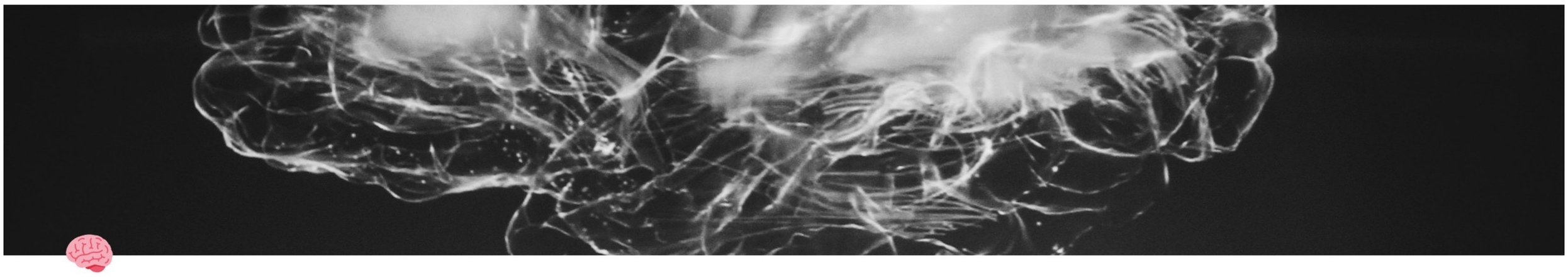


M8 - Neurological Infection

3 more properties

Learning Objectives

- Understand that infections of the central nervous system is a medical emergency
  - life-threatening & severe sequelae [危及生命&严重后遗症]

Coma	Decreased mental capacity	Seizure, evolving to epilepsy	Persistent neurological deficit
昏迷	智力下降	癫痫发作→癫痫	持续的神经系统缺陷

- Know the different types of CNS infections
- Appreciate the different routes of acquiring CNS infections
- Describe the principles in interpreting the CSF findings in meningitis/meningoencephalitis
- Know the principle of treatment for meningitis/meningoencephalitis
  - CSF Collection → Empirical treatment
  - √ CSF Penetration & Bactericidal Antimicrobials [Prolonged Course > 2 Weeks]

Introduction to Neurological Infections

Anatomy of Neurological System

- CNS → Brain & Spinal Cord

[Innermost] Pia mater → Subarachnoid space → Arachnoid mater → Meningeal Layer {Dura Mater} → CSF → Periosteal Layer {Dura Mater} [Outermost]

- PNS → Peripheral Nerves

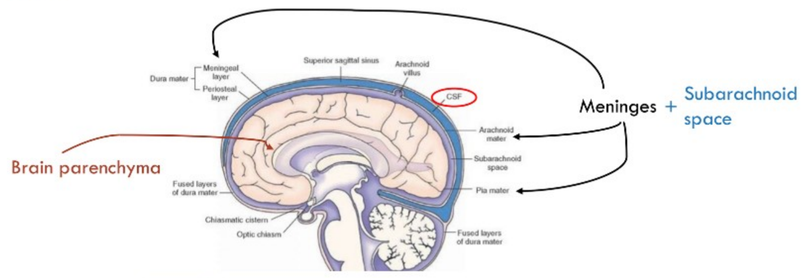
Routes of Neurological Infections

Routes	Description
Haematogenous spread	Choroid plexus or Blood vessels of brain → Subarachnoid space **The most common route of CNS infections*
Direct spread ← Adj. infected site	Otitis media [中耳炎] Sinusitis [鼻窦炎] Mastoiditis [乳突炎]
Anatomic defects → Microbes → CNS	Surgery Trauma Congenital abnormalities [先天性异常]
Nerves → Brain	Rabies HSV - Herpes Simplex Virus **The least common route of CNS infection*

Types of Neurological Infections

Name	Translation	Definition
Meningitis	脑膜炎	Infection within subarachnoid space / leptomeninges
Encephalitis	脑炎	Inflammation of brain parenchyma
Meningoencephalitis	脑膜脑炎	Concomitant meningitis with encephalitis [并发脑膜炎伴脑炎]
Brain abscess	脑脓肿	Localized collections of pus in brain

Remarks:



- Leptomeninges → Pia mater & Arachnoid mater.

