

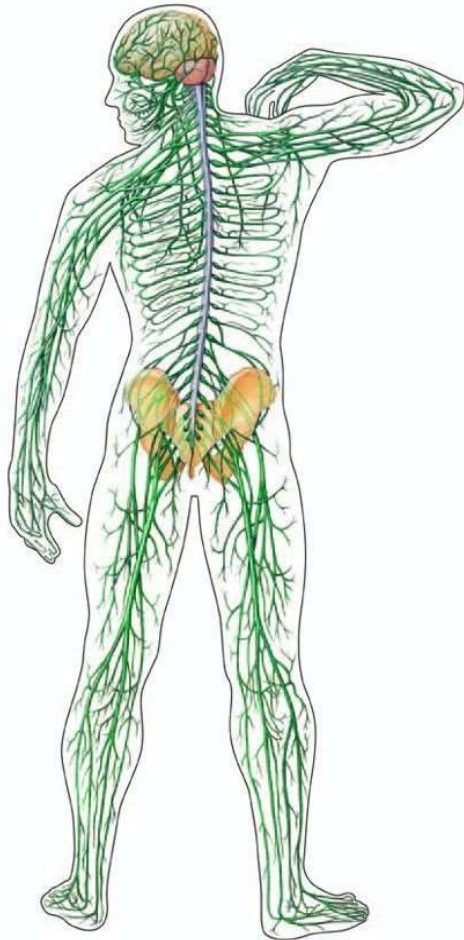
# Neuroinfectious Diseases

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# Objectives

- Recall the components of the neuroaxis. Discuss which locations may be affected by each pathogen.
- Review patient cases, each focusing on a different neuroinfectious disease.
- Identify pathogens (bacterial, viral, and fungal) that commonly invade the neuraxis.
- Identify the epidemiology of pathogens.
- Discuss the broad spectrum of clinical presentations associated with meningitis, encephalitis, myelitis, and others.
- Learn how to evaluate for and ultimately diagnose each entity by interpreting cerebral spinal fluid and neuroimaging studies including MRI.
- Discuss the management of neuroinvasive infections and the most common complications including abscesses and hydrocephalous.

# What is the Neuro Axis?



<https://i.pinimg.com/originals/01/4b/4f/014b4fcfc5e36 added99c7c0ce92ee2da5.jpg>

- Cerebrum
- Basal Ganglia
- Cerebellum
- Brainstem
- Spinal Cord
- Motor Neuron
- Neuromuscular Junction
- Peripheral Nerve
- Muscle
- Autonomic

# Definitions

- Meningitis = Inflammation of the meninges
- Aseptic meningitis = Nonbacterial meningitis, can be viral or other cause
- Chronic meningitis = Persistent or recurrent symptoms >4 weeks
- Encephalitis = Inflammation of the brain parenchyma
- Meningoencephalitis = Meningitis + Encephalitis
- Myelitis = Inflammation of the spinal cord
- Pleocytosis = Elevated WBC in the CSF

# Clinical Presentation: Meningitis

## Classic triad

1. Fever (85%)
2. Headache (50%)
  1. Migrainous phenotype: nausea, vomiting, light/noise sensitivity
  2. High pressure: worse with supine/valsalva, wakes from sleep
3. Neck stiffness

3/3: 42% of patients

2/3: 95% of patients

+/- Altered mental status

Atypical presentations are common:

- Immunocompromised hosts
- Older adults
- Anti-inflammatory agent use

Keep a high index of suspicion for CNS infection.

# Clinical Presentation: Encephalitis & Myelitis

- Encephalitis

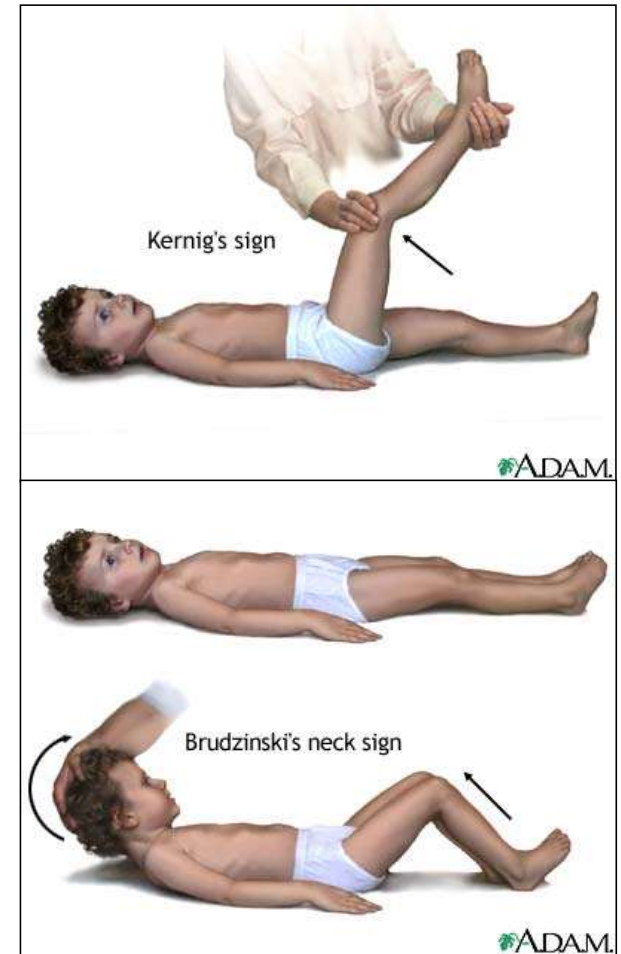
- Headache
- Altered mental status, confusion
- Focal neurologic deficit
- Seizure

- Myelitis

- Para/quadriplegia
- Sensory level
- Autonomic dysfunction

# Physical Examination

- ABC/VS
- Neuro
  - AMS/Coma
  - Weakness, numbness, ataxia, tremor
  - CN Palsy, pupillary changes, EOM impairment, papilledema, vision loss
  - Language dysfunction
- Neck
  - ROM impaired/stiff/causes pain
  - Kernig/Brudzinski
    - High specificity, low sensitivity



<http://www.nlm.nih.gov/medlineplus/ency/article/000680.htm>

# Other Helpful Signs & Symptoms

## Infectious spread

- Hematogenous, pulmonary, nasopharynx, birth canal
- Skin: rash, genital lesions
- HEENT: otitis, sinusitis
- Pulmonary: pneumonia, mass lesion
- Cardio: endocarditis
- Gastrointestinal: colitis, n/v, diarrhea
- Genitourinary: orchitis



# Other Pertinent Questions

- PMHx/PSHx

- Immunocompromised state
- Cardiac hx: mechanical valve
- Head trauma, CSF leak
- Neurosurgical intervention
- Indwelling devices
  - Shunt/Ommaya

- Social Hx

- Place of residence
- Travel
- Outdoor/animal exposure
- Sick contacts
- Sexual history, STIs
- Diet
- Drugs

# Case 1

Ms. Smith

# Ms. Smith

- 19 yo RHD F
- PMHx: Healthy
- HPI:
  - URI symptoms last week, now mostly resolved
  - Since last night- severe holocephalic HA which is worse when she coughs, associated w/ light sensitivity
  - Feeling feverish and very fatigued

# Ms. Smith's Exam

- VS: T 39.2C, BP 92/44
- General: Uncomfortable, in a dark room, tired/sleeping but arousable, following commands, oriented.
- Neck: Meningismus. Stiffness with active and passive ROM.
- Neuro: Nonfocal. No papilledema.

Q: What type of CNS infection does Ms. Smith most likely have?

