

# **CNS infections**

Dr Chandrika Azad  
Assistant Professor  
Pediatrics

# **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 (eg, 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**

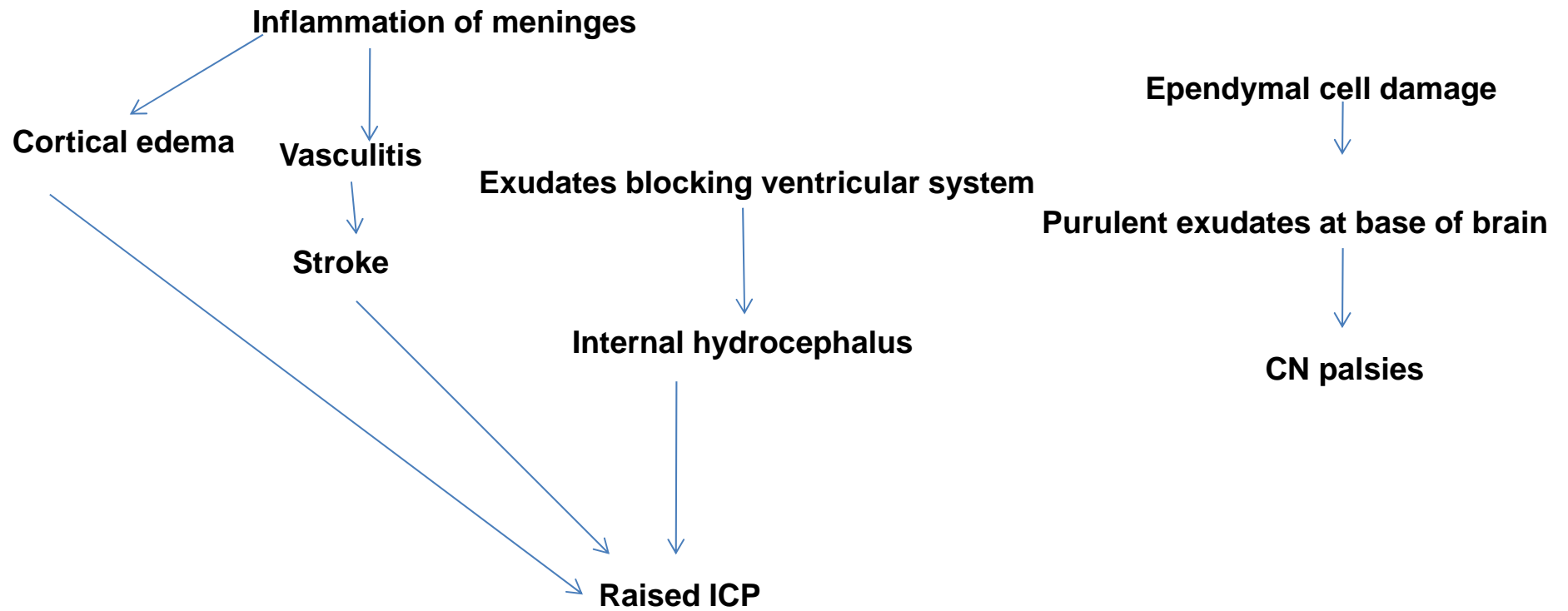


**Capillary endothelium damage**



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

# Pathophysiology



- **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

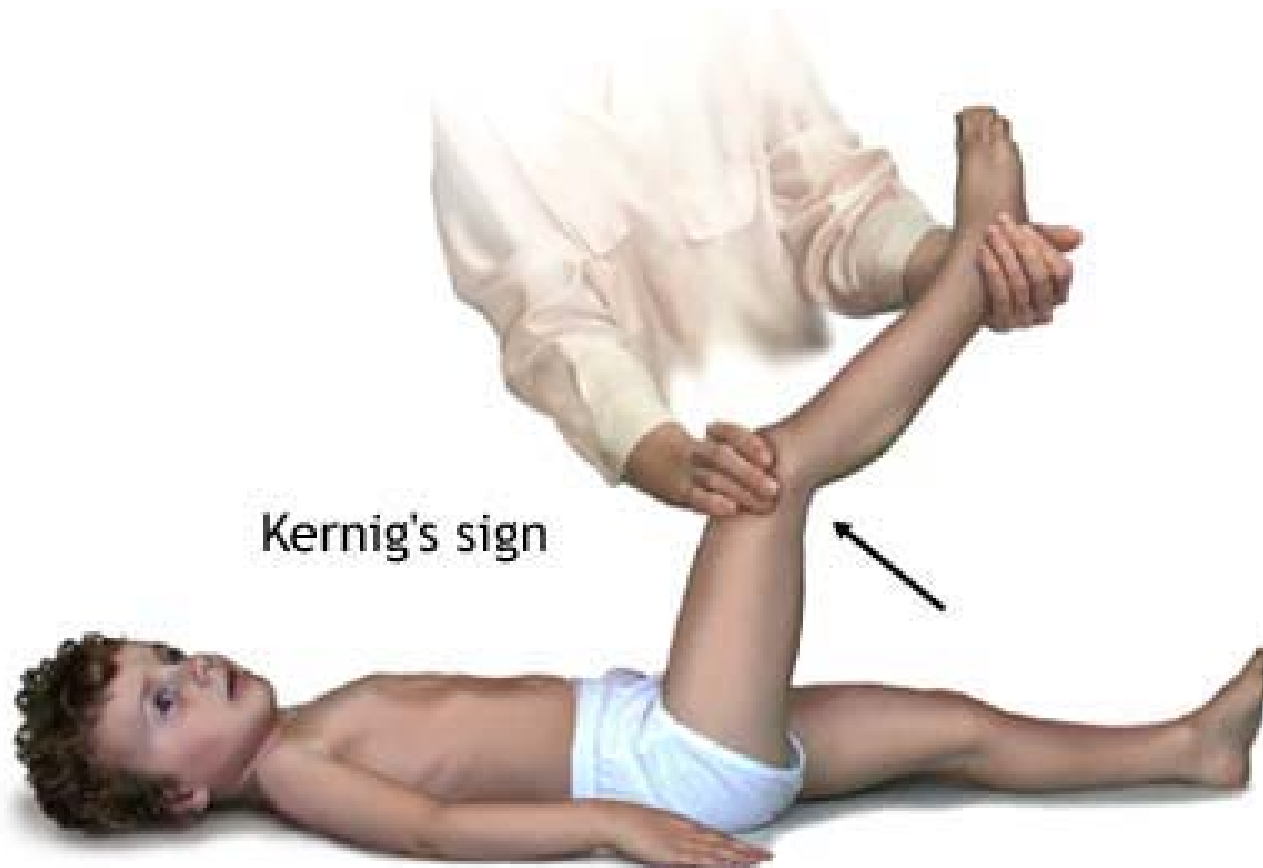
**Focal neurological signs ( 10- 20%)**

**Altered mental status**

# Meningococcal Meningitis







Kernig's 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)

