Wernicke’s Encephalopathy: The Neuroradiologic Evaluation of a Patient with Altered Mental Status

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Agenda

- Review the work-up and differential diagnosis of acute mental status change
- Examine common modalities of neuroimaging as well as their roles and limitations
- Review the pathophysiology of Wernicke’s encephalopathy
- Recognize the radiologic appearance of Wernicke’s encephalopathy on MRI
- Learn a differential diagnosis of this radiologic appearance
Patient JH: History

- JH is a 59 year-old man with a longstanding history of alcohol abuse who initially presented with pancreatitis and alcohol withdrawal. During his hospital course he had two **falls** and continued to have **confusion** and mild **agitation**.
Patient JH: Physical Exam

- Vital Signs: T: 97.7  P: 94  R: 18  BP: 120/76 SaO2: 100% RA
- Physical exam: remarkable only for several ecchymoses on upper extremities bilaterally
- Neurological exam:
  - Mental Status: alert, oriented to person only, inattentive, 0/3 registration on memory test, naming intact
  - Cranial Nerves II-XII: nystagmus
  - Motor: asterixis in upper extremities bilaterally, intention tremor
  - Strength: intact throughout
  - Reflexes: areflexic throughout; Babinski: mute
  - Sensation: light touch, temperature, vibration, joint position sense intact throughout
  - Coordination: finger-nose-finger intact but slow and clumsy
  - Gait: could not assess, very unsteady while standing
Before we take a look at our patient JH’s imaging, let’s review:

- The general work-up of a patient with acute **mental status change** and the role of neuroimaging
- A few points about CT and MRI modalities
Acute MSΔ: Work-up & DDx

Vascular (stroke)
Inflammatory
Trauma / Toxins (drugs, EtOH, poisons)
Autoimmune
Metabolic (electrolyte disturbance, nutritional deficiency, hyper/hypoglycemia) / Medication
Infection (sepsis, fever, CNS infxn/abscess)
Neoplastic (brain tumor)
Acquired (organ failure, psychiatric)
Congenital (inborn errors of metabolism)
Degenerative
Endocrine/Electrical (endocrine disturbance, seizures)

DDx mnemonic = VITAMIN A/C/D/E (note there is a lack of vit B)

Acute MSΔ: The Role of Neuroimaging in Diagnosis

- As we saw earlier, there is a huge differential in diagnosing acute mental status change.
- Neuropsychiatric diagnoses of altered mental status are largely clinical diagnoses.
- Neuroimaging is never a primary means of diagnosis.
- However, neuroimaging can lend support to a diagnosis and help rule out other pathologies.
- Neuroimaging may be especially helpful in situations where little or no history can be obtained.
Menu of Tests: Imaging the Brain

- **Non-contrast CT:**
  - Faster and cheaper than MRI
  - Excellent for visualizing “bones, blood, bullets, fat, fluid”
  - Good initial test to evaluate for hemorrhage, large mass/ mass effect, hydrocephalus, large infarct

- **MRI:**
  - Much better than CT for visualizing soft tissue detail (eg. gray/ white matter, vasculature)
  - Test of choice to evaluate for infarct, neoplasm, infection (eg. abscess, meningitis), demyelinating process (eg. MS, ADEM), subtle soft tissue structural abnormality
Menu of Tests: MRI Sequences

- Different MRI sequences highlight different tissues:
  - T1: (fat is bright, CSF is dark) anatomic structures of the brain
  - T2: (fat is dark, CSF is bright) focal abnormalities like infarct or edema
  - FLAIR: (like T2 but free fluid is dark, we often start with this sequence) focal abnormalities like infarct or edema
  - DWI: focal abnormalities like early infarct or abscess
Now on to patient JH’s imaging...
Patient JH: Brain Atrophy on CT

No evidence of hemorrhage, midline shift, or hypodensity concerning for infarct

No fractures in bone windows (not shown)

Prominent ventricles and sulci as sequelae of alcohol abuse
Normal Anatomy on MRI

Corpus Callosum
Lateral Ventricle
Thalamus
Third Ventricle
Mamillary Body
Pons

Aqueduct of Sylvius
Midbrain
Fourth Ventricle
Cerebellum
Medulla

Sagittal T1 MRI C-
(Remember, anatomy is best seen on T1 MRI)
Patient JH: Mamillary Bodies on MRI