- A. Bacterial
- B. Mycobacterial
- C. Viral
- D. Fungal
- E. Not an infection

# Bacterial Meningitis

- Acute onset- hours to days
- More severe at presentation
- More severe complications
- \*some exceptions\*
  - Herpes viruses

# Microbes: Bacterial

- Children and Adults
  - Streptococcus pneumoniae #1
  - Neisseria meningitidis #2
  - Haemophilus influenza, less common with vaccination
- Immunocompromised, older patients
  - Listeria monocytogenes
- Neurosurgical intervention/indwelling devices
  - Staphylococcus species
  - Pseudomonas

# First Steps: Run Don't Walk

- Thinking **acute** CNS infection?
- Neurologic emergency!
- Delay in treatment = worse outcomes

## Plan:

1. Obtain blood cultures x2
2. Perform LP, obtain CSF
3. Start antimicrobial therapy and steroids



# Lumbar Puncture and CSF Analysis

- Needed for definitive diagnosis
  - Microbial diagnostic tests
    - Imperfect sensitivity
- Allows us to adjust/narrow antimicrobial regimen
- CSF obtained after abx have been started?
  - Cellular/biochemical changes last for up to 2-3 days after abx initiated
  - CSF does not become sterile until hours after abx initiated
  - Cultures should still be performed

	Cell count (mm <sup>3</sup> ) Differential	Glucose (mg/dL)	Protein (mg/dL)	Pressure (mm H <sub>2</sub> O)	Notes
Normal values	<5 Lymphocytic	>40% serum	<35	90-180	
Bacterial	>500 Polymorphonuclear (PMN)	<40% serum	>100	Elevated	Culture is gold standard! Gram stain. PCR, ME panel.
Viral	10-500 Lymphocytic	>40% serum	<120	Normal to slightly elevated	Viral culture not very helpful. PCR, ME panel. Serologies, Ab testing. WNV and LCMV can be PMN predominant. RBCs seen with HSV encephalitis.
Fungal	<500 Lymphocytic	<40% serum	Elevated	Normal to elevated	PCR, ME panel. Serologies, Ab testing. Fungal culture.
Atypical bacterial (granulomatous, TB)	10-10,000 Lymphocytic	<40% serum	> 50	Normal to elevated	

These are general rules/trends. If the time between antimicrobial initiation and LP/CSF eval is prolonged, these things may not apply. Same goes for immunocompromised hosts, they may not mount the expected response.

Adapted from Continuum: Meningitis 2021

# Ms. Smith's CSF: Basic Profile

- Opening pressure: 38 (H)
- Pending studies
  - Gram stain
  - Culture
  - Meningitis/encephalitis panel
    - PCR testing for 14 most common CSF infections










CEREBRAL SPINAL F...  	
CSF Gross Appearance	Hazy
CSF Color	Colorless
CSF Tube Number	Cup
Nucleated Cells	<b>1783.3</b> 
Erythrocytes	100.0
Neutrophils	<b>91</b> 
Lymphocytes	<b>1</b> 
Monocytes	<b>8</b> 
Eosinophils	0
Basophils	0
Plasma Cells %	0
Blasts	0
CSF Lining Cells	0
Other Cells	0
CELL REVIEW (CSF)	
Protein, Total, CSF	<b>114</b> 
Glucose, CSF	44 

TABLE 1-1

Recommended CSF Diagnostic Testing for Common Neurologic Infections

Cause of infection	Most sensitive CSF diagnostic tests
<b>Bacteria</b>	
Gram-positive and gram-negative	Gram stain and culture
Mycobacteria	Polymerase chain reaction (PCR) (Xpert MTB/RIF), culture
Spirochetes	
Lyme disease	IgG
Syphilis	Venereal Disease Research Laboratory (VDRL), fluorescent treponemal antibody absorption (FTA-ABS)
<b>Viruses</b>	
Herpesviruses	
Herpes simplex virus	PCR
Varicella-zoster virus	PCR (meningitis, encephalitis), IgG (myelitis, vasculitis)
Human herpesvirus 6	PCR
Enteroviruses	PCR
Arboviruses	IgM
JC virus	PCR
<b>Fungi</b>	
<i>Cryptococcus</i>	Antigen
Histoplasmosis, blastomycosis, coccidioidomycosis	Antigen and antibody
<i>Candida</i>	Culture and (1,3)- $\beta$ -D-glucan
<i>Aspergillus</i>	PCR and galactomannan

CSF = cerebrospinal fluid; IgG = immunoglobulin G; IgM = immunoglobulin M.

Q: Which antimicrobials should we start empirically?

- A. Ceftriaxone, Vancomycin
- B. Ceftriaxone, Vancomycin, Ampicillin
- C. Cefepime, Vancomycin
- D. Cefepime, Vancomycin, Acyclovir

# Empiric Antimicrobial Treatment:

- Third generation cephalosporin
  - Ceftriaxone 2g IV Q 12hrs OR ceftoxamine 2g IV Q 4-6 hrs
- Vancomycin 15-20mg/kg Q 8-12hrs
- Special populations:
  - >50yo/immunocompromised/ETOH abuse?
    - Add Ampicillin 2g IV Q 4hrs
  - Neurosurgical intervention/penetrating trauma?
    - Drop third generation cephalosporin
    - Add cefepime, meropenem, or ceftazidime
  - Concern for viral encephalitis/temporal lobe dysfunction?
    - Add acyclovir 10mg/kg Q8hrs

# Steroid Treatment

- What? Dexamethasone 10mg IV Q 6hrs x4 days
- When? With OR before antibiotics, NOT after
- Why?
  - Reduces mortality in adults with s. pneumo
  - Decreases risk of hearing loss in children with h. flu
  - Discontinue if neither of these entities are identified
- Other uses?
  - Abscess with significant edema
  - Vasculitis

# Ms. Smith's CSF: Culture

## Results

! Bacterial Culture, Aerobic + Susc (Order 2223158503579)

### ! Bacterial Culture, Aerobic + Susc

Order: 2223158503579

Bacterial Culture, Aerobic + Susc

!  
STREPTOCOCCUS INTERMEDIUS  
4+

Resulting Agency AZMH

#### Susceptibility

	Streptococcus intermedius SUSCEPTIBILITY, MIC (MCG/ML)	
Ceftriaxone	<=0.12 mcg/mL	Susceptible
Penicillin	<=0.06 mcg/mL	Susceptible
Vancomycin	0.25 mcg/mL	Susceptible



# Targeted Treatment Duration: Bacterial

## Duration of Antibiotic Therapy for Meningitis Caused by Bacterial Organisms<sup>a</sup>

Organism	Duration of therapy (days)
<i>Streptococcus pneumoniae</i>	10-14
<i>Listeria monocytogenes</i>	21
<i>Neisseria meningitidis</i>	7
<i>Staphylococcus</i>	Variable
Gram-negative bacilli	21
Group B <i>Streptococcus</i>	14-21
<i>Haemophilus influenzae</i>	7-10

<sup>a</sup> Data from Wilson JW, Oxford University Press.<sup>20</sup>

Q: If our patient's exam was notable for a focal deficit. What would we have changed?

- A. Start empiric medications before blood cultures
- B. Perform CT head before lumbar puncture
- C. Omit the steroids
- D. Add acyclovir

# CT Head BEFORE LP

- When?
  - Immunocompromised host
  - >60yo
  - Focal neurologic signs/symptoms
  - Seizure
  - AMS
  - Papilledema
  - Hx of neurologic disease
- Why?
  - Rule out a mass lesion
    - May increase risk of herniation with LP/CSF removal

# CT Head BEFORE LP

- When:
  - Immunocompromised host
  - >60yo
  - Focal neurologic signs/symptoms
  - Seizure
  - AMS
  - Papilledema
  - Hx of neurologic disease
- Why:
  - Rule out a mass lesion
    - May increase risk of herniation with LP/CSF removal

## LP Checklist!

- Antithrombotic use, last dose
- CBC, platelet count
- Coags

Do not delay antimicrobial and steroid treatment! Administer before CT head.

# Neuroimaging: CT Head, MRI Brain

WITH and without contrast

- Meningeal enhancement
- Mass lesion, abscess
- Cerebritis, encephalitis
- Cerebral edema
- Hydrocephalous
- Stroke (ischemic, hemorrhagic)
- Other clues:
  - Sinusitis, dental infections

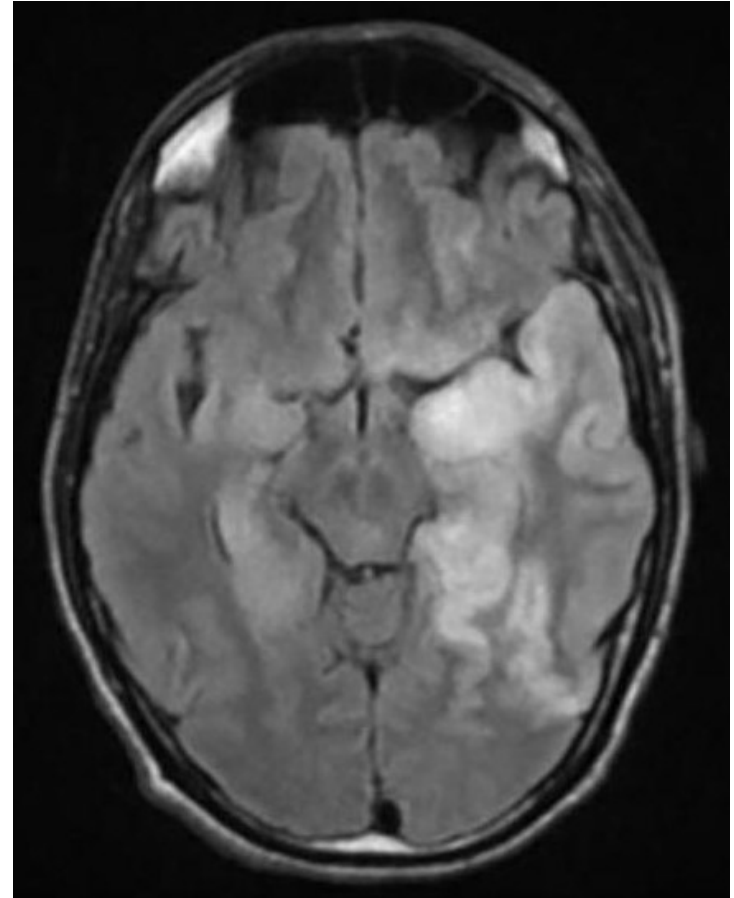
Normal neuroimaging does not rule out meningitis!

