobic bacterium.
- > 1/3 of the world population has been exposed to TB.
- It commonly seeds the lungs, but can also affect other areas including the CNS, lymphatics, circulatory system, GU system, bones, joints, and skin.
- Resurgence of TB secondary to HIV/AIDS.
- Anecdotal cases of TB reactivation secondary to pregnancy.
CNS Tuberculosis

- Occurs after hematogenous spread of the mycobacterium.

- 3 clinical Categories:
  - Meningitis, intracranial tuberculoma, spinal tuberculosis
  - Meningitis most common
Monitoring of CNS Tuberculosis

- After diagnosis of tuberculoma and initiation of treatment usually repeat MRI (6-8 wks) to determine whether there is any change in the size of the granuloma.
- No screening currently. Tuberculoma usually an incidental finding.

Jasmer, M. et.al. 2002
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