Meningitis

Clinical Presentation

	Presentation	Chinese
Primary	Fever	發燒
	Headache	頭痛
	Neck stiffness	頸部僵硬
Secondary	Photophobia	畏光
	Vomiting	嘔吐
	Altered mental status	精神状态改变
	Seizures	抽搐
	Focal neurological deficits	局灶性神经功能缺损
	Disseminated disease	播散性疾病

Remarks

- **Focal neurological deficits** refer to specific impairments in the function of a particular area of the nervous system.

Prevention

Vaccination	Streptococcus Pneumonia
	Hemophilus influenza
	Neisseria meningitidis
Chemoprophylaxis	β-Strep. carrying pregnant women

Classification of Meningitis

> Factors → Classification:
> - Speed of onset of initial presentation
> - Rate of progression of illness
> - CSF Findings

Acute Bacterial	Acute Viral	Subacute/Chronic - Days ~ Weeks
Escherichia Coli	Enterovirus	Mycobacterium Tuberculosis
Group B Strep.	HSV-2	Cryptococcus - 隐球酵母属
Strep. Pneumonia	VZV	Histoplasma - 组织浆膜虫
Hemophilus Influenza B	Arbovirus	Coccidioides - 球孢子虫
Listeria Monocytogenes	Mumps	
Neisseria Meningitidis		
Pseudomonas aeruginosa		
Staph. aureus		
Staph. epidermis		
Gram (-) Bacilli		

Remarks

- Group B Strep. refers to β-hemolytic Strep., which can complete dissolve in blood.
- VZV stands for Varicella-Zoster Virus. It is a virus that causes two distinct diseases: chickenpox (varicella) and shingles (herpes zoster).
  它是一种引起两种不同疾病的病毒：水痘（水痘）和带状疱疹（带状疱疹）。
- Arbovirus: 虫媒病毒

CSF Findings & Diagnosis

Findings	Reference Lv.	Infection Lv.
Opening Pressure	<200mmH2O	↑
White Blood Count	0~5/mm³	Bacterial: Δ800 Viral: Δ80 Chronic: Δ100
Predominant Cell	None	Bacterial: PMN Other: Lymphocytes
Proteins	15-50 mg/dL	Chronic: >50 Bacterial: >100 Viral: Normal /50~100
Glucose	>0.6 CSF/Blood	Viral: Normal Bacterial / Chronic: ↓

> Lumbar Puncture → CSF
> (+): **Opening Pressure, Cell Count, Protein, Glucose Test**

Identification of Pathogens

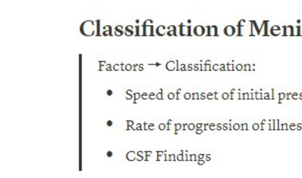
1. India Ink Test
2. Gram Stain
3. PCR (Hours ~ Days)
4. Antigen detection
5. Serologic tests for specific antibody
6. Antibodies

More About Chemically Important Neurological Pathogens

Neisseria Meningitis - Gram (-)

- Occur intracellularly
- Occur extracellularly in PMN leukocytes
- Coffee-bean shaped diplococci in CSF

N. Meningitis → Purpura Fulminans

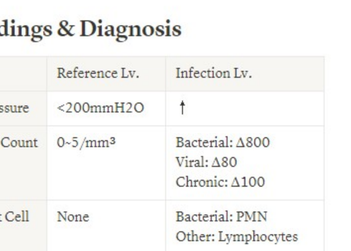


- Rapidly progressing skin hemorrhages and blood clotting abnormalities.
  快速进展的皮肤出血和凝血异常
- Small blood vessels throughout the body become damaged, leading to internal bleeding.
  全身小血管受损，导致内出血。

Staphylococcus Pneumoniae - Gram (+)

- Occur intracellularly
- Occur extracellularly
- Short Chain / Diplococci in CSF

Cryptococcus Spp. & India Ink Test



- India Ink Test → Detection of Cryptococcus spp.
- A distinctive thick polysaccharide capsule of the Cryptococcus cells against a white background
- Presence of capsules → Halo around the yeast cells

Encephalitis

Clinical Presentation

	Presentation	Chinese
Primary	Fever	發燒
	Headache	頭痛
	Altered mental status	精神状态改变
Secondary	Seizures	抽搐
	Coma	昏迷
	Focal neurological deficits	局灶性神经功能缺损

Treatment / Care

- Supportive Care
  - Prevent further deterioration and preserve organ function
  - Maintain quality of life and comfort
  - Prolong survival, if possible
- If available → Antiviral

