CNS infections

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Pyogenic meningitis
Meningitis

- Primary inflammation of Meninges

Etiology:

- Infections: Viral/Bacterial/ Fungal/ Parasitic/
- Drugs
- Autoimmune disorders
- Malignancies
- Post neurosurgery
- Post infectious
- Miscellaneous: Foreign body, Heavy metal poisoning, IVH
Pyogenic meningitis

• Inflammatory disease of the leptomeninges
• Acute purulent infection within the subarachnoid space
• The Meninges, subarachnoid space & brain parenchyma are all frequently involved in inflammatory reaction
Bacterial meningitis

- In neonatal period
- Beyond neonatal period
Neonatal meningitis

- Organisms: mostly reflect maternal GI and genitourinary flora
- E coli, Strep pneumoniae, Salmonella species, Pseudomonas aeruginosa, Strep fecalis, Staph aureus
Clinical features:

• Atypical
• Fever/ hypothermia
• Vacant stare
• Persistent vomiting
• Alternating irritability and drowsiness
• Refusal to feed
• Poor tone and cry
• Shock
• Seizures
Beyond Neonatal period

2 month - 2 years —
• H. influenzae (60-70%)
• S. pneumoniae
• Neisseria meningitidis
• Group B streptococcus (18 percent).

2 - 18 years —
N. meningitidis - 59 percent of cases,
S. pneumoniae (approximately 25 percent)
Hib (approximately 8 percent).
Pathophysiology

- Hematogenous spread
- Direct spread:
  - Contiguous focus (e.g., sinusitis, mastoiditis, otitis media)
  - Through an injury, such as a skull fracture.

Recurrent meningitis:
- # of cribriform plate or sinuses, pilonidal sinus, congenital fistulae, immune deficiency disorders
Pathophysiology

Colonization of nasopharynx

Viral infection

Bacteremic phase- penetration of BBB

Inflammatory response

Capillary endothelium damage

Disruption of the blood brain barrier, vasodilation, neuronal toxicity, meningeal inflammation, platelet aggregation, and activation of leukocytes.
Pathophysiology

Inflammation of meninges
  - Cortical edema
  - Vasculitis
    - Stroke
    - Exudates blocking ventricular system
      - Internal hydrocephalus
        - Raised ICP
  - Stroke
  - Exudates blocking ventricular system
    - Ependymal cell damage
      - Purulent exudates at base of brain
      - CN palsies
  - Vasculitis
  - Stroke
  - Exudates blocking ventricular system
    - Internal hydrocephalus
      - Raised ICP
• **Meningeal signs:**
  Inflammation of spinal roots/ Nerves

• **Neuropathy of 2, 3, 7, 8 N:**
  Inflammation of cranial Nerves
Raised ICP

1) Cytotoxic Cerebral edema: Cell death
2) Vasogenic: increased capillary vascular permeability
3) Interstitial: increased hydrostatic pressure
Hydrocephalus

• **Communicating type:**
  Adhesive thickening of arachnoid villi around cisterns of brain l/t interference with CSF absorption

• **Obstructive type:**
  Fibrosis & gliosis of aqueduct / foramina of Magendie & Luschka
Subdural effusion

- Increased permeability of BBB causing exudation of albumin rich fluid in subdural space
Clinical manifestation

2 presentations:

1) **Dramatically acute presentation:**
   - Rapid progressive manifestations of shock, purpura, DIC, altered sensorium, usually death within 24 hours

2) **Acute presentation:**
   - Sx progress over several days
Nonspecific findings:

- Fever, Anorexia, lethargy, URI or GIT sx,
- Petechie/ purpura/ macular rash
- f/o shock

S/o meningeal irritation

f/o raised ICP: headache, vomiting, bulging AF, hypertension, posturing, papillaedema

Focal neurological signs (10-20%)

Altered mental status
Meningococcal Meningitis
Brudzinski’s neck sign
D/D

- TBM
- Viral meningoencephalitis
- Aseptic meningitis
- Cryptococcal meningitis
- Meningismus d/t other reasons: enteric, apical pneumonia, poliomyelitis
- Subarachnoid hemorrhage
- Lyme disease
Investigations

- CBC
- SERFT
- Blood C/S
- CSF analysis (if no contraindications)
- Rapid diagnostic tests
- Neuroimaging
Lumbar puncture

- b/w L3 & L4/ L4 & L5

- **Microscopy:**
  
  CSF pleocytosis- Neutrophilic( absence of pleocytosis is a poor prognostic sign)
  
  Gram staining, India ink preparation

- **Biochemistry:** protein, sugar

- **Culture**

- **Bacterial panel:** Rapid antigen detection test
Cerebrospinal fluid drawn from between two vertebrae
Treatment

Supportive management:

• ABC
• Management of fluid & electrolytes
• Management of raised ICP
• Management of seizures
• Care of back, bladder & bowel
• Nutrition
Specific management

Antibiotics:

• **Hib, Meningococcal, Pneumococcal, Gm negative:** IV Ceftriaxone/ Cefotaxime

• **Hib:** Ampicillin + Chloremphenicol

• **Listeria:** Ampicillin + Aminoglycoside

• **Staph:** Methicillin /Vancomycin

• **Pseudomonas:** Ceftazidime + Amonoglycoside

**Duration of Tt:**

10 -14 days in uncomplicated cases

Staph: 3-4 weeks
Steroids:

- **IV dexamethasone** 15 mg/kg/dose 6 hourly X 5 days
- 1\textsuperscript{st} dose: 15 min. before antibiotics
- Useful in reducing incidence of sensorineural deafness

