Serious Pediatric Infections

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Objectives

By the end of this session you will:

- Learn special concepts pertinent to children ID
- Outline a frame work for study of infectious diseases
- Enumerate examples of serious infections
- Classify episodes of bacteremia based on the clinical pattern
- Describe how the child age and other risk factors determine etiology of certain infections in pediatrics
- Appreciate utilization of knowledge of pathogenesis of diseases in the therapeutic and preventive measures

Pediatric Infections Diseases

*SPECIAL CONSIDERATIONS

- **First exposure**

  most children will encounter the organism for the first time, whereas elderly will have had previous exposure with same or similar organism, which will cross react and form AB with less intense symptoms than pediatrics.

- **Immature Immune System**

  more infection in mucosal surfaces i.e. more gastroenteritis.
  IgM starts forming in utero and reaches adult number by the first year of life.
  IgG is not formed until 3-4 years.
  IgA by 10-14 years.

Guidelines for study of Infectious Disease

- Etiology
- Pathogenesis
- Clinical Manifestations/course
  - ✓ Immunocompetent
  - ✓ Immunocompromized

- Epidemiology
  - ✓ Mode of transmission
  - ✓ Incubation period
  - ✓ Reservoir
  - ✓ Period of communicability
  - ✓ Susceptible individuals

Serious Pediatric Infections

1. Bacteremias
2. Meningitis and encephalitis
3. Neonatal jaundice
4. Neonatal sepsis
5. Epiglotitis
6. Osteomyelitis
7. Septic arthritis
8. Endocarditis
9. Tuberculosis…. Etc.

Bacterial meningitis

MENINGITIS

- Etiology
- Pathogenesis
- Molecular pathophysiology
- Clinical Manifestations
- Diagnosis
- Therapy
- Complications
- Prevention
  - Chemoprophylaxis
  - Vaccination

Clinical description

- **Meningitis** is the inflammation of the protective membranes covering the brain and spinal cord known as the meninges.
- The inflammation is usually caused by an infection of the fluid surrounding the brain and spinal cord.
- Meningitis can be life-threatening because of the inflammation's proximity to the brain and spinal cord; therefore the condition is classified as a medical emergency.