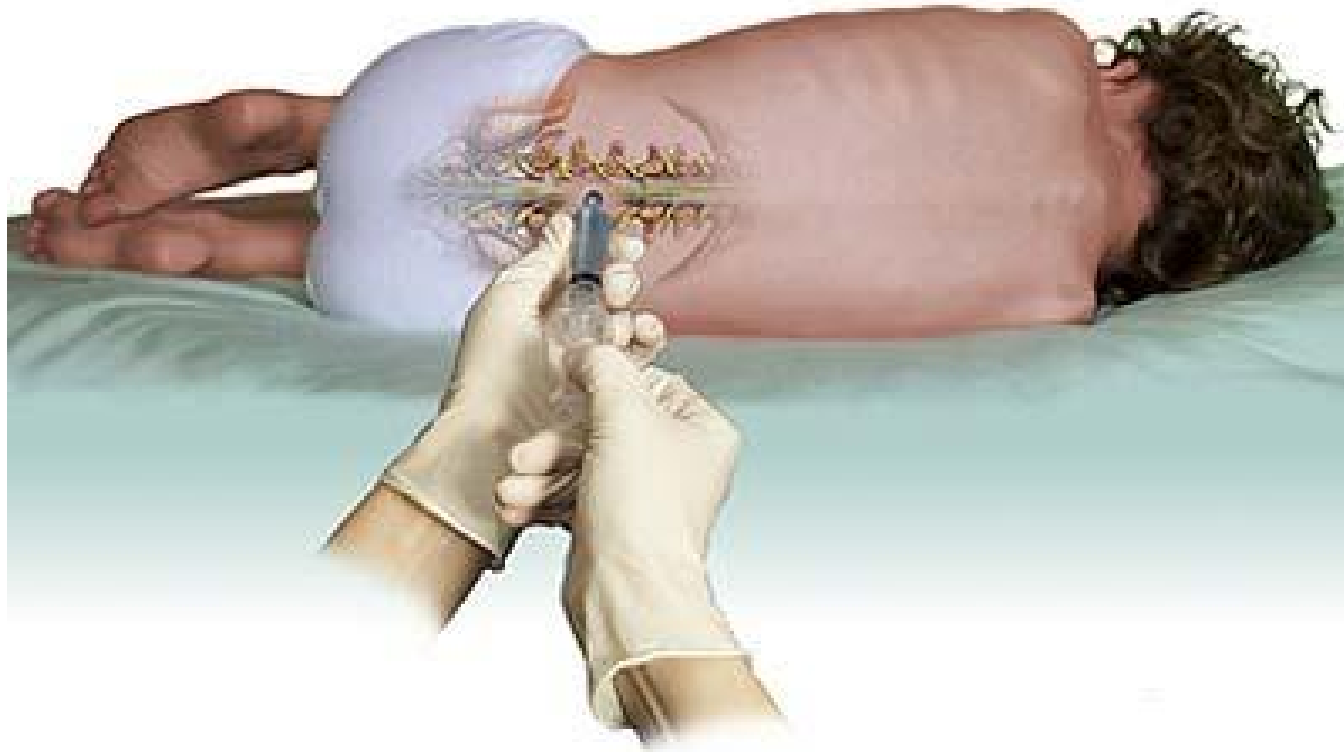
Gram staining, India ink preparation

- **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 + Chloramphenicol
- **Listeria:** Ampicillin + Aminoglycoside
- **Staph:** Methicillin /Vancomycin
- **Pseudomonas:** Ceftazidime + Aminoglycoside

## 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<sup>st</sup> 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**

