Summary of CNS Block – Microbiology

Lecture 1: Otitis Media

The most common organisms in general are **Streptococcus Pneumoniae** and **Haemophilus Influenzae** Type B.
The Most common Viral cause is **RSV**.
Otitis Media is usually accompanied with viral upper respiratory tract infection.
We have 3 types:

1- Acute. 2- Serous (Which is not important in microbiology). 3- Chronic.

Acute OM:

For newborns (3 month or younger): Streptococcus pneumoniae (40%), group B Streptococci, Haemophilus influenzae.
Older than 3 months: most common: Streptococcus Pneumoniae, Haemophilus influenzae and Moraxella Catarrhalis.

Chronic OM:

Result from unresolved acute infection: 40% **Mixed Flora**, Pseudomonas, H. Influenzae, Staph. aureus, proteus spp. and anaerobes.
Most Dangerous Complication: **Meningitis**
Treatment is empirical using **Amoxicillin** with or without clavulanate.

Lecture 2: Acute Pyogenic Meningitis

Three main Bacterial Species (In general):

- **Neisseria meningitidis.**
- **Streptococcus pneumoniae.**
- **Haemophilus influenzae.**

Newborns	**E. Coli (Most common)** – Group B Streptococci – Listeria monocytogenes
Infants / Children	Streptococcus pneumoniae – Neisseria meningitides – Haemophilus Influenzae
Adults	Streptococcus pneumoniae – Neisseria meningitides
Elderly	**+ Listeria monocytogenes**

Neisseria meningitides	→ Gram Negative diplococci, Capsulated, Normal Flora in Nasopharynx (10% of pop.), common in children. Transmitted by inhalation of droplets, Serotype A has an epidemic potential in Sub-Saharan Africa, produce endotoxin (LPS), No Vaccine for Serotype B.
Streptococcus pneumoniae	→ Gram positive diplococci, polysaccharide polymer capsule, Pharynx Normal Flora, **Usually after Skull trauma (fracture of the base of the skull)**, **Pneumolysin** decreases inflammatory immune response → severe infection. Best treatment: **Vancomycin**
Haemophilus influenzae	→ Gram Negative Coccobacilli, Type B Has polysaccharide capsule, Need blood for optimal growth: **Hematin** (factor X) and **NAD** (factor V), Hib Vaccine.
E. coli	→ Gram Negative Bacilli, **Most common Cause of Neonatal meningitis**.
Listeria Monocytogenes	→ Gram Positive Bacilli, **Wide spread among animals in nature including those associated with food supply. Treatment: ampicillin.**
Group B Streptococci	→ Gram Positive cocci in chains, **Normal Flora in Vagina** and GIT.

Treatment: **IV Ceftriaxone + Vancomycin** for adults // **Ampicillin + Gentamicin** OR **Cefotaxime** for neonates.

Lecture 3: Fungal Infections of the CNS

Generally, not common. Many risk factors include immunocompromised, diabetes, Surgery, Trauma, Catheters.

Cryptococcal Meningitis	Most common etiology is Cryptococcus neoformans, **Capsulated Yeast**, **Naturally in Pigeon habitats** (Pigeon Droppings), Acquired by inhalation, **stained with India ink**. Serology for Cryptococcal antigen (Latex agglutination). **Treatment: Amphotericin B + combination with Flucytosine**
Candidiasis	Most common species: Candida albicans. **Yeast cells with Pseudohyphae**. Can cause Cerebral microabscesses, Cerebral abscesses, Meningitis, Vascular complications (infarcts, hemorrhage), **Mannan antigen**. **Treatment: Amphotericin B**, Caspofungin, Fluconazole, Voriconazole,
CNS Aspergillosis	Most common species: Aspergillus fumigatus, A. flavus. **Septate Branching Hyphae**. Usually causes brain abscesses, it is a severe complication of hematological malignancies and cancer chemotherapy, transplantation. **Galactomannan antigen**. **Treatment: Voriconazole + combination with caspofungin.**
CNS Zygomycosis (mucoromycosis)	Etiology: Zygomycetes e.g. Rhizopus. **Broad non-septate fungal hyphae**. Fast growing, in **Diabetics with ketoacidosis**. **Treatment: Amphotericin B, Posaconazole**
Pheohyphomycosis	Rhinocladiella mackenziei, **Brown Septate hyphae**. **dematiaceous fungi, Reported in immunocompetent hosts**, usually brain abcesses. **Treatment: Itraconazole**, Amphotericin B

Lecture 4: Viral Infections of the CNS

Acute CNS Viral Infections → Meningitis "aseptic" – Paralysis – Encephalitis.

Viral Meningitis

The most common etiological Agent for aseptic meningitis are **Enteroviruses** (**Nonenveloped, icosahedral, ss (+) RNA**).
Enteroviruses belong to Picornaviridae family. Enteroviruses include:

- Poliovirus (1, 2&3 types)
- Coxsackieviruses (A&B)
- Echoviruses
- Enteroviruses (68-71).

Enteroviral Infections generally are **asymptomatic**.
Polio, in 2% of infections → damage motor neurons → cause **paralysis**.
Best sample to isolate Enteroviruses: **stool**, then inoculate in monkey kidney cell (MKC) and Human diploid fibroblasts.
CSF: lymphocytosis, can detect the virus RNA through RT-PCR. **No Treatment!**
Prevention: **Polio vaccines: Inactivated for adults (IM), Live-attenuated for Children (Oral).**
Pediarix Vaccine: "Diphtheria and Tetanus Toxoids and Acellular Pertussis Adsorbed, Hepatitis B (Recombinant) and Inactivated Poliovirus Vaccine".