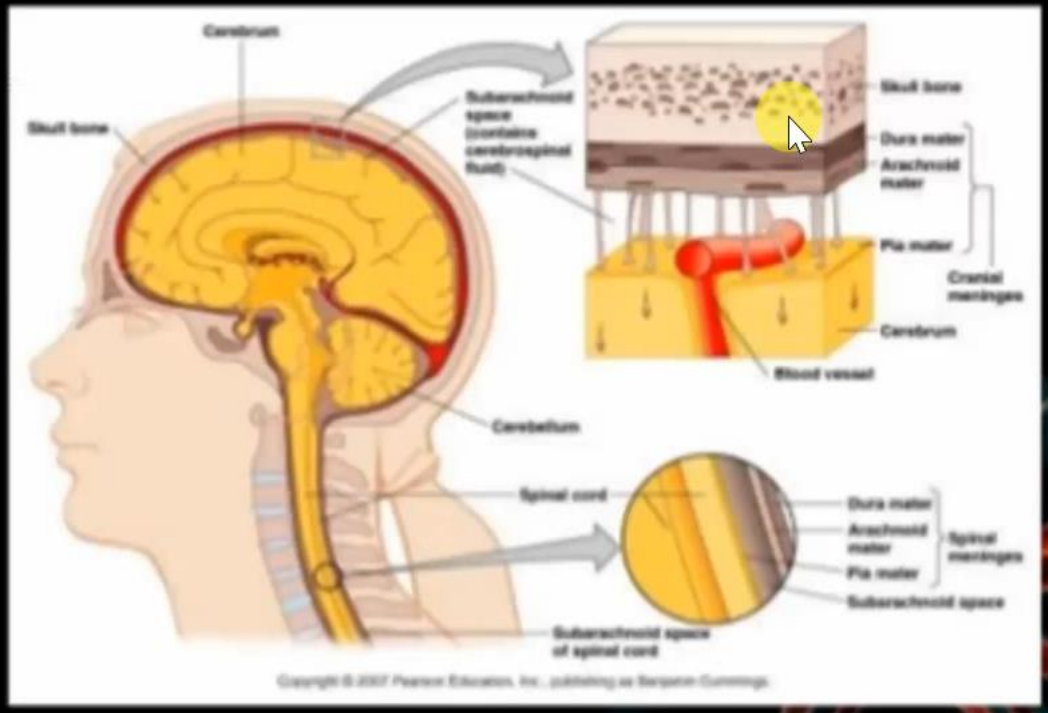
Meninges

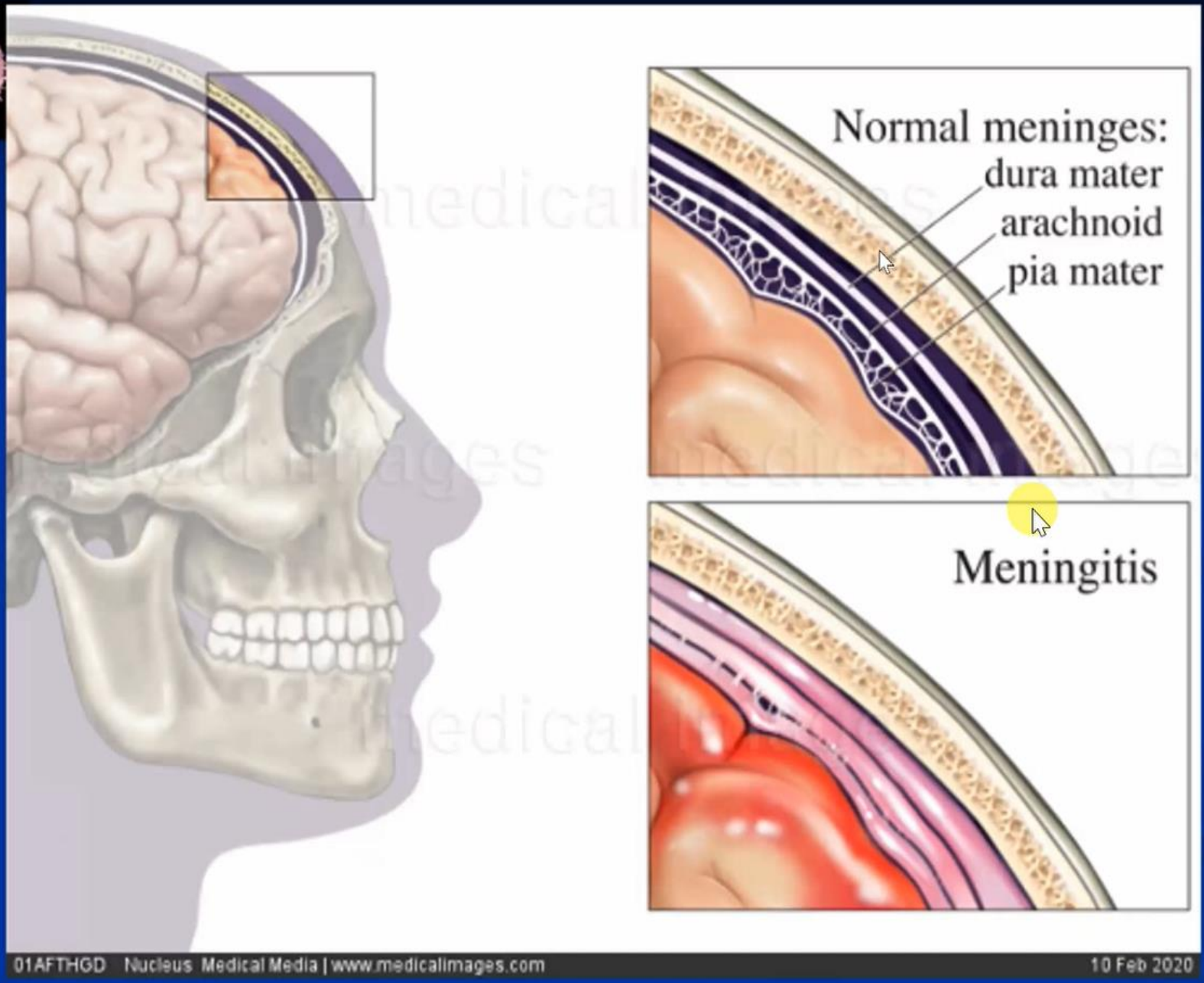
The **meninges** is the system of membranes which envelops the central nervous system.

It has 3 layers:

1. **Dura mater**
2. **Arachnoid mater**
3. **Pia mater**

Subarachnoid space - is the space which exists between the arachnoid and the pia mater, which is filled with **cerebrospinal fluid.**




Normal meninges:
dura mater
arachnoid
pia mater
Meningitis
01AFTHGD Nucleus Medical Media | www.medicalimages.com
10 Feb 2020

- **BACTERIAL AGENTS**:

  Neonatal: ***E. coli***
  Group B Streptococci
  Infants: ***Hemophilus influenzae***
  Adolescents and young adults:
  Niesseria meningitidis(most common)
  Streptococcus pneumoniae
  Elderly: ***Listeria monocytogens***
  Streptococcus pneumoniae

- **VIRAL AGENTS**: **Enterovirus***(most common)*, **Mumps virus, Coxsackie virus, HSVII, EBV**

- **FUNGAL AGENTS**: ***Candida albicans, Cryptococcus neoformans, Blastomyces dermatidis, Coccidiodesimitis***

- **PARASITES**: **Protozoa, Nematodes, Cestodes**

BACTERIAL MENINGITIS

ETIOLOGY

Determined by:

(I) AGE

- Neonates (< 3 months) : Group B strep > E-coli (and other gram negatives)> listeria.
- 3 months – 5 years: strep. pneumoniae > N. meningitides > HiB.
- >5 years: No HiB even in non-vaccinated children because of vaccination.

(II) SPECIAL RISK FACTORS:

- Post-traumatic: Basal skull fractures: 80% are strep. pneumoniae.
- Post neurosurgical: staph and gram negatives.
- Ventricular shunts: staph epidermidis (coagulase negative).
- Immunocompromised: depends on the organism.
- Asplenia and SCD: Salmonella and encapsulated organisms.

