CNS Viral Infections

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Section A

Meningitis and Encephalitis
CNS Viral Infections

- Syndromes of aseptic meningitis, encephalitis and flaccid paralysis (poliomyelitis)
- Most represent uncommon complications of common systemic infections
- Over 100 etiologic agents (some are not viruses)
- Spectrum of agents and syndromes overlap
- Most IMPORTANT:
  - Rule out non-viral causes that require specific treatment
  - Do not miss herpes simplex encephalitis, which has highly effective treatment
Viruses

- Enteroviruses 40%
- Mumps 15%
- Lymphocytic choriomeningitis 5%
- Other 10%
- Unknown 30%
Viruses and Severity of Disease

- Enterovirus
- Mumps & LCM
- Herpes Simplex
- Arbovirus

Severity Levels:
- Mild Meningitis
- Severe Meningitis
- Mild Encephalitis
- Fatal Encephalitis
Seasonal Distribution

- Poliovirus (155 cases)
- Coxsackie (83 cases)
- Echo (53 cases)
- Arthropod borne (22 cases)
- Mumps (91 cases)
- LCM (56 cases)
- Leptospira (19 cases)
- Herpes simplex (19 cases)

Month of Onset:
- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Nov
- Dec
Mistakes about Poliomyelitis

- Olfactory spread—mistake of translational research
- Flies as vectors
- Swimming pools
Epidemiology of Enteroviruses

- Hand to mouth transmission
- Role of children and family
- Causes of “nonparalytic polio”
Severe and Fatal Encephalitis

- Arthropod-borne viruses
- Herpes simplex viruses
Herpes Simplex Virus

Trigeminal Nerve (CN V)

Herpes simplex virus

Primary infection

Trigeminal ganglion

Ophthalmic n. (V1)

Maxillary n. (V2)

Mandibular n. (V3)
Herpes Simplex Virus

Herpes simplex virus

Latency

Trigeminal ganglion

Trigeminal Nerve (CN V)
Herpes Simplex Virus

Herpes simplex virus

Trigeminal Nerve (CN V)

Trigeminal ganglion

Reactivated infection
Section B

Arthropod-borne Viruses
Arthropod-borne Viruses = Arboviruses

- Biological transmission with infectious cycle in arthropod vs.
- Mechanical transmission with contaminated extremities or mouthparts
Occurrence of Arthropod-Borne Encephalitis

Seasonal Occurrence of Arthropod-Borne Encephalitis

Graph showing the seasonal occurrence of arthropod-borne encephalitis, with a peak in August.
Colorado Tick Fever Virus

Distribution of *Dermacentor andersoni* ticks and patients from whom Colorado tick fever virus was isolated in western U.S.A.
A. aegypti

Source: CDC PHIL
Geographic Distribution of Arbovirus Encephalitis

- **Eastern Encephalitis**
- **Western Encephalitis**
- **St. Louis Encephalitis**
- **California Encephalitis**

Number of Cases:
- Light tan: 1-4
- Orange: 5-50
- Dark red: 50+

[Map showing geographic distribution of arbovirus encephalitis cases across the United States, with different colors indicating the number of cases.]
Eastern Encephalitis Virus

**Natural Cycle**

- Marsh Birds
- *Culiseta melanura*

**Overflow Cycle**

- Marsh Birds
- *Aedes*
- Wild Birds & Mammals

**Clinical Disease**

- Humans, Horses, Pheasants
Sentinel Species

Equine Death from Viral Encephalitis

Source: CDC
St. Louis and Western Encephalitis

**Natural Cycle**
- Wild Birds
- *Culex tarsalis*
- Wild Birds

**Amplifying Cycle**
- Domestic, Wild Birds & Mammals

**Clinical Disease**
- St. Louis
- Western
- Humans
- Humans, Horses
California Encephalitis

Natural Cycle

Aedes triseriatus

Small Mammals

Aedes triseriatus

Humans

Amplifying Cycle

Venereal
Tree Hole

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Man-Made Breeding Places

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Regions Reporting Japanese Encephalitis

- Malaysia

Monthly Number of Reported Encephalitis Cases
1970-83, Thailand
Japanese Encephalitis Virus

Natural Cycle

Amplifying Cycle

Humans

Piglets

Waterfowl

Culex tritaeniorhynchus

Culex tritaeniorhynchus
Rice Fields

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Cumulative Attack Rate for Encephalitis Due to Japanese Encephalitis Virus

- Placebo
- Monovalent
- Bivalent

Rate per 100,000
Section C

West Nile Virus
West Nile Virus: History

- '37: Virus (neurotropic in mice) isolated from blood of febrile woman in Uganda
- '54: Encephalitis in cancer patients experimentally infected in NYC
- '62: Few cases in Southern France
- '94: Recognized as endemic disease of children in Egypt and Sudan
- '96: Epidemic disease in Israel, South Africa, and India
- '99: Major epidemic in Southeastern Romania with frequent encephalitis, 10% fatality
- Present: Epidemic in Russia, New York City outbreak

CTLT
West Nile Virus: 1999 New York City Epidemic

- **8/23**
  - ID physician called NYC DOH about two patients in Queens with suspected encephalitis

- **8/27**
  - Same physician called about two more cases

- **8/29**
  - DOH found eight cases in four-by-four-mile area of Queens—58–87 years old, no common exposure, no illness in household; all spent time outdoors

- **9/2**
  - Tentative diagnosis of SLE; mosquito control begun

- Before and concurrent—increased NYC bird deaths, particularly crows

- Bronx Zoo—death of cormorant, flamingos, Asian pheasant; WNV isolated

- Virus closely related to Israeli isolate
How Did West Nile Virus Cross The Atlantic?

- Man
  - Viremic patient (unlikely due to brief viremia and low titer)
  - Intentional (unlikely choice as a weapon)
- Bird
  - Migratory, windblown or hitchhiker
  - Contraband
- Mosquito
  - On airplane
West Nile Virus: 1999 and 2000
West Nile Virus Activity, by State

West Nile Virus Activity by State
United States, 1999-2002

[Map of the United States showing the activity levels of West Nile Virus by state, with color coding for each year: 1999, 2000, 2001, 2002, and a note indicating states with no human cases.]
West Nile Virus 2003
Cumulative 2004 Data as of 3 a.m., Oct. 26, 2004. USGS/CDC.
Human cases of West Nile 2005 (November). USGS/CDC.