Sagittal T1 MRI C-

Atrophied mamillary bodies

Normal comparison
Patient JH: Enhancing Mamillary Bodies on MRI

Axial T1 MRI C-  Hyperintense signal in the mamillary bodies post-contrast  Axial T1 MRI C+

BIDMC PACS  BIDMC PACS
Patient JH: Pertinent Negatives

- No abnormal hyperintensities seen on FLAIR or DWI images, suggesting no acute infarcts
Putting Everything Together

- Now let’s consider JH’s clinical presentation, imaging findings, and diagnosis...
  - History: longstanding alcohol abuse
  - Exam: triad of nystagmus, ataxia, and confusional state
  - Imaging: enhancing, atrophied mamillary bodies on T1 MRI post-contrast, global brain atrophy

- Not a stroke but acute Wernicke’s encephalopathy
Wernicke’s Encephalopathy (WE)

- WE is an acute neuropsychiatric condition due to thiamine (vitamin B1) deficiency.
- The classical triad of ocular signs, ataxia, and altered consciousness was first described by Carl Wernicke in 1881.
- WE can progress to Korsakoff’s Syndrome, which results in permanent brain damage involving severe short term memory loss.
- The classical triad only occurs in 16-38% of all patients, so WE is often under-diagnosed.
- Failure to diagnose WE results in KS in 75% and death in 20%.
- WE is reversible with prompt treatment with thiamine supplementation.
WE: Pathophysiology

- Thiamine is needed by cell membranes to maintain osmotic gradients in the brain.
- It is hypothesized that the lesions seen on MRI may be areas where there is a high rate of thiamine-related metabolism.
- Thiamine deficiency causes cell dysfunction → cytotoxic edema and blood-brain barrier breakdown → neuronal death
Acute WE: Radiologic Signs

- Typical MRI findings: bilateral hyperintensity generally in mamillary bodies, medial thalami, periventricular gray matter, inferior and superior colliculi
- Contrast MRI is usually not required but in some patients contrast enhancement of the mamillary bodies may be the only sign of WE.
- MRI: 53% sensitivity, 93% specificity for detecting WE → useful in supporting WE diagnosis
- CT: not useful
WE: Typical MRI Findings

Axial FLAIR MRI

DDx of Medial Thalami Abnormalities on MRI

- Tumor: primary cerebral lymphoma
- Infection: variant CJD, influenza A, West Nile, CMV, JEV
- Infarct: ischemia artery of Percheron, deep cerebral vein thrombosis, global hypoxia
DDx: Deep Cerebral Vein Thrombosis

Courtesy of Dr. Bhadelia
DDx: Global Hypoxic Injury

Courtesy of Dr. Bhadelia
DDx: Japanese Encephalitis

Companion Patient 1: Presentation

- Presentation: 23 year-old woman, status post bariatric surgery, with uncontrollable vomiting, who later became dizzy and ataxic.
Companion Patient 1: WE on MRI

- Remember, WE can occur in any patient with nutritional deficiencies, not just those with alcoholism.

Axial FLAIR MRI

Hyperintense signal in the mamillary bodies and colliculi

Hyperintense signal in the medial thalamii

Courtesy of Dr. Caplan
Companion Patient 2: Presentation

- Presentation: 87 year-old man in his usual state health until he was found unconscious by his wife. No seizure activity noted.

- DDx: Stroke vs. Wernicke’s encephalopathy
Companion patient 2: ?WE on MRI

Imaging at initial hospital presentation: Axial FLAIR MRI

Hyperintense signal in the periventricular area

Hyperintense signal in the medial thalami
Companion patient 2: Follow-up MRI

Imaging 9 months later: Axial FLAIR MRI

- Reduction of hyperintense signal in the periventricular area
- Reduction of hyperintense signal in the medial thalami
Companion Patient 2: Axial DWI

- No hyperintensities at thalami that suggest acute thalamic stroke
Companion Patient 2: Controversy

- The primary team decided the diagnosis was stroke.
- The neuroimaging was read as Wernicke’s encephalopathy.
- It is necessary to correlate neuroimaging with clinical presentation.
Summary

- We have learned:
  - The work-up and differential diagnosis of acute mental status change
  - The common modalities of neuroimaging as well as their roles and limitations
  - The pathophysiology of Wernicke’s encephalopathy
  - The typical radiologic appearance of Wernicke’s encephalopathy on MRI
  - The necessity to correlate neuroimaging with clinical presentation
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References