Pathophysiology

Causative organism enters the blood stream

Cross the blood barriers

Inflammatory reaction in meninges

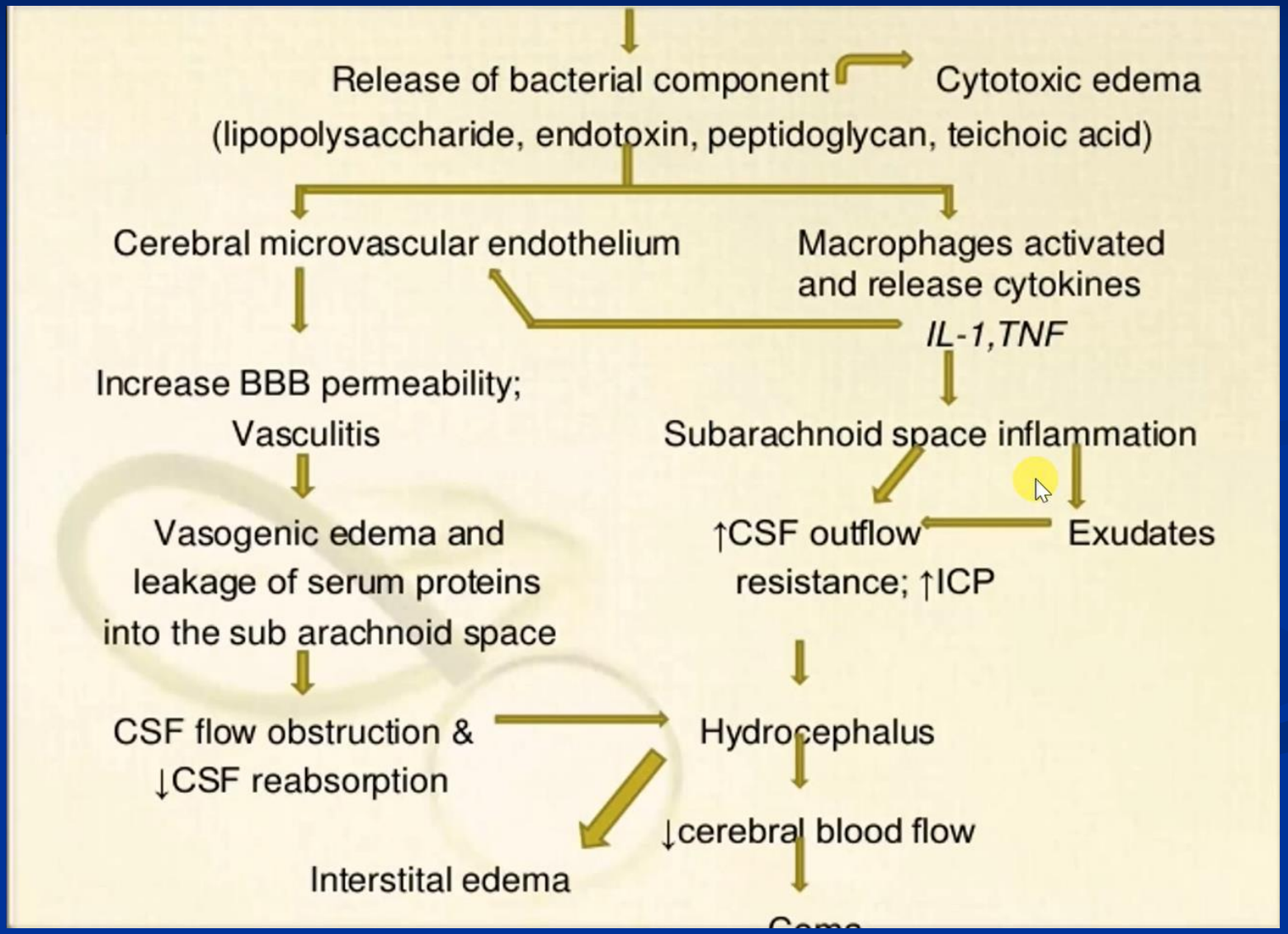
Inflammation of subarachnoid space and pia meter occur

Inflammation may cause ICP

CSF cloudness or infected

CSF cell count increase

CSF flows in subarachnoid space

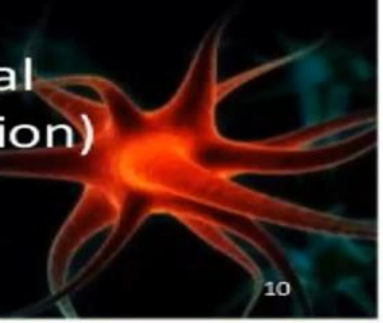

Release of bacterial component
(lipopolysaccharide, endotoxin, peptidoglycan, teichoic acid)
Cytotoxic edema
Cerebral microvascular endothelium
Macrophages activated and release cytokines
IL-1,TNF
Increase BBB permeability;
Vasculitis
Subarachnoid space inflammation
Vasogenic edema and leakage of serum proteins into the sub arachnoid space
↑CSF outflow resistance; ↑ICP
Exudates
CSF flow obstruction & ↓CSF reabsorption
Hydrocephalus
↓cerebral blood flow
Interstital edema

CLINICAL PRESENTATION

- IN NEONATE & IN OLDER CHILDREN

Sign and symptoms

- Severe headache
- Irritability
- Restlessness
- Stiffness of neck
- Malaise
- Nausea/vomiting
- High grade fever
- Tachypnea
- Seizures
- Disorientation
- Tachycardia
- Coma
- Sleeplessness
- Phonophopia
- Photophobia
- Altered mental status(confusion)



Kernig's is performed by having the supine patient, with hips and knees flexed, extend the leg passively. The test is positive if the leg extension causes pain.