# Neuroimaging



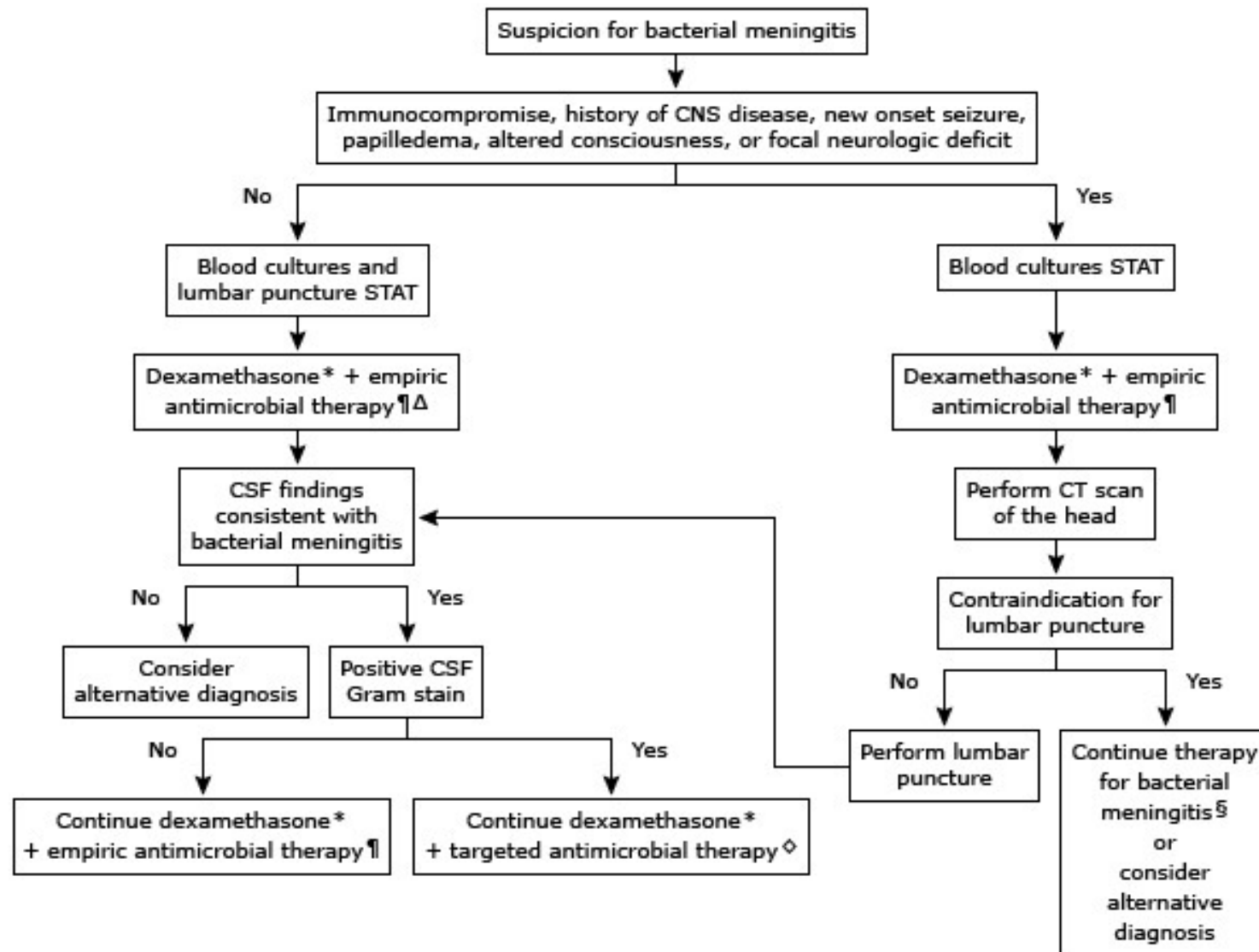
CTH w/ contrast: LM enhancement, meningitis

<https://radiopaedia.org/cases/bacterial-meningitis?lang=us>



MRI Brain w/ contrast: viral encephalitis

<https://radiopaedia.org/cases/herpes-simplex-encephalitis-14?lang=us>



# Bacterial Meningitis: Complications

- Systemic: Sepsis, shock
- Other body systems: DIC, ARDS, hearing loss (s. pneumo and h. flu)
- Ventriculitis
- Hydrocephalous
- Abscess
- Cerebrovascular sinus thrombosis (CVST)
- Vasculitis
- Stroke
- Cognitive impairment
- Seizures

Many of these complications have specific targeted treatment that would need to be initiated.



# Abscess

- May not have systemic symptoms
- Focal neurologic deficit, seizure, HA
- Locations: Intracranial (cerebral, epidural), spinal (epidural)
- Focal or multifocal
- Direct or hematogenous spread
- Associated edema

# Bacterial Abscess

## Direct Spread

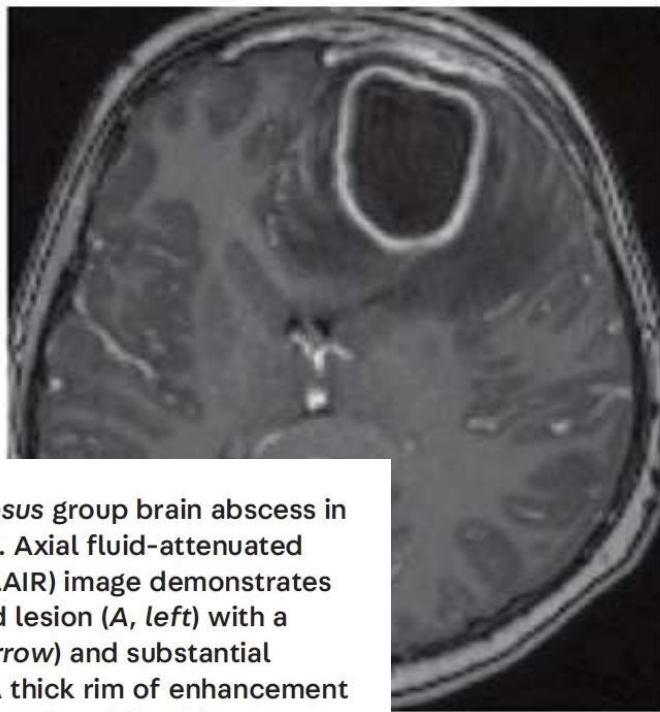
- Single > Multiple
- Bacterial, fungal, parasitic
- Adjacent site of infection
- Associated with
  - Meningitis
  - Head/facial trauma
  - Neurosurgical or spinal procedure
  - HEENT infections

## Hematogenous Spread

- Multiple > Single
- Bacterial
- More distal site of infection
- Associated with
  - Bacteremia
  - Bacterial endocarditis
  - Other, more distal, sites of infection
  - No site/underlying condition identified in 20-40%

# Bacterial Abscess

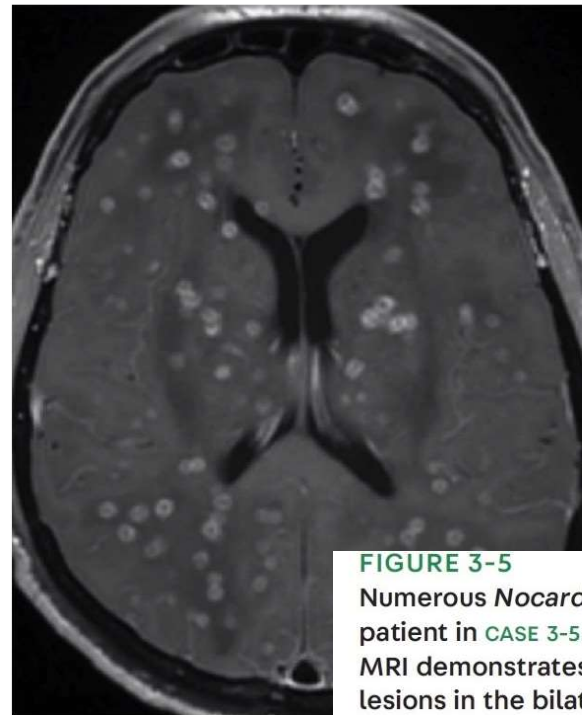
## Direct Spread



**FIGURE 3-4**

*Streptococcus anginosus* group brain abscess in the patient in **CASE 3-4**. Axial fluid-attenuated inversion recovery (FLAIR) image demonstrates a large, circumscribed lesion (**A, left**) with a hypointense rim (**A, arrow**) and substantial surrounding edema. A thick rim of enhancement is seen on postcontrast T1-weighted image (**A, right**). The center of the lesion markedly

## Hematogenous Spread



**FIGURE 3-5**

Numerous *Nocardia farcinica* abscesses in the patient in **CASE 3-5**. Axial postcontrast T1-weighted MRI demonstrates multiple small ring-enhancing lesions in the bilateral cerebral hemispheres, some of which are present at the cortical gray-white matter interface.