Treatment of complications
Immediate Complications

- Subdural effusion/ empyema
- Ventriculitis
- Arachnoiditis
- Brain abscess
- Hydrocephalus
- Shock
- ARDS
- Myocarditis
- SIADH
Late complications/ Sequelae

- Hemiplegia/ monoplegia
- SN deafness
- Blindness
- Aphasia
- Ocular palsies (squint)
- Mental retardation
- Seizure disorder
Neurotuberculosis
• Serious type of tuberculosis
• Major cause of morbidity & mortality in children
• > common in malnourished children
• In BCG vaccinated children, atypical localized involvement seen d/t activated T lymphocytes
Classification

• TBM with characteristic CSF findings
• Serous TBM-
  Normal CSF
  Mild ↑ in proteins & cells
• Tuberculous encephalopathy- normal CSF
• Acute infantile hemiplegia
• Localized Meningitis
  
  a) Localized basal meningitis
  
  b) Posterior fossa meningitis

• Isolated spinal TBM

• Tubercular polyneuritis

• Tubercular polyradiculoneuropathy

• Tubercular neuritis

• Tuberculoma (with or without TBM)
Tubercular Meningitis

- most important cause of death d/t neurotuberculosis in children.
- Age group: <5 years (65%)
- Males > Females
- > common in malnourished children
- Stages: 3 stages (clinical features overlap)
- Untreated illness usually fatal within 4-8 weeks
Pathophysiology

Hematogenous spread of TB
In primary infection

Rich’s focus

Bursts in subarachnoid space

Gen. Meningitis

Vasculitis

Exudates at base of brain

Brain edema

Infarcts

Hydrocephalus

Cranial N palsy

Tuberculoma
Stages

1\textsuperscript{st} Stage:

- stage of meningeal irritation
- Acute/ Subacute
  - Acute: presents like pyogenic meningitis
  - Subacute: Behavioral disturbances
- Fever, headache, vomiting, apathy, constipation, photophobia
- Brisk DTR
- Regression of milestones
2nd stage:

- Symptoms of cerebral involvement +
- Convulsions (65%)
- Neurological deficits
- Cranial Nerve Palsies
- Meningeal signs
- f/o raised ICP
- **Sensorium deteriorates** (semicomatosed)
- ANS abnormalities
3rd stage:

• Deep coma
• s/o meningeal irritation
• Neurological deficits
• Posturing (decorticate/ decerebrate)
• Dilated, fixed pupils
• Irregular breathing
Investigations

- **CBC**: ↑ TLC with predominance of lymphocytes
- **Mx**: may be positive
- **CXR**
- **Sputum/ Gastric aspirate for AFB**
- **FNAC**: if lymphadenopathy +
- **HIV**
CSF

Xanthochromic
Cobweb coagulum
Proteins: 50 - 300 mg% (may be upto 1-3 gm%),
Sugar: 20-40 mg%
Chlorides: ↓
Cells: Pleocytosis with lymphocytosis (in acute stages, may simulate pyogenic meningitis)
AFB: in 2-3% cases only
Neuroimaging

CT/ MRI:

- Basal exudates
- Hydrocephalus
- Infarct
- Tuberculoma
- Cerebral edema (particularly of white matter)
TBM

Basal exudates

Infarct
Tuberculoma
D/D

- Partially treated meningitis
- Viral encephalitis
- Cerebral malaria
- Typhoid meningitis/encephalopathy
- Brain tumour
- Brain abscess
- Chronic subdural hematoma
- Amebic meningoencephalitis
Management

Supportive:

• ABC
• Hydration
• Correction of Electrolyte imbalance
• Management of raised ICP
• Seizure control
• Back, bladder & bowel care
Management of raised ICP

- Head end elevation
- **Glucocorticoids**: Reduce cerebral edema, risk of development of arachnoiditis, fibrosis, spinal block
  Dexamethasone 1.5- 2 mg/kg/d X 1-2 weeks
  then gradually taper
- **Mannitol**: 1-2 ml/kg/dose SOS
- Glycerol
- Acetazolamide
- Surgical intervention: VP shunting
Specific management

ATT:
• Prolonged (1 year)
• 2 RHZE or 2 SHZE + 10 RHE
Prognosis

Depends upon

• Age of patient
• Stage of disease
• Adequacy of treatment
• Complications
• In stage I all patients recover
• Mortality: Stage II : 20-25%, Stage III: 50%
Sequelae

- Neurological deficits
- Cranial N palsies (Especially optic N)
- Acquired mental retardation
- Epilepsy
- Bladder/ Bowel symptoms (d/t arachnoiditis & spinal block)
Encephalitis
Etiology

Viral:

• Mumps, measles, rubella, enterovirus
• HSV, CMV, EBV, Varicella
• Japanese encephalitis, West Nile, Russian spring summer, Equine virus
• Rabies
• Lymphocytic choriomeningitis
• Dengue
• Influenza
Nonviral:
• Rickettsia
• Mycoplasma pneumoniae
• Bacterial: TB, Enteric fever, Shigella etc.
• Spirochetal
• Fungal
• Protozoal
Clinical picture

- Acute onset
- High fever
- Rash±
- Headache
- Vomiting
- Altered sensorium
- Seizures
- Neurological deficits (HSV: focality +)
- H/o similar illness in the community
Investigations

CSF:
• Protein, sugar usually normal (in mumps ↓)
• Pleocytosis: lymphocytosis

Viral work up for JE, HSV, Measles, Dengue etc (in CSF & in blood)

EEG

Neuroimaging
Treatment

- Supportive
- Specific:
  - HSV: Acyclovir: 10 mg/kg/dose for 14 days