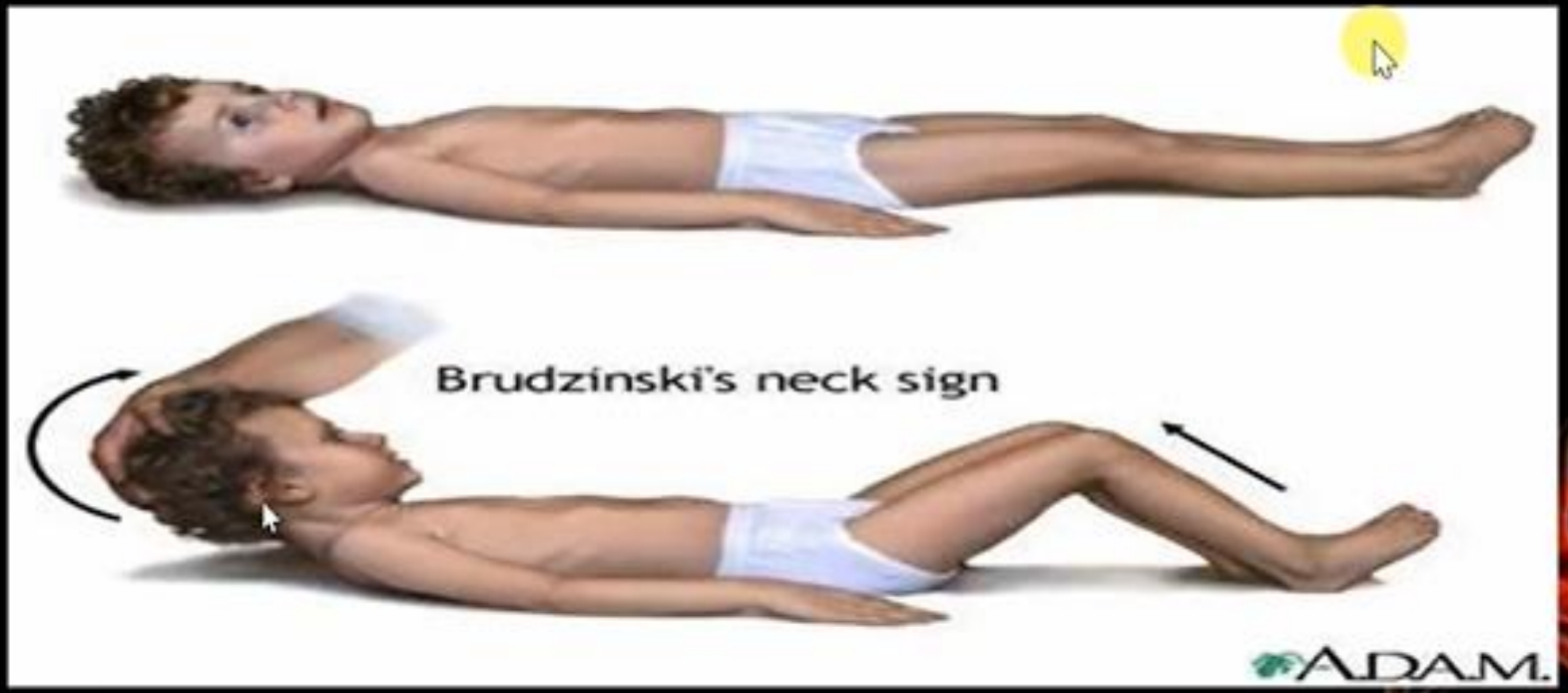
Clinical manifestation

Confirmative sign:

- Positive kernig's sign

The Brudzinski's sign is positive when passive forward flexion of the neck causes the patient to involuntarily raise his knees or hips in flexion

Brudzinski's Sign



DIAGNOSIS

- **CBC** - leucocytosis or leucopenia (worst prognosis signifies meningococcal disease). Never discharge a patient with normal CBC and fitting clinical picture.