# Cerebral Abscess: Eval/Management

- Obtain a fluid sample
  - CT guided aspiration vs open debridement
  - CSF usually unrevealing
- IV Antimicrobials
  - 4-8 weeks
- Steroids can be used if significant, symptomatic edema
- Repeat MRI weeks later to monitor

# Case 2

Mrs. Shannon

# Mrs. Shannon

- 43 yo LHD F
- PMHx: breast cancer s/p resection and chemotherapy in remission, depression
- HPI:
  - HA, fever x 2 days treated with NSAIDS
  - Husband had trouble waking her up this am. Then was confused and had garbled speech.
  - Seizure, GTC. Came to ED

# Mrs. Shannon's Exam

- VS: 37.4
- General: Lethargic. Disoriented.
- Language: Mixed aphasia. Paraphasic errors. Impaired fluency. Impaired ability to follow commands.
- Vision: R homonymous quadrantanopsia.

# Mrs. Shannon's Diagnostics/Initial Plan

- Blood cultures
- Ceftriaxone, vancomycin, ampicillin, and acyclovir
  - CTH prior to LP- seizure
  - Added acyclovir given the concern for viral encephalitis
- CTH unrevealing for mass lesion
- CSF
  - NC 379 (H)
    - Lymphocytes 76%
  - RBCs 808 (H)
  - Protein 76 (H)
  - Glucose 63
  - Meningitis/Encephalitis panel: negative



# Microbes: Viral

- Enteroviruses

- Coxsackie
- Echovirus

- Herpes viruses

- HSV 1
- HSV 2
- VZV

- Arboviruses

- West Nile Virus (WNV)
- St Louis Encephalitis
- Eastern equine virus
- Japanese encephalitis

# Mrs. Smith's Next Steps

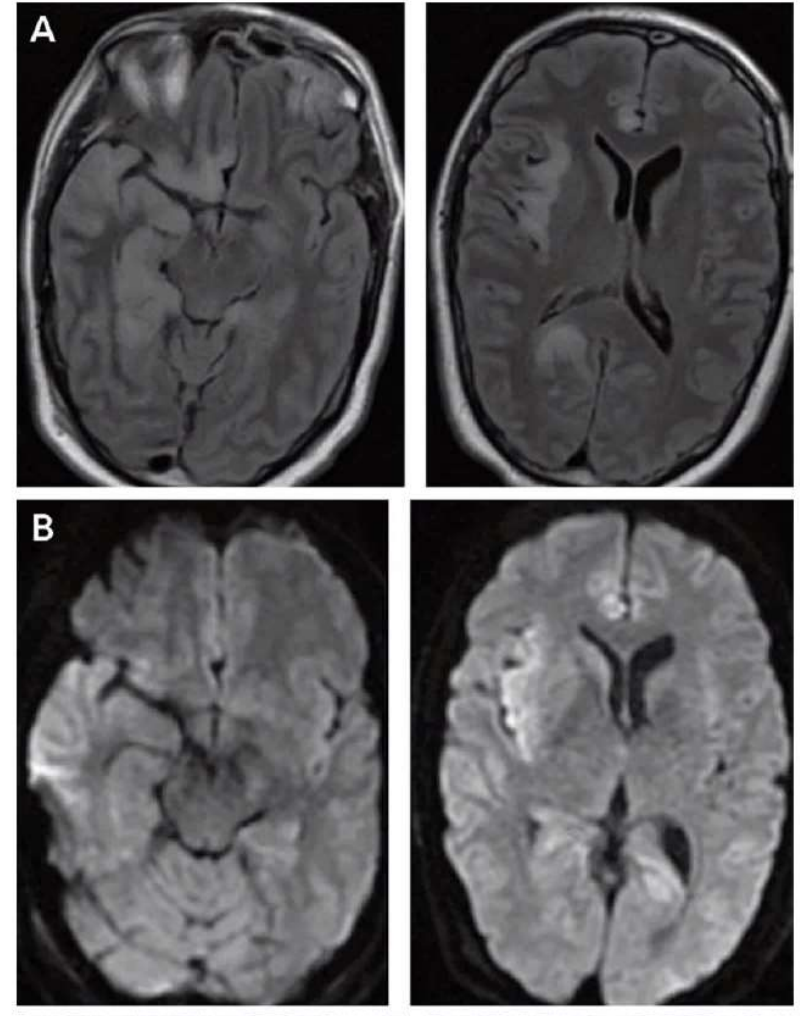
- CSF results
  - Gram stain negative
  - Culture x48 hrs negative
- EEG: Lateralized periodic discharges
- De-escalate antimicrobial therapy
  - D/C Ceftriaxone, Vancomycin, and Ampicillin
- Continue Acyclovir, high suspicion for HSV encephalitis
- CSF HSV1 PCR in CSF may be negative initially (first 72 hours).
  - If HSV is suspected, continue acyclovir and repeat CSF PCR in 3-7 days.
- Repeat CSF: HSV1 PCR positive

Q: Which part of the CNS is most likely to be affected?

- A. Temporal Lobe
- B. Basal Ganglia
- C. Brainstem
- D. Spinal Cord

# HSV1 MRI Brain

- Hyperintensities
  - T2/FLAIR (A)
  - DWI (B)
    - May be more sensitive early on in dx course
- Temporal lobes, insula, cingulate regions
- Asymmetric
- Other findings:
  - Hemorrhagic foci
  - Contrast enhancement



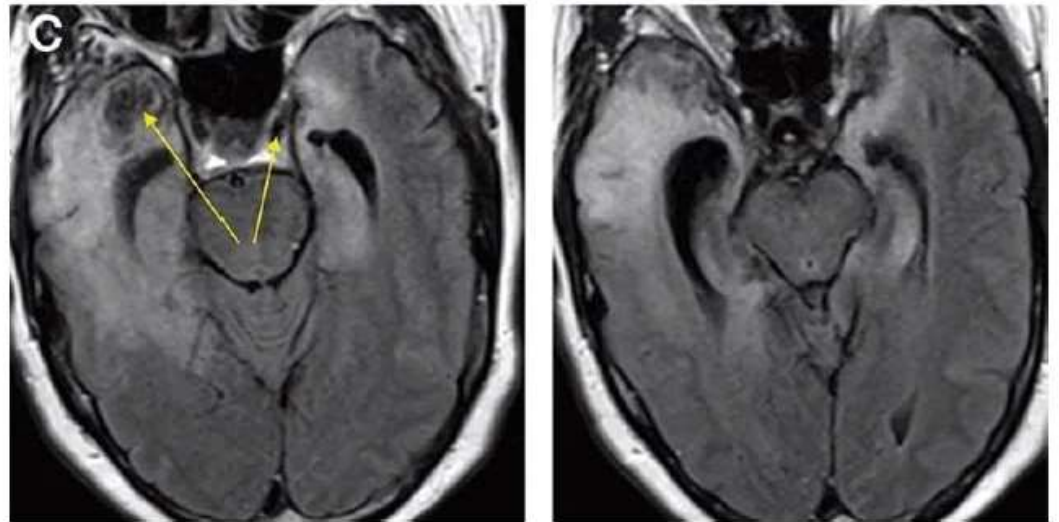
# HSV1 Treatment/Prognosis

## #1 Cause of fatal viral encephalitis

- Antiviral medication
  - IV Acyclovir
  - 10-14 days
  - Early initiation
  - Monitor for AKI, hydration
- Fatal if untreated
- < 20% with appropriate treatment
- Long term physical, cognitive, and behavioral issues that impact quality of life

# Herpes Viruses Complications

- Stroke
  - Ischemic
  - Hemorrhagic
- Vasculitis
  - VZV
- Seizures
  - Temporal lobe
- Necrosis
- Associated with autoimmune encephalitis (NMDA)



Many of these complications have specific targeted treatment that would need to be initiated.