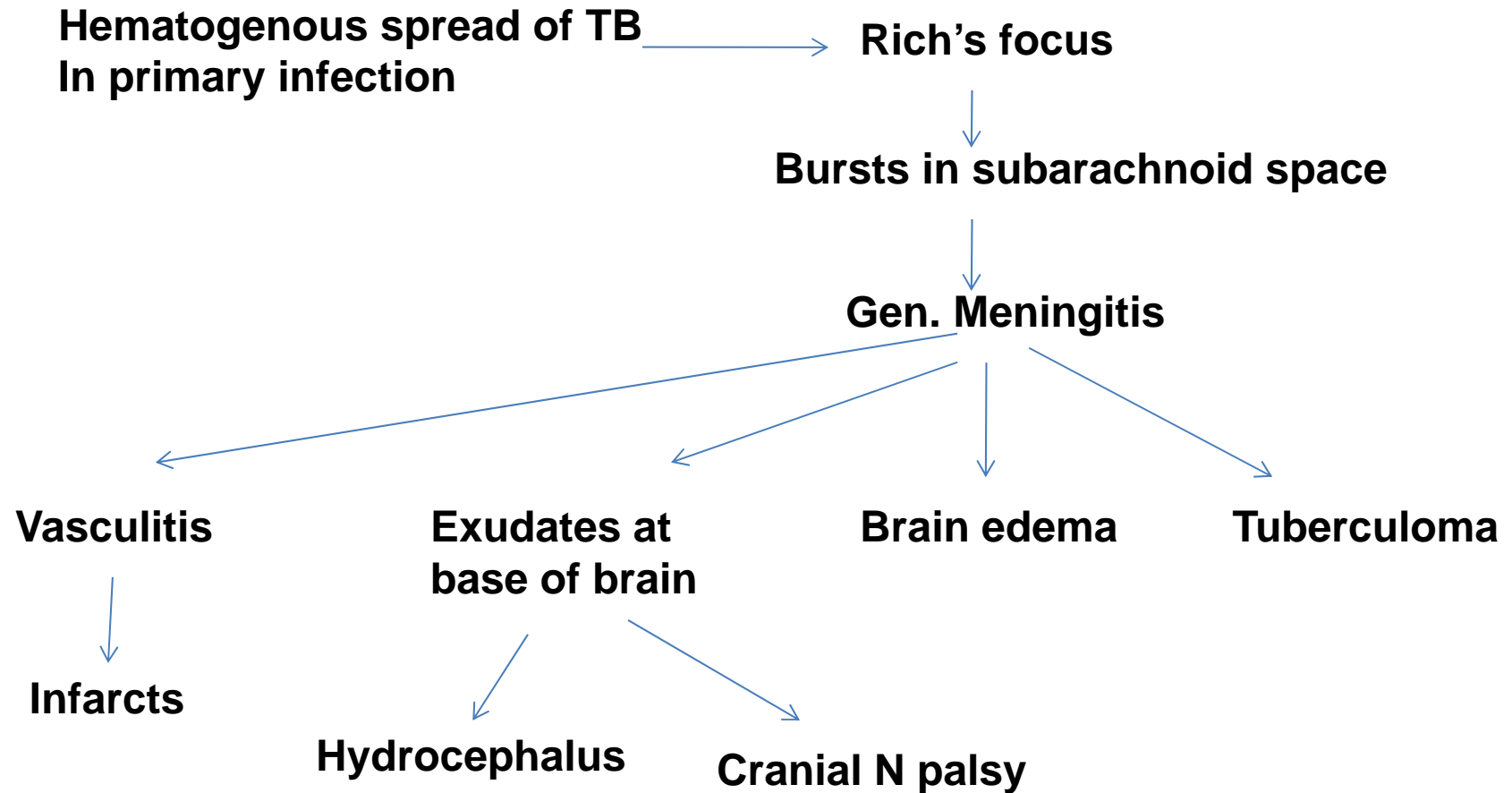


- **Localized Meningitis**
  - a) **Localized basal meningitis**
  - b) **Posterior fossa meningitis**
- **Isolated spinal TBM**
- **Tubercular polyneuritis**
- **Tubercular polyradiculoneuropathy**
- **Tubercular neuritis**
- **Tuberculoma ( with or without TBM)**