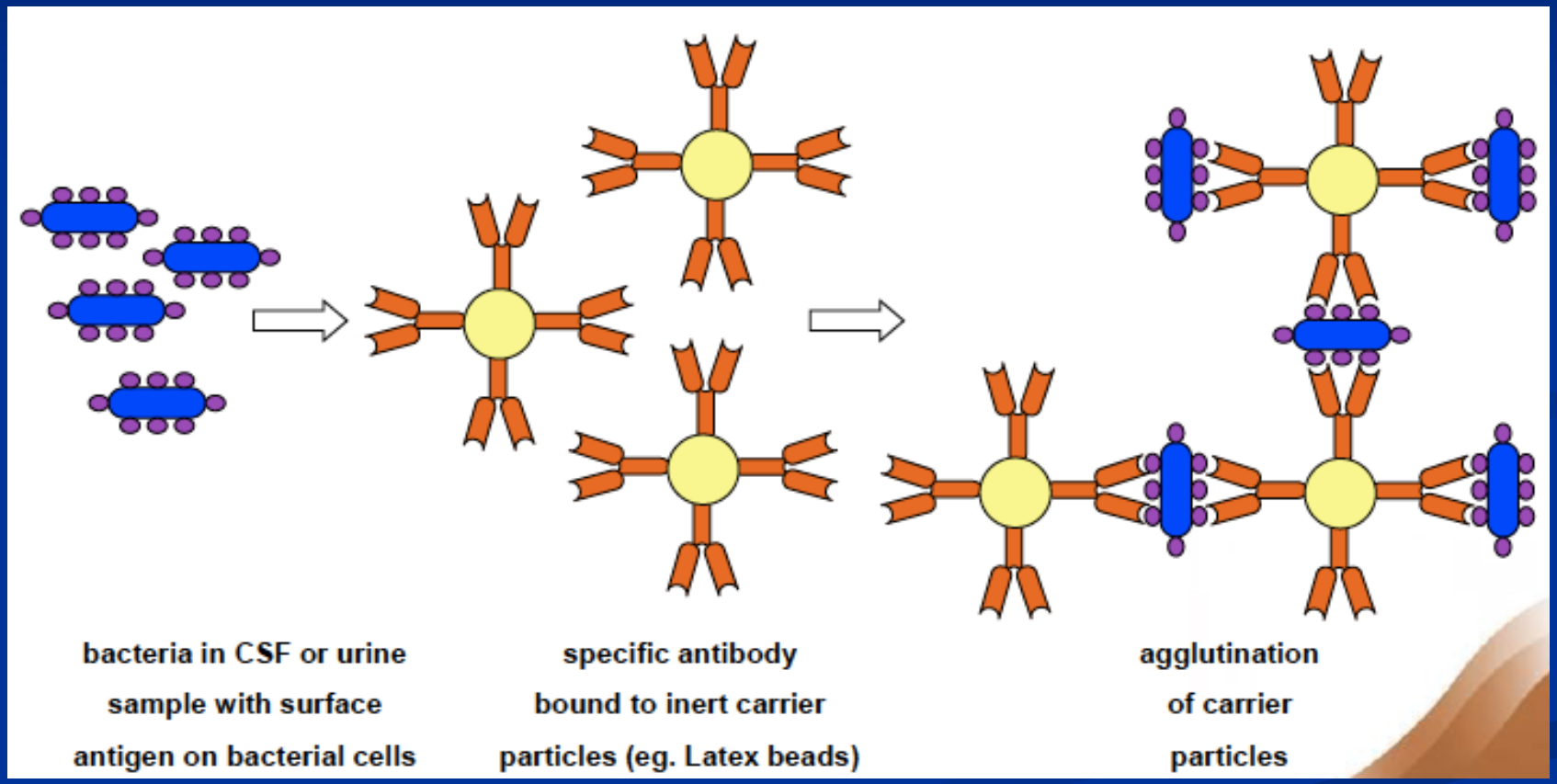
- **BLOOD CULTURE** - 60-70% specific.

- **CSF** Color
  - Cell count and differential.
  - Chemistry: Sugar & Proteins
  - Gram stain is positive in 70-80% of the patients.
  - Latex agglutination or co-agglutination is used to detect the antigen instead of culture because the culture takes 24 hours. → not accurate if the pt on Abx
  - Culture is the gold standard

DIAGNOSIS

- CSF - there are three components in the CSF we should look at- WBC, glucose, and protein
- For bacterial meningitis, the WBC is mainly polymorphic and the glucose is less that 50% of serum glucose (normal is 2/3 of serum glucose). If it was partially treated bacterial meningitis the lymphocyte predominates.
- For Viral or TB, the WBC is mainly lymphocytic. Sugar is normal.
- For fungal and TB meningitis, the glucose is less than 50% the serum glucose. The protein is raised in all, but might be normal in viral.

LATEX AGGLUTINATION OR CO-AGGLUTINATION



MANAGEMENT

- **Supportive care** -is the most important. Careful monitoring of the patient, by checking the blood pressure for hypertension and the respiration for the RR, and pH.

- **Antibiotics**
  - Which one?
  - How much?
  - For how long?

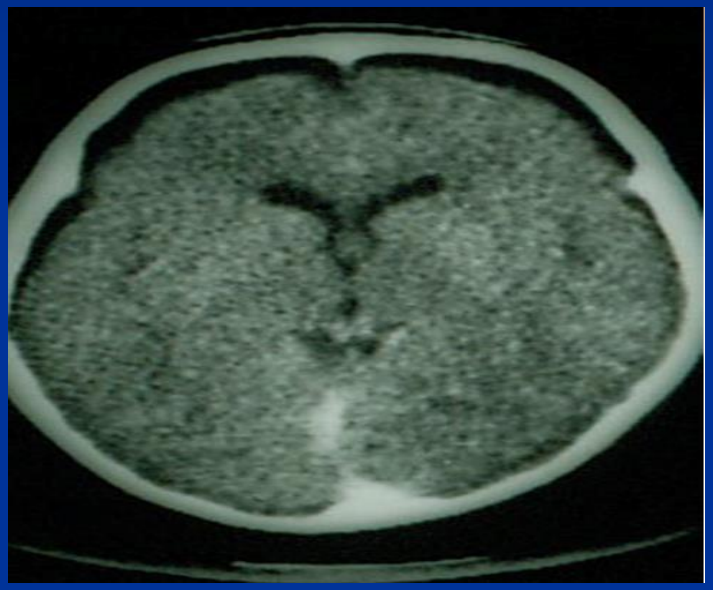
- **Children**
  - **Ceftriaxone + vancomycin**
- **Neonates**
  - Cefotaxime + ampicillin
  - Gentamycin + ampicillin