Acyclovir	VZV, HSV
Oseltamivir	Influenza

Causative Agents

Predisposing factors	Organisms
Neonate - 新生儿	HSV-2
Person > 1age	HSV-1 VZV
Mosquito bites	Japanese encephalitis
Animal bites	Rabies
Travelling history	Arboviruses E.g.: West Nile virus E.g.: Eastern and Western equine encephalitis
Immunization encephalitis 免疫脑炎	VZV Measles - 德國麻疹 Influenza

▼ *Remarks*

- Immunization encephalitis is inflammation of the brain caused by certain antibodies which happened Post-Infection.
- Patient with HSV will have active HSV lesions

CSF Findings & Diagnosis

> Lumbar Puncture → CSF → PCR-based Testing
> (-): **Opening Pressure, Cell Count, Protein, Glucose Test**
> *As all of these findings can be normal*

▼ Identification of Pathogens

1. PCR (Hours ~ Days)
2. MRI
3. EEG
4. Serologic tests for viral-specific antibody

▼ Rabies: Identification

1. PCR of CSF/Saliva/Brain tissues
2. Nuchal (脊髓) biopsy with fluorescent antibody staining.

Prevention

- Rabies
  - Pre- and post-exposure vaccination
- Caesarian section (剖腹产) → Women [active HSV lesions]

▼ Brain Abscess → Intracranial Hypertension

Clinical Presentation

	Presentation	Chinese
Primary	Fever	發燒
	Headache	頭痛
Secondary	Papilloedema	視乳頭水腫
	Vomiting	嘔吐
	Nausea	恶心
	Seizures	抽搐
	Focal neurological deficits	局灶性神经功能缺损
	Behavioural changes	行爲改變

Diagnosis & Treatment

> Lumbar puncture is absolutely contraindicated
> 腰椎穿刺是绝对禁忌的

- CT / MRI → rim-enhancing lesions in brain parenchyma
  CT / MRI → 检查脑实质中任何边缘增强病变
- Drained pus for microscopy and culture
  - Surgical Drainage → Reduce bacterial load in lesions
- Serology

Why Surgical Drainage is Important ?

> **Pus Inhibit the Antimicrobials**

1. Difficult to penetrate → Abscess
2. Highly Acidic Abscess → Effect of Antimicrobials ↓

Causative Agents

Type	Predisposing factors 诱发因素	Name of Pathogens
Bacteria	Otitis media or sinusitis	★ S. pneumoniae ★ Anaerobic Strep. Gram (-) anaerobes: ★ Bacteroides ★ Prevotella ★ Fusobacterium
	Dental infection	★ Viridans Strep. ★ Anaerobic Strep. ★ **Gram (-) Anaerobes** ★ Actinomyces
	Trauma or neurosurgery	★ S. aureus ★ S. epidermidis ★ Strep. spp.
	Neutropenia (中性粒细胞减少)	**Aerobic gram-negative rods:** ★ Enterobacteriaceae
	HIV	★ Listeria spp. ★ Nocardia spp. ★ Mycobacterium spp.
	Endocarditis (心内膜炎)	★ S. aureus ★ Viridans Strep.
Fungi	Immunocompromised 免疫功能低下	★ Moulds: Aspergillus, Mucor, Rhizopus 曲霉菌、毛霉、根霉属 ★ Cryptococcus
Parasites	HIV	★ Toxoplasma gondii 刚地弓形虫
	Feaces- contaminated raw food	★ Cysticercosis by cysts of Taenia solium 猪带绦虫囊肿引起的囊虫病

▼ Remarks

- There are 3 important examples for Gram (-) Anaerobes:
  [Bacteroides, Prevotella, Fusobacterium]

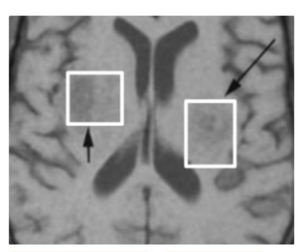
Analyzing MRI Imaging

1. **Streptococcus Salivarius** → Occipital lobe
2. **Toxoplasma Gondii with HIV** → Thalami

Streptococcus Salivarius

Hypointense Leisions in region of occipital lobe

HIV Infection



Region of the thalami ← Toxoplasmosis
[弓形体病]