

* unlike other systems have endogeneous Protective defence Mechanism
Normal Microflora that exist in Respiratory, Gi, urogenital tract and Skin →
كل System فيه Normal Microflora

لو صار alteration فيها بتتحير Pathogenic وبقيل مرض

Free on Microflora ← **CNS** → brains + spinal cords
لكن عنده Protective Mechanism

- 1. The nervous system is ordinarily sterile and has no normal microflora. Bacterial and viral pathogens, however, can enter cerebrospinal fluid from the blood.
- 2. The CNS is well protected by bone and meninges from invasion by pathogens.
- 3. In addition, phagocytes of the nervous system called *microglial cells* can destroy invaders that reach the brain and spinal cord.
- 4. The brain itself has special thick-walled capillaries without pores in their walls. These capillaries form the **blood-brain barrier**

* Protective Mechanism For CNS:

1] brain inside skull

دماغ في الجمجمة ← meninges غشاء

2] blood brain barrier ← BBB وفيه
capillary network forms

* BBB → it will control the passing
substances in brain
ويعبر highly lipid substances

3] microglial cell → Macrophages
تلتهم المواد الغريبة
Substances engulf

* على الرغم من وجود هذه الآليات
Protective Mechanism

العدوانية حدوث CNS infections

CNS infections

①②③ ← Complications ← CNS Infections

- Central nervous system (CNS) infections are often life threatening and can have severe sequelae (e.g. cranial nerve damage, epilepsy, deafness), as inflammatory changes and/or raised intracranial pressure can cause irreversible damage to neuronal tissue.

not easily to gain back

- The most common causes of CNS infections are bacteria and viruses, but fungi, protozoa, and helminths also cause these infections.

↑ ← CNS Infections *
ممكن تصير عن طريق

له مثل التهاب السحايا ممكن يحدث بسبب بكتيريا، فيروس، فطريات

فلازم نعرف سبب المرض حتى نحدد best treatment
لو كانت سبب مثلك فيروس يعطى antiviral ما ينفع اشي
antibacterial مثلك

COMMON CNS INFECTIONS

BACTERIAL INFECTIONS

- Bacterial meningitis
- Tuberculosis *cause by Mycobacterium*
- Brain abscess
- Lysteriosis
- Neurosyphilis

Acid Fast bacteria

FUNGAL INFECTIONS

- Cryptococcal meningitis
- ↳ example

VIRAL INFECTIONS

- Viral meningitis
- Herpes simplex encephalitis
- Rabies *السعار*
↳ disease in CNS
نبتة عض من كلب مسعور

PARASITIC INFECTIONS

- Neurocysticercosis
- Toxoplasmosis → *infection in GI و CNS*

CNS infections

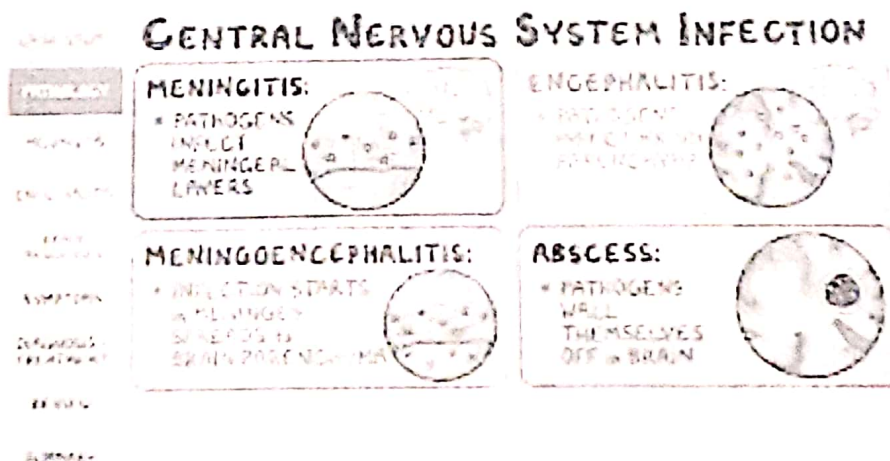
- Meningitis: an infection of the meninges, the membranous covering of the brain and spinal cord.
the meninges are inflamed for layers that cover brain and spinal cord
- Encephalitis: infection of the brain tissue, frequently accompanied by inflammation of the meninges (meningoencephalitis). خلايا brain او tissue brain يكون داخله التهاب
- Brain abscess: is a focal (or, less frequently, multifocal) pus-forming process that develops within the brain parenchyma. فمفصلة حدة في brain عادة تكون focal او local ونادراً ما تكون في كل brain

meningitis is associated with encephalitis and ~~called~~ called → meningoencephalitis
يكونوا 2 مع بعض
أغلب الحالات