# Case 3

Mr. Tatum

# Mr. Tatum

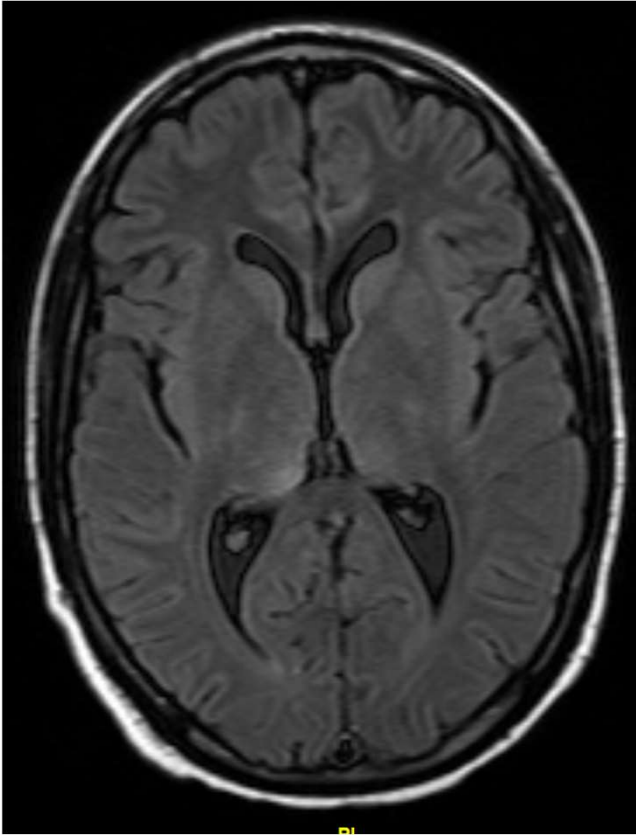
- 60 yo M who presented to the ED in late July
- PMHx: HIV, well controlled on ART
- HPI:
  - 3 days prior to admission
    - HA, fatigue, nausea, subjective fever
  - 1 day prior to admission
    - Lethargic, slow, postural instability, shuffling gait
  - Hospital day 3
    - Increased lethargy, confusion, agitation, tremor
- Social Hx:
  - Camping last weekend



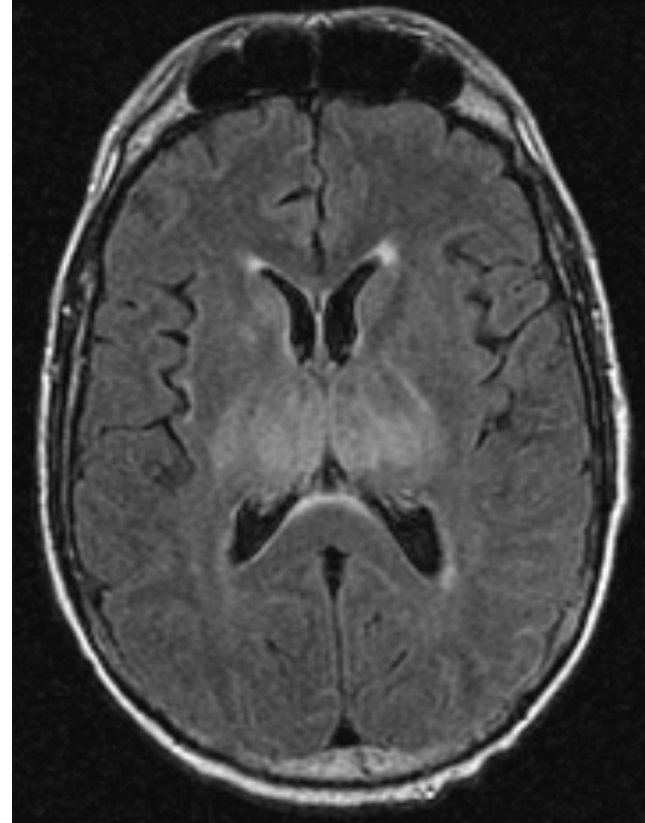
# Mr. Tatum's Exam

- VS: T 38.2 C
- Gen: Lethargic.
- Language: Hypophonic, slow responses.
- Motor/Mvmt:
  - Myoclonus noted over face (corners of mouth, eyebrows twitching).
  - Cogwheeling rigidity at L wrist.
  - Tremulous in BUE.
- Coordination: RAM with finger tapping are slow with breakdown, L > R.

# Mr. Tatum's MRI Brain



Hospital Day 1



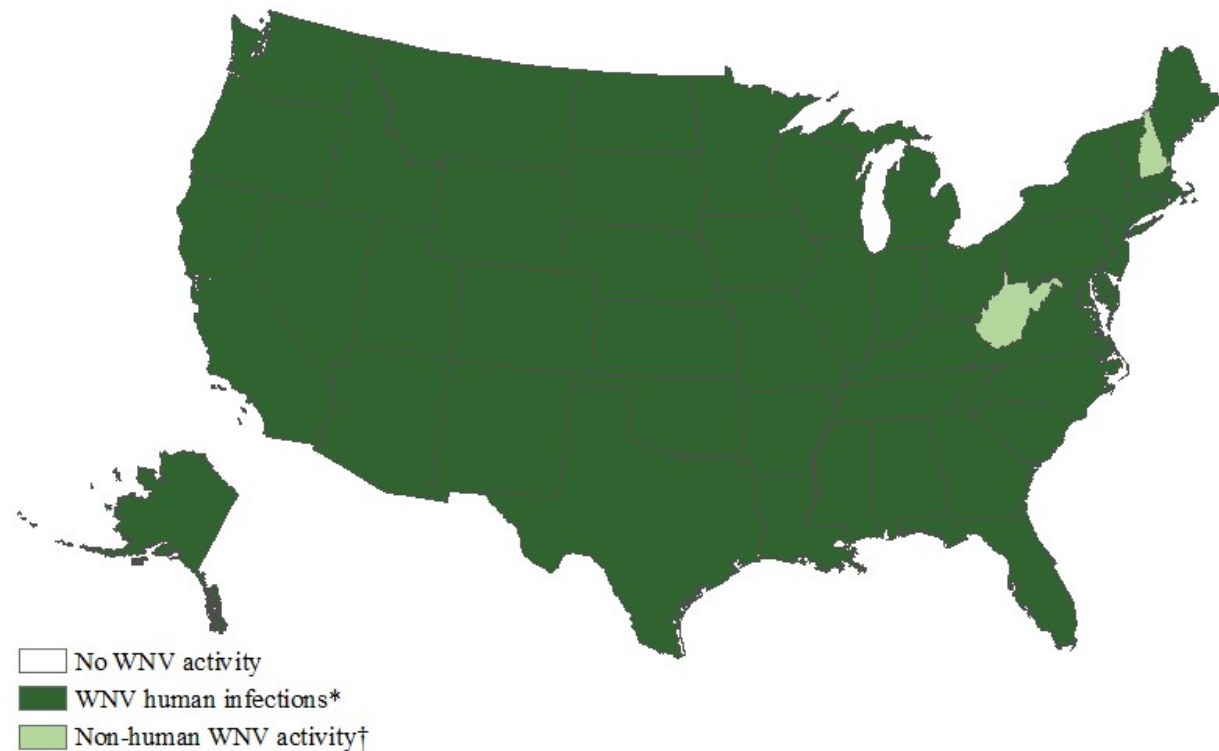
Hospital Day 5

Mr. Tatum has the most common cause of endemic viral encephalitis in the US. What does he have?