# 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



# Stages

## **1<sup>st</sup> 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

## **2<sup>nd</sup> stage:**

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

### **3<sup>rd</sup> 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- 40mg%**

**Chlorides: ↓**

**Cells: Pleocytosis with lymphocytosis ( in acute stages,  
may simulate pyogenic meningitis)**

**AFB: in 2-3 % cases only**

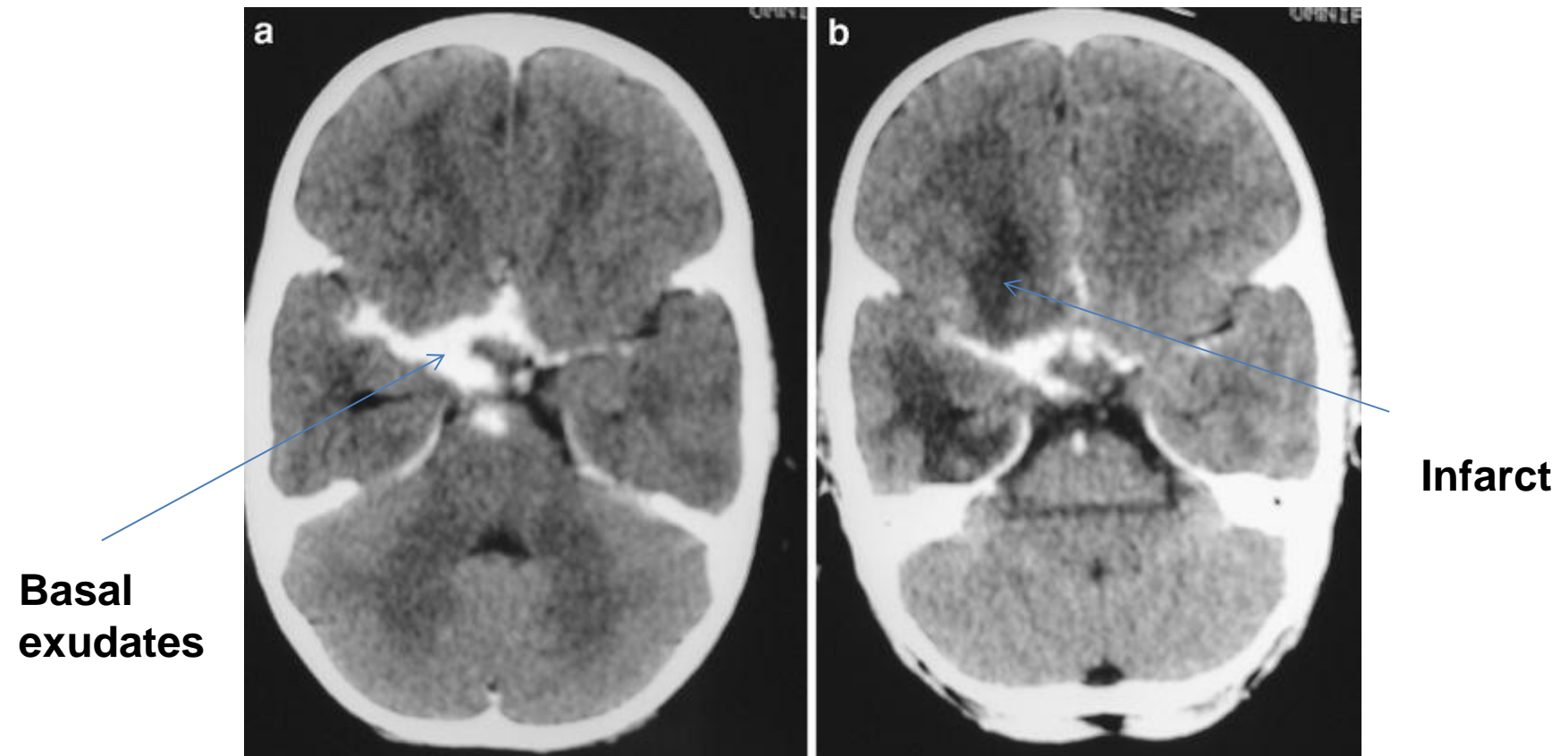


# Neuroimaging

## CT/ MRI:

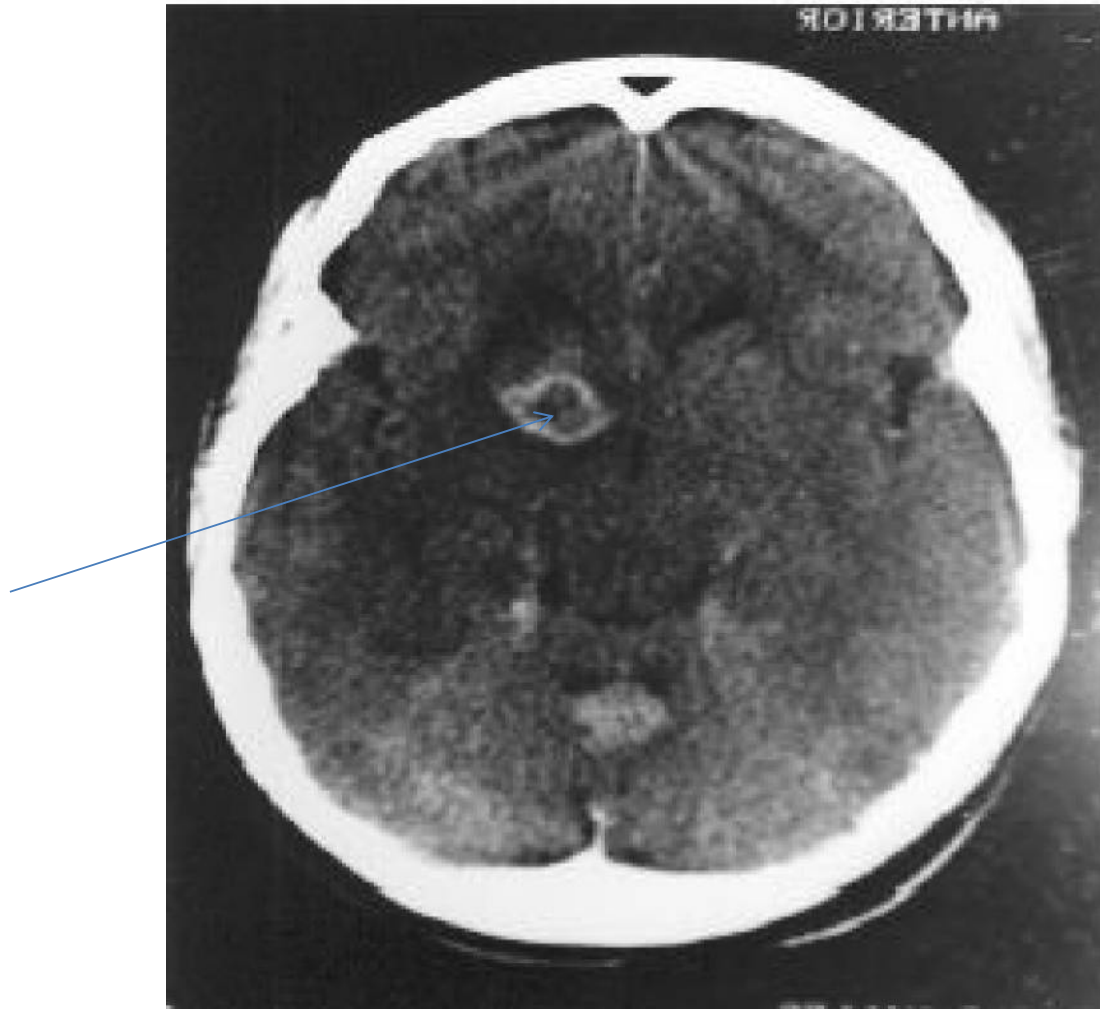
- Basal exudates
- Hydrocephalus
- Infarct
- Tuberculoma
- Cerebral edema ( particularly of white matter)

# TBM





# 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 dev 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

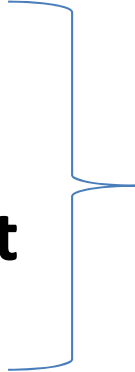
**ATT:**

- **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**