Brain Infections

تكون عبارة عن جوف
حالة
abscess و pus
حبيب عليها وقد تحتاج

Sure



Meningitis

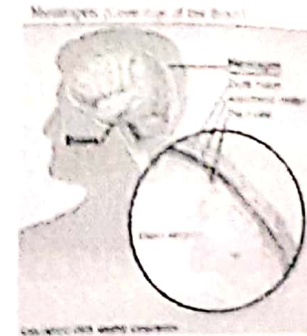
• TYPES OF MENINGITIS

- ✓ Bacterial meningitis
- ✓ Tuberculous meningitis
- ✓ Viral meningitis
- ✓ Fungal meningitis
- ✓ Parasitic meningitis
- ✓ Non-Infectious meningitis.

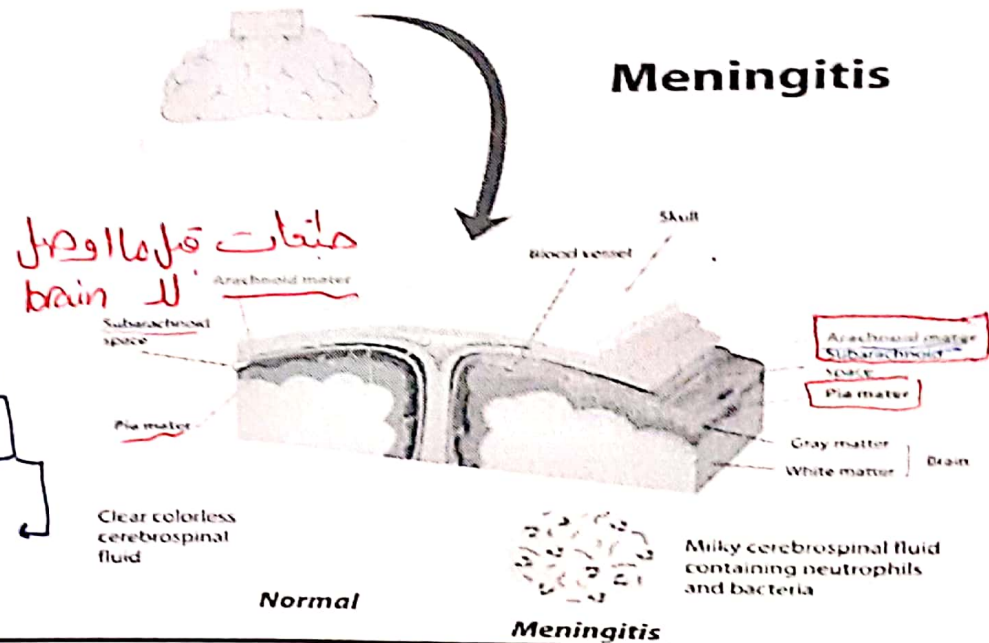
MENINGITIS MAY BE

Acute meningitis < 4 weeks

Chronic meningitis > 4 weeks



Meningitis



* لازم أحد نوعي المسبب لا meningitis حتى أقدر أعالجها

* أعراض meningitis ← Serious ويمكن نقل
→ complications (مضاعفات)

Bacterial meningitis

أسهل أنواع البكتريا التي تسبب meningitis

- Acute meningitis is caused by either *Streptococcus pneumoniae* and *Neisseria meningitidis* (2)
- Meningitis causes *necrosis* (death of tissues in a given area), increased pressure within the skull from edema, decreased cerebrospinal fluid flow, and impaired central nervous system function.

- Symptoms: headache, fever, stiff neck, chills, rarely