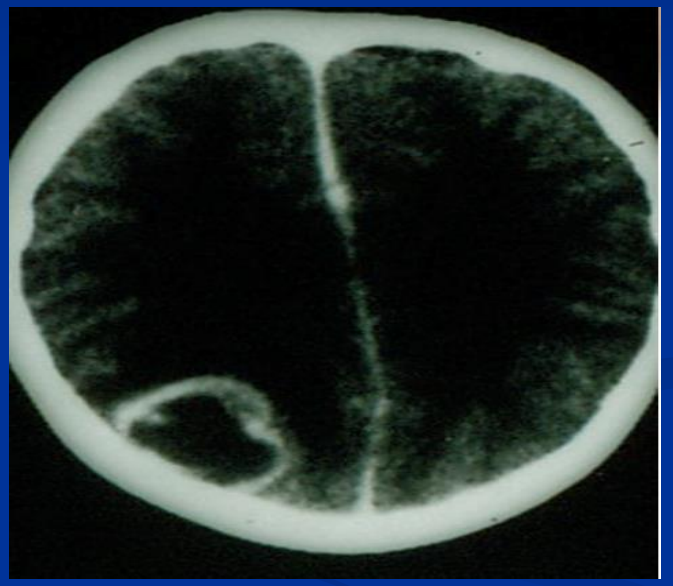
- Dexamethasone - modulates the release of inflammatory mediated factors.
- Dexamethasone with AB gave promising results with values approaching the normal. There is still a need for more data to indicate the need for dexamethasone in every case. Dexamethasone should be given at the time of AB and not after and in some cases it can be given just before (don't give dexamethasone if it's late presentation). Long-term dexamethasone decreases deafness, which is a complication of meningitis.
- Steroids are important because they decrease the level of inflammatory mediators, which are the cause of complications.

COMPLICATIONS

- **EARLY** - subdural effusion with fever resolves alone when the patient is on antibiotics. It rarely needs drainage.

- **LATE** - brain abscess is a rare complication of meningitis and is seen in a specific age group and bacterial organism.





PREVENTION

- CHEMOPROPHYLAXIS
  - Rationale - If one person is infected with meningococcal meningitis, it increases the risk by an 800 to 1000 fold of the community being affected; therefore, we treat the entire family.
  - Protocol
- VACCINATION - HiB, meningococcal, and some require pneumococcal vaccine.

ENCEPHALITIS

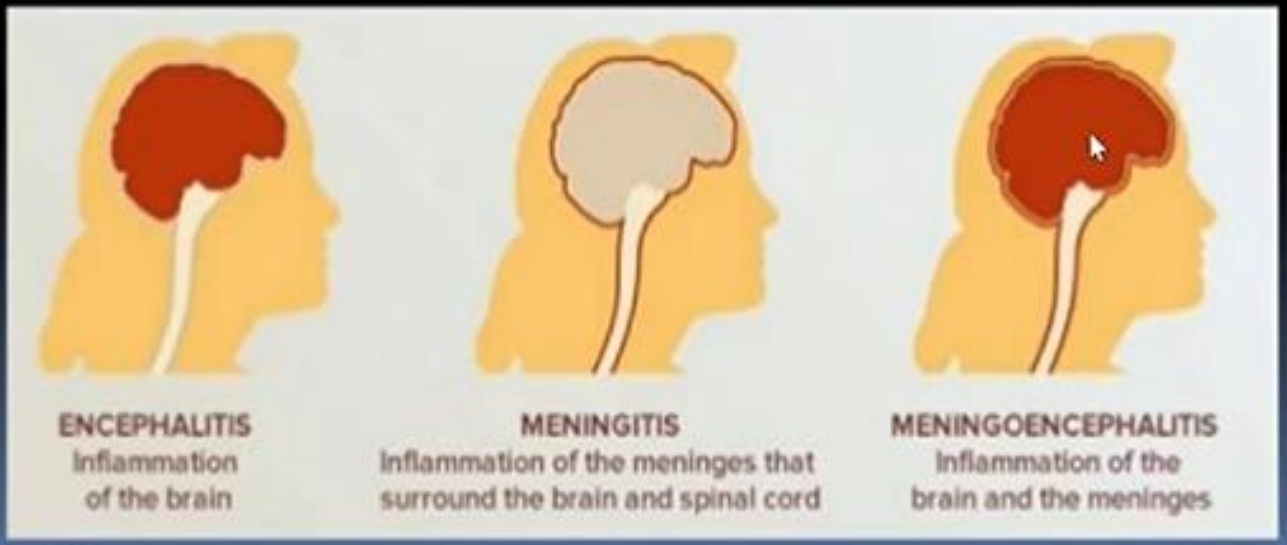
Introduction

- Encephalitis is defined as an inflammation of the brain caused either by infection, usually with a virus, or from a primary autoimmune process .

- Many patients with encephalitis also have evidence of associated meningitis (meningoencephalitis) and, in some cases, involvement of the spinal cord or nerve roots (encephalomyelitis, encephalomyeloradiculitis)

Definitions

- **Meningoencephalitis** - is an acute inflammatory process involving the meninges and to a variable degree, brain tissue. Is a common term that recognizes the overlap
- **Encephalopathy** - describes a clinical syndrome of altered mental status, manifesting as reduced consciousness or altered behaviour.



General:

Most common pathogen in pediatrics is entero-viruses fortunately they are self-limiting, and the most serious is HSV, which increases morbidity and mortality.

Diagnosis:

Previously by brain biopsy but nowadays PCR is the diagnostic tool.
MRI shows the effects early.

Treatment:

If HSV encephalitis is *suspected*, start acyclovir immediately even if the diagnosis was not yet confirmed because this type is very serious.

OSTEOARTICULAR INFECTIONS

Presentation: the commonest presentation.