- A. Varicella Zoster Virus (VZV)
- B. Echovirus
- C. Coxsackie
- D. West Nile Virus (WNV)
- E. Human Immunodeficiency Virus (HIV)

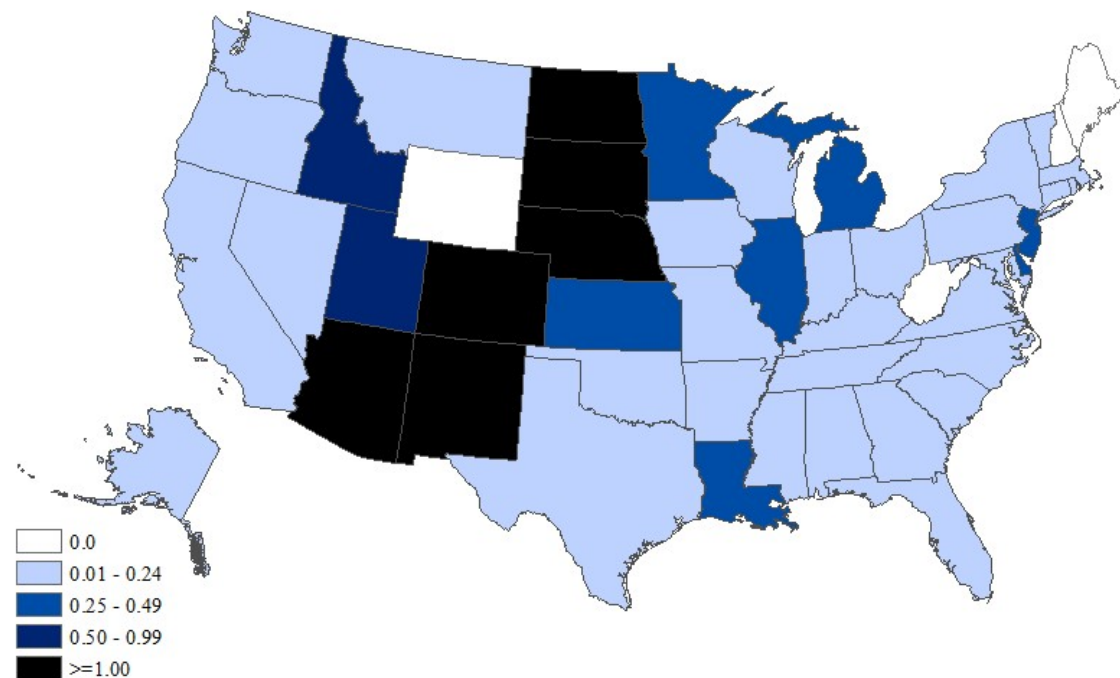
# West Nile Virus Activity by State – United States, 2021

(as of January 11, 2022)



# West Nile Virus Neuroinvasive Disease Incidence by State – United States, 2021

(as of January 11, 2022)



# West Nile Virus (WNV)

- Most common cause of endemic viral encephalitis in the US
- Mosquito borne infection
- Systemic: Nonspecific viral illness, URI symptoms, rash
- 1/150 patients known to be infected with WNV will have neurologic involvement
- Most at risk of neurologic involvement:
  - Advanced age, >60
  - Immunosuppressed state: organ transplantation
  - Chronic illness: HTN, DM

# Mr. Tatum's Lab Work

## CSF

- WBC 28 (H)
  - 62% **neutrophils**, 35% lymphocytes
- Protein 71(H)
- Glucose 65
- OP 20
- WNV IgM in CSF: Negative
- WNV IgG in CSF: Negative
- WNV PCR in CSF: Positive

## Serum

- WBC 10.2 (H)
- ESR/CRP: wnl
- WNV IgM: Positive
- WNV IgG: Negative

# Typical WNV Lab Work

- Pleocytosis: Average 226
  - Lymphocytic predominant
  - Neutrophilic (PMN) predominant initially
    - 48 hrs to 1 wk
- Protein: Mildly elevated
- Glucose: Normal
- Opening pressure: Normal
- Serum WBC, ESR, CRP: Elevated
- WNV PCR
  - High specificity
  - Low sensitivity
  - Less useful the longer the patient has been symptomatic
- WNV WNV IgM
  - May not be positive until 7 days after infection
  - May stay positive for mos-yrs



Q: What other part of the nervous system is commonly affected by WNV?

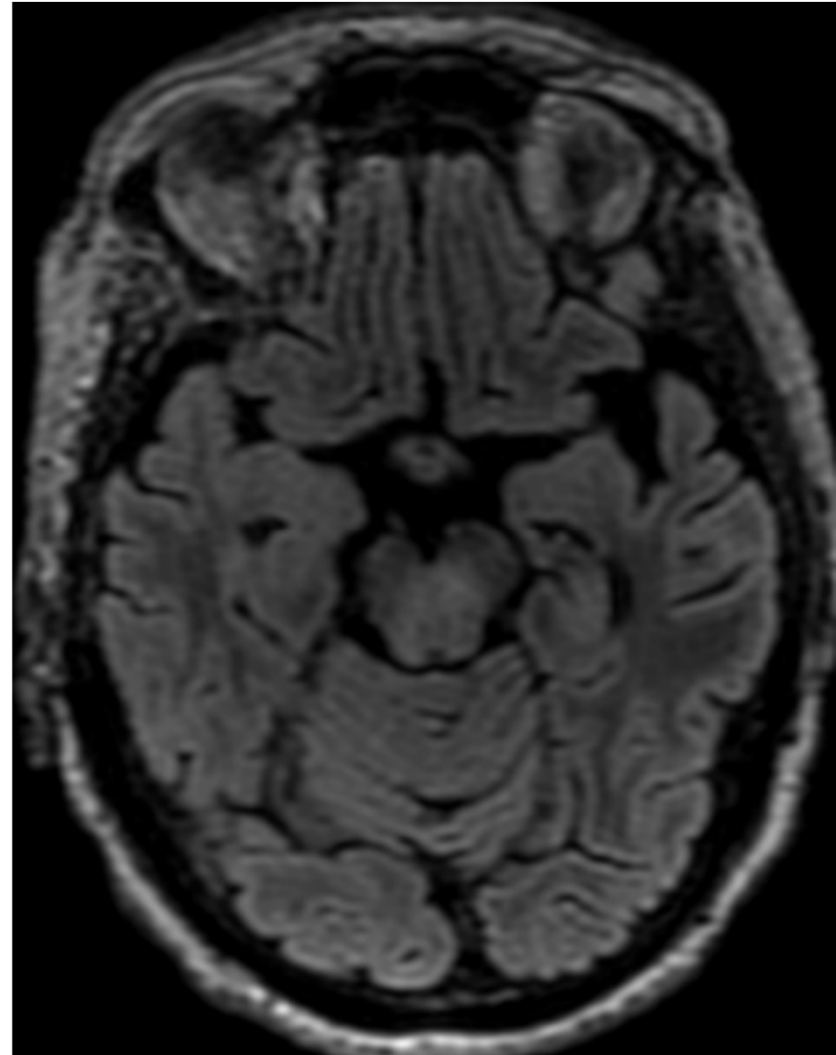
- A. Brain stem
- B. Spinal cord
- C. Peripheral nerve
- D. Muscle
- E. A & B

# Neuroinvasive WNV

- Signs/symptoms
  - Encephalopathy
  - Parkinsonism (tremor, rigidity)
  - Flaccid paralysis, asymmetric
  - Rash
- CNS involvement
  - Basal ganglia
  - Thalami
  - Brainstem
  - Cerebellum
  - Spinal cord/nerve root
    - Ventral
    - Anterior horn cells

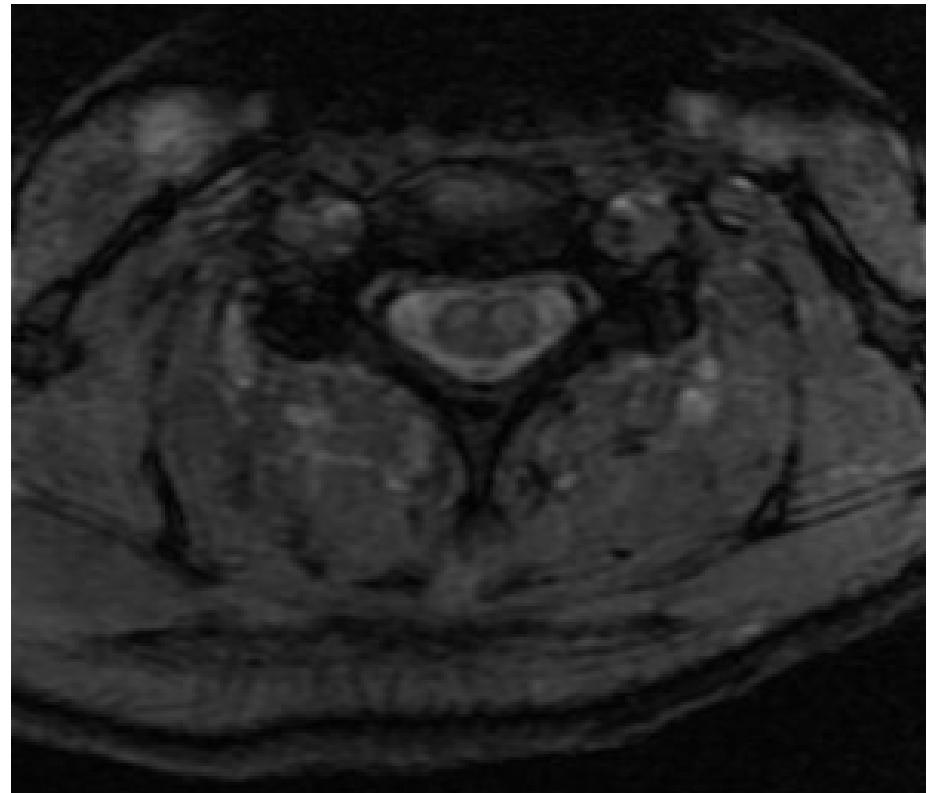
# MRI Brain

Brainstem Encephalitis



# MRI Cervical Spine

## Myelitis



# Neuroinvasive WNV Management

- No approved vaccines or treatments
- Supportive care:
  - Fever, HA, and N/V management
- Monitor for complications
  - Seizures
  - Bulbar/respiratory dysfunction
  - Autonomic symptoms
- Therapy evaluations, rehab
- Unclear evidence:
  - IVIG, Interferon-alpha, ribavirin, acyclovir, steroids
- Significant morbidity and mortality, especially in immunocompromised individuals