Viral Encephalitis

Main Etiological Agents:

- Enteroviruses
- Herpes viruses.
- Rabies virus
- Arboviruses.

HSV Encephalitis is caused by Herpes simplex virus -1 (HSV-1) (**dsDNA, Enveloped, Icosahedral Virus**).

Clinical Findings: Fever, headache, vomiting, seizures & altered mental status.
Diagnosis: MRI | CSF: Lymphocytosis, Normal Glucose and increased protein | Detection of HSV-1 DNA by PCR.
Treatment: **Acyclovir.**
Rabies virus, Belongs to Rhabdoviridae family, **ss (-) RNA genome, Helical nucleocapsid, Bullet shaped, Enveloped** virus.
Common route of transmission: Bite by a rabid animal (Dogs), causes fatal acute encephalitis. 4 Phases:

1- Incubation.
2- Prodromal (Fever, Headache, Malaise, Anorexia, Nausea & Vomiting. Abnormal sensation around the wound).
3- Neurological Phase.
    a. Encephalitis: Nervous, lacrimation, salivation, hydrophobia, convulsions, coma & death.
    b. Ascending Paralysis associated with bat bite.
4- Recovery (Rare).

Diagnosis: Saliva PCR | **Rapid Antigen Test** (IF) "Neck Skin, Corneal impressions, Brain tissue" |Histopathology: **Negri Bodies** (intracytoplasmic inclusions) | Cultivation.
No Treatment! **Vaccine Available** | Post exposure: **Human Diploid Cell Vaccine (HDCV)**
Arboviruses: → **West Nile virus** → Transmitted by **mosquitos**. usually asymptomatic.
Diagnosis: Isolation is the gold standard | **Igm Antibody – ELISA, IF is most used** | can do RT-PCR.
Prevention: Tick-borne encephalitis vaccine - Japanese encephalitis vaccine.

Lecture 5: Cerebral TB and other Chronic Cerebral Infections

Signs and Symptoms for overlong period or recurrent. Slow, insidious onset with progression of signs and symptoms over a period of weeks. Usually diagnosed after more than 4 weeks. CSF: Lymphocytosis. Causes:

Bacterial	Tuberculosis	Mycobacterium tuberculosis, Direct Microscopy with Z-N stain (AFB), CSF culture with LJ Media. If chest is effected → hemoptysis. Treatment: Rifampicin + Isoniazid + Ethambutol + Pyrazinamide for 2 months. Then: Rifampin + INH for 7 – 10 months **(Takes Long time!!)**
	Brucellosis	**Who consume raw milk and milk products,** presents with fever of unknown organism of intermittent nature, accompanied by night sweating, The commonest causes in Saudi Arabia is **Br.melitensis**. Treatment: 2 of the following: Tetracycline, **Rifampicin, Cotrimoxazole**
	Syphilis-caused by Treponema Pallidium	Diagnosis: **VDRL Serology**
	Other: **Partially Treated Acute Meningitis**. Liptosporosis- caused by L.Icter haemorraghia. Lyme disease-caused by Borrelia burgdorferi not common in Saudi Arabia. Nocardiosis - caused by Nocardia speciese.g N.Asteroids.	
Fungal	Cryptococcus neoformans, Candida species in Saudi Arabia species mainly Candida albicans in immunocompromised patients, Aspergillus species, Histoplasma capsulatum	
Parasitic	Toxoplasma gonodii → Cat Exposure (most common) Trypanosoiasis Rare causes Acanthamoeba spp	
Viral	Mumps - Herpes simplex – HIV	

Rifampin (or Rifampicin) can be used to treat TB and Brucella.

Lecture 5: Cerebral Malaria

Generally we have 4 Species can cause malaria:

- **Plasmodium falciparum**: malignant tertian malaria
- Plasmodium ovale : benign tertian malaria
- Plasmodium vivax: benign tertian malaria
- Plasmodium malariae: quartan malaria

How does the organism (Plasmodium falciparum) cause symptoms? By 2 mechanisms:

- Rupture of RBCs → Anemia (all organisms).
- Impairment of Microcirculations (P. falciparum)

Both of them will lead to tissue anoxia, so the patient may have:

- Acute renal failure, metabolic acidosis with respiratory distress, **cerebral malaria**, Severe anemia... etc…

Malaria Has 3 Stages:

1- Cold stage. 2- Hot Stage. 3- Sweating Stage

Non-immune host will develop acute febrile disease which may progress to cerebral malaria which can be fatal.

Clinical Signs: Prostration, High fever, Respiratory Distress, Impaired conscious.

Cerebral Malaria: malaria with persisting coma for more than 30 minutes.

It's necessary to exclude other etiologies (febrile convulsions, hypoglycemia, sedative drugs… etc…).

Blantyre coma scale maximum score is 5, other than that it is abnormal.

Clinical Picture:

- muscles can be either of the flaccid type ("broken neck syndrome") or hypertonic type "opithotonos".
- The grinding of teeth is frequent ("bruxism").
- The convulsions are common before or after the onset of coma.
- Disconjugate gaze
- Retinal Hemorrhages.

Management of Cerebral Malaria:

Treat hypoglycemia, exclude meningitis (if cannot, give iv antibiotics with anti malarial).

Anti-malarial Drugs: ARTEMETHER*, **ARTESUNATE*** QUININE.

Good Luck in Your Exam :)

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