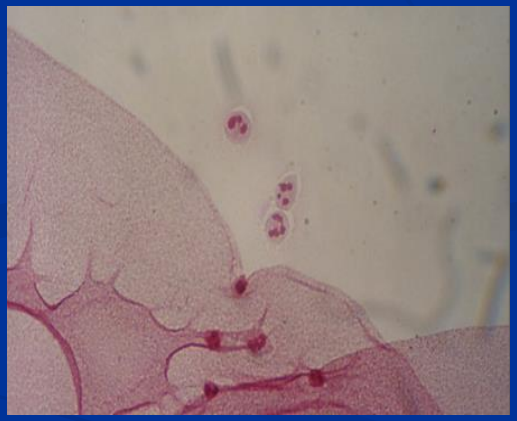
1. Pain.

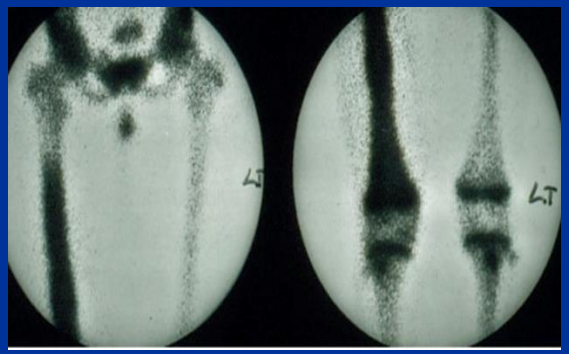
2. Limping.

3. Swelling.

   Note: Septic arthritis of the hip is very dangerous because it is a deep-seated infection and doesn't cause any swelling. It can lead to vascular necrosis because the blood supply is from the acetabulum and goes around the joint, if there is pus it will press on the vessels therefore ER drainage is important.

4. In neonates, it is not obvious because they can't complain but it is noticed when the mother changes the diaper and the baby cries. The neonates usually maintain their hip in lateral rotation and flexion to have more space in the joint and thus relieving the pressure.





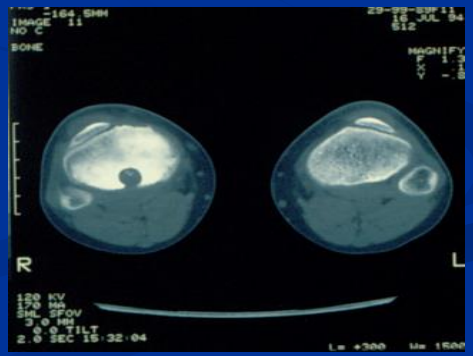


IMAGE 11
BONE
R
L

Imaging

- Bone change (such as avascular necrosis or periosteal reaction) is not seen on X-ray until the 10th day, but it can be detect it earlier by nuclear scan.
- The radionuclear scan will show increased uptake **sequestrum** by the osteoclasts and periosteal reaction, which indicates chronic infection.
- If there is any radiolucency, suspect malignancy.

Complications

1. Avascular necrosis.
2. Joint destruction.

Treatment

1. **Debridement** and removal of sequestrum to prevent recurrence along with
2. Long-term antibiotics. Antibiotics use in acute osteomyelitis is 4-6 weeks, and 4-6 months in chronic.

Case: 10 year old limping for two months

CONGENITAL INFECTIONS (TORCHS)

TORCHS and others no longer limited to TORCHS.
Certain presentation common to all

1. Hydrocephlus

2. Cerebral Calcifications (seen in toxoplasmosis and CMV)

3. Blue muffin syndrome seen in all

Tetanus in neonates

- Prevented by vaccination of the mother.
- Two doses if mother is not vaccinated or the doses can’t be determined.
- The vaccine is safe during pregnancy but better given before.

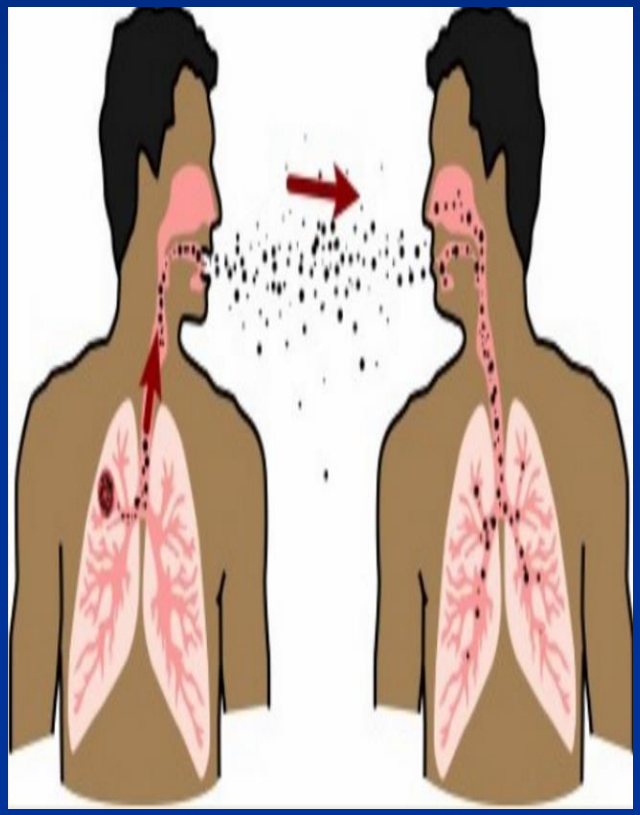
Childhood Tuberculosis

- **Tuberculosis** is a chronic infectious disease caused by *Mycobacterium tuberculosis* characterized by vague constitutional symptoms and a protracted course of illness with remissions and exacerbations

TB Diagnosis in Children

- Bacteriologic confirmation is achieved in only about 30-40% of cases
- Therefore, diagnosis often based on presence of a combination of the following characteristics:
  - History of close contact with adult with TB (especially if smear positive)
  - Triad of :
    - Signs and symptoms compatible with TB disease
    - A positive tuberculin skin test (TST)
    - Suggestive lab results or radiographic findings

How TB is Transmitted?