# Case 4

Mr. Brown

# Mr. Brown

- 67 yo M
- PMHx: IBD disease on immunotherapy, migraine without aura
- HPI:
  - 2 wks ago- PCP: Headache, worsening x weeks-months. Increased frequency and duration from his migraines. More N/V than usual. CTH wnl.
  - ED: Gait instability and double vision.
  - PCP: Few months ago: Persistent cough and fatigue. Took PO antibiotics.
- Social Hx:
  - Born in Connecticut, moved to Arizona a few years ago. Enjoys hiking and landscaping in his backyard.

## Mr. Brown's Exam

- VS: T 37.2
- Gen: Appears thin and tired. Uncomfortable. Only opens one eye at a time given photophobia and diplopia.
- CN: B/I CN 6 (LR) palsies, subtle.
- Gait: Unsteady causal gait, cautious. Inability to tandem walk without assistance.



Q: The Neurology team was consulted given concern for meningitis. How should we have classified Mr. Brown's meningitis?

- A. Acute infectious
- B. Subacute infectious
- C. Subacute autoimmune
- D. Chronic infectious

# Microbes: Chronic Meningitis

- Fungi
  - Coccidioidomycosis
  - Histoplasmosis
  - Blastomycosis
  - Cryptococcus
  - Aspergillosis
- Atypical bacteria
  - Tuberculosis
  - Syphilis
  - Borreliosis

# Mr. Brown's Laboratory Studies

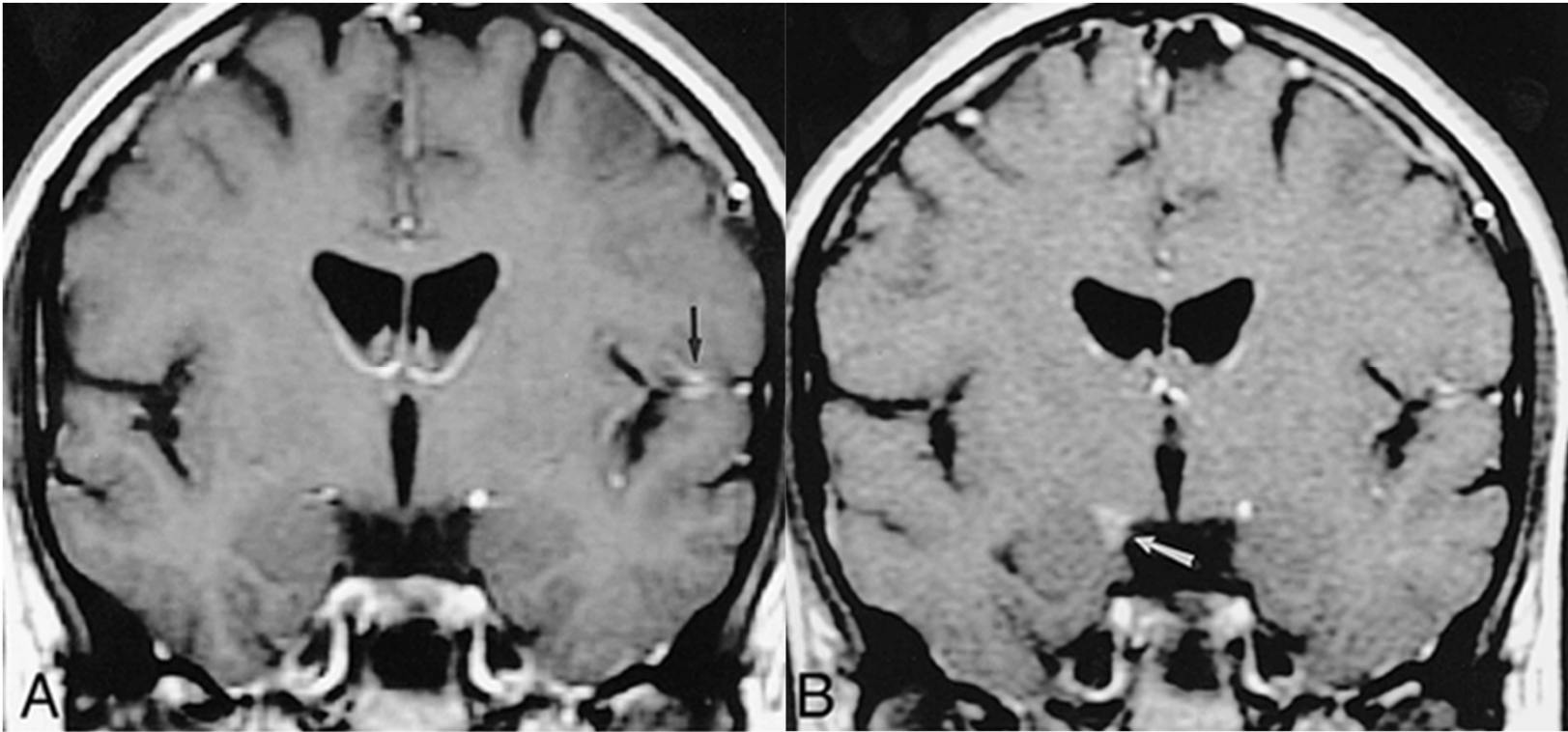
## CSF:

- WBC 382 (H)
  - 64% lymphocytes, 27% neutrophils, 9% monocytes
- Protein 189 (H)
- Glucose 34 (L)
- OP 31 (H)

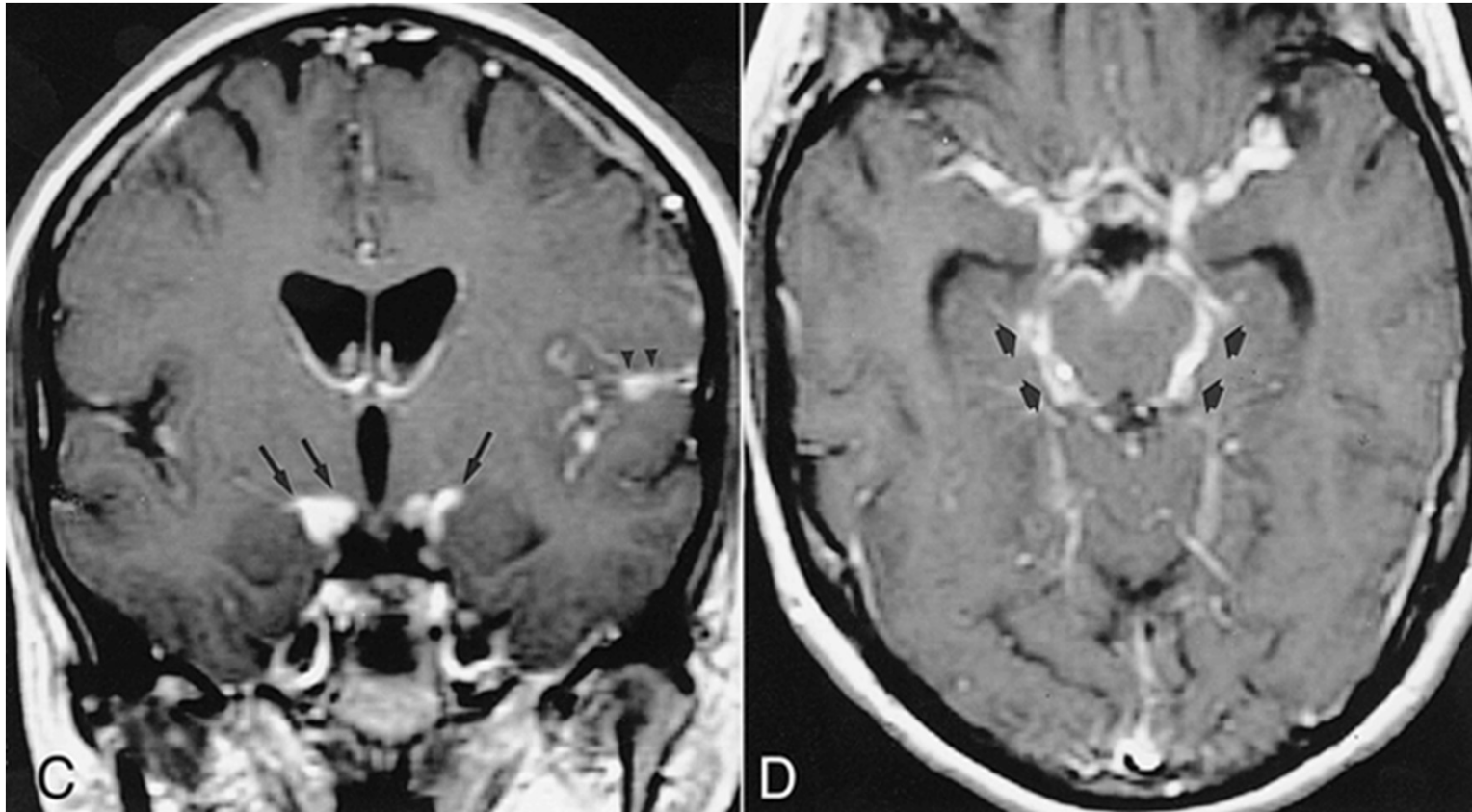
## Serum:

- WBC 11.0 (H)

# Mr. Brown's MRI Brain WITH Contrast



## Repeat Imaging 10 days later



# Additional Lab Work

## CSF

- Antibody testing
  - ID with complement fixation > EIA
- Antigen testing
- PCR testing
  - Lacks sensitivity
- Fungal culture
  - <10-30%, but diagnostic if positive

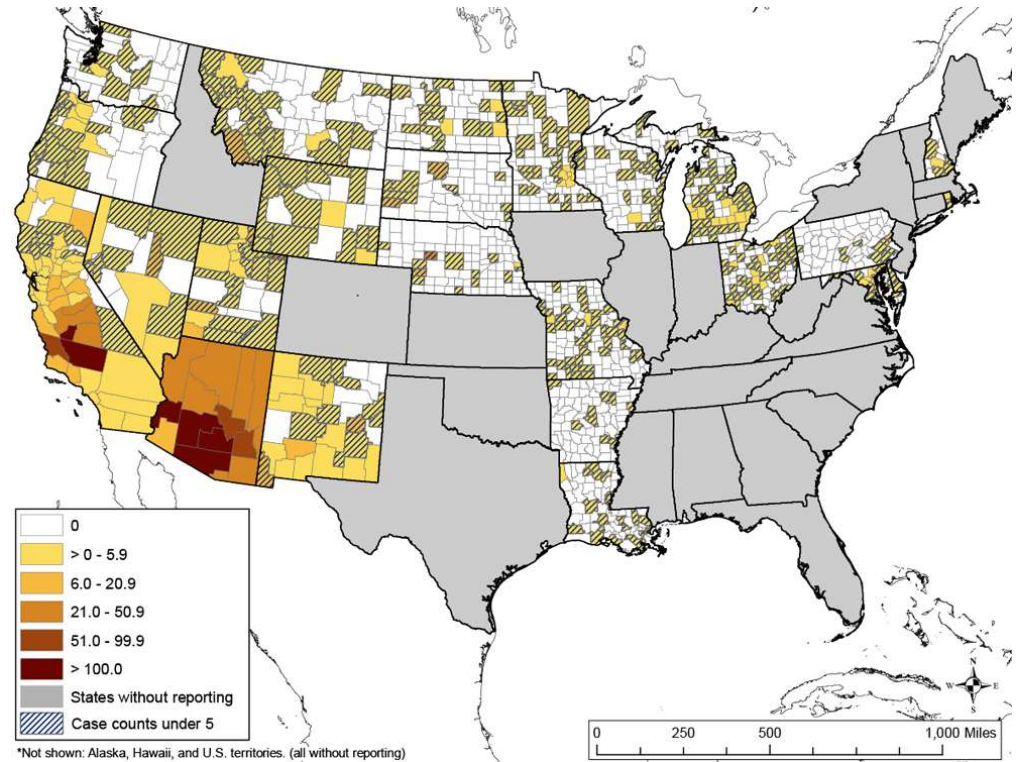
## Serum

- Antibody testing
  - About 70% sensitive
- Antigen testing

# Coccidioidomycosis

- Chronic fungal infection from dust/soil in endemic areas
- Systemic infection:
  - Asymptomatic/mild URI: 60%
  - Pneumonia, other complications: 40%
- 1-8% of new cocci infections are disseminated
  - CNS
  - Skin
  - Joint
- Most at risk for neurologic involvement
  - Advanced age, immunosuppressed state, chronic illness, pregnancy

Coccidioidomycosis:  
average incidence of  
reported infections per  
100,000 people, by  
county  
2011–2017





# Estimated Areas with Coccidioidomycosis: Worldwide



# Neuroinvasive Coccidioidomycosis Presentation

- Meningoencephalitis
  - Basilar predominant
  - Most common neurologic syndrome
- Signs and symptoms depend on which part of the nervous system is affected
  - Headache, high pressure
  - AMS/coma
  - Cognitive complaints
  - Cranial nerve palsies
  - Gait dysfunction
  - Weakness

Q: How long should Mr. Brown remain on antifungal therapy?

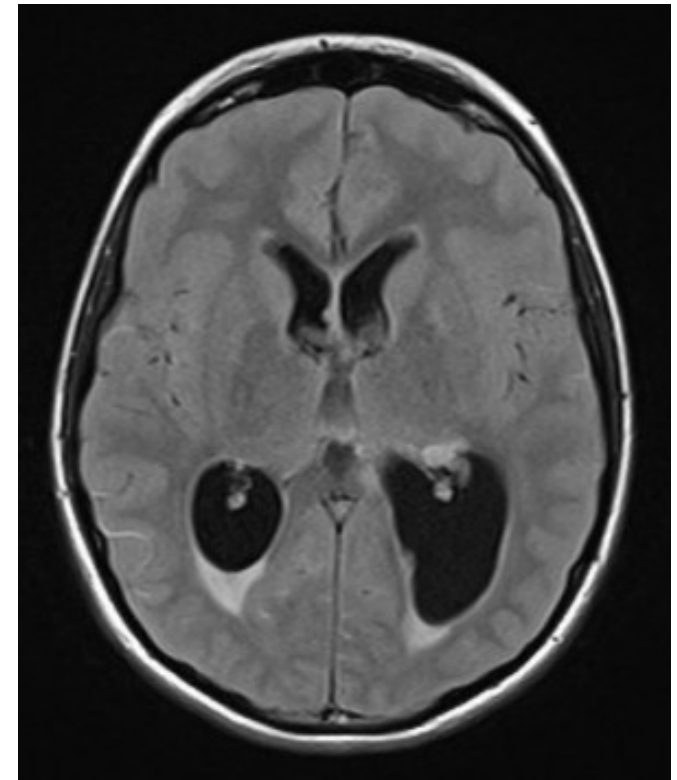
- A. 2 weeks
- B. 3 months
- C. 6 months
- D. Lifelong

# Coccidioidomycosis Meningitis: Treatment

- LIFELONG AZOLE THERAPY
  - Fluconazole: 400–800\*mg PO daily
- 80% chance of relapse if discontinued
- If stable and/or improving, no need for repeat CSF or neuroimaging
- Follow serum serologies, titers

# Coccidioidomycosis Meningitis: Complications

- Elevated ICP
- Hydrocephalous\*
  - Regularly scheduled LPs
  - VP shunt
    - Even before CSF cleared
- Coccidioidomas = abscesses
  - Drainage
- CN palsies
- Vasculitis
- Strokes



Many of these complications have specific targeted treatment that would need to be initiated.

# Take Home Points

- Start antimicrobials ASAP, targeted to most likely/deadly microbes including bacterial infections and HSV.
- Consider CTH before LP in certain patient populations. Otherwise, do not delay LP/CSF evaluation.
- HSV PCR can be negative initially. If suspicion remains high, continue acyclovir and repeat CSF.
- Consider endemic infections and ask about recent travel/outdoor activities.
- Be on the look out for common complications of CNS infections.
- Immunocompromised and older patients may have atypical presentations and less impressive lab values. Have a high index of suspicion for CNS infection.

# References

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