- Person-to-person
  - Through the air by a person with pulmonary TB disease of the lungs when he or she coughs, sneezes, or speaks
- Less frequently transmitted by ingestion of Mycobacterium bovis
  - Found in unpasteurized milk products
- Other modes of transmission
  - Vertical transmission (rare) – congenital TB
  - Contaminated bodily fluids (very rare)

TB: Adults vs Children

Compared to adults, children:

1. Tend to develop primary active TB more often afer initial infection (0-4 years)
2. Are more likely to have extra-pulmonary disease, especially TB meningitis (0-4 years)
3. Are more likely to have extra
4. Are less contagious
5. Are more difficult to diagnose
6. A child with active TB is an indicator of unidentified contagious adult/adolescent with TB
7. A child suspected of having active TB may not yield any positive cultures/smears
8. Need the adult contact's culture results for drug sensitivities and to determine treatment regimen for the child

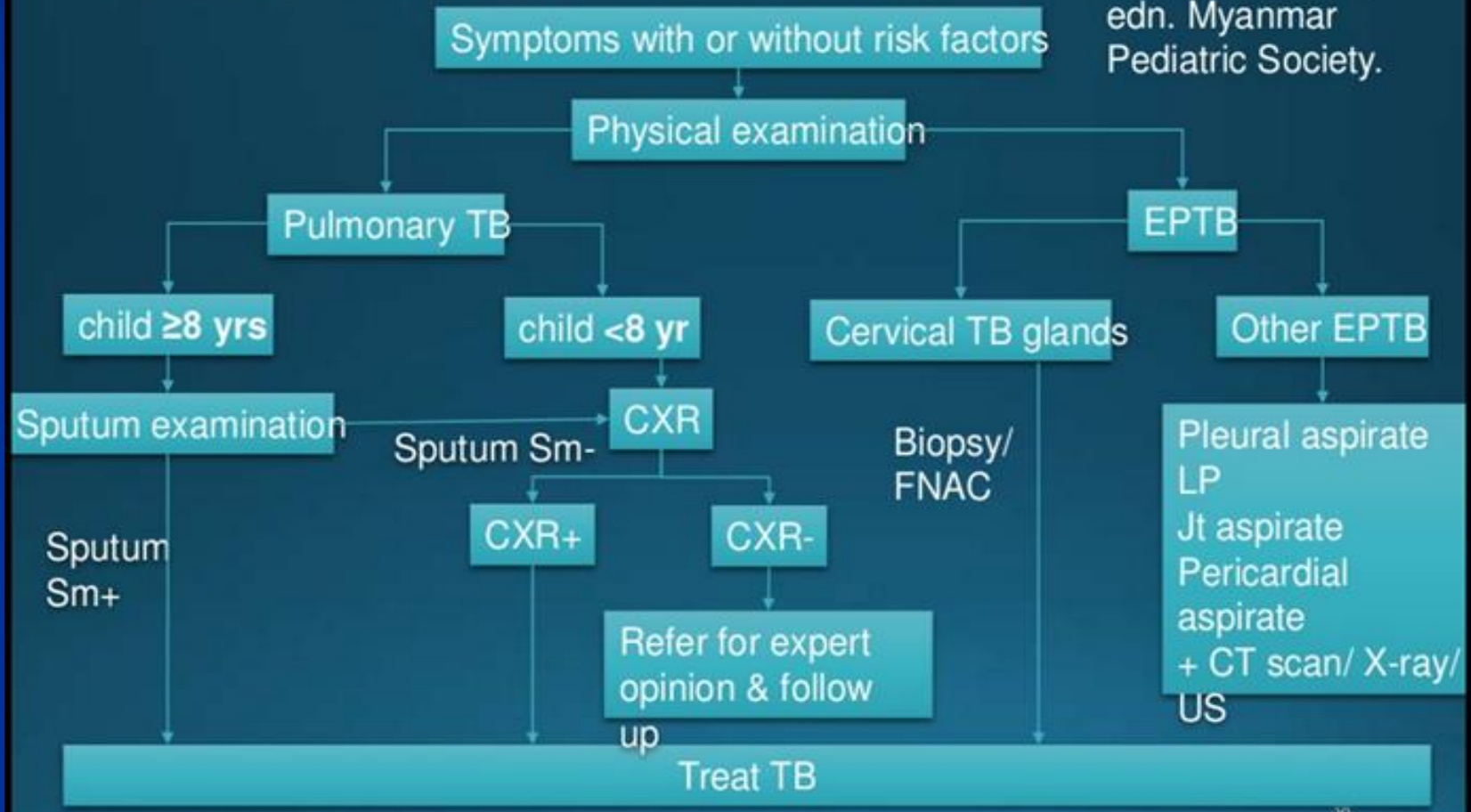
Abhjiit Mukherjee, et. al, 2014

TB IN Children

- Points to remember:
  - Diagnosis may be difficult;
  - Sputum cannot often obtained;
  - Sputum often negative for AFB even on culture;
  - Symptoms are atypical
  - Diagnosis depends on clinical history, family contact history, X-ray examination and TST.

General approach to Dx of TB in children

Pediatrics for undergraduates, 2nd edn. Myanmar Pediatric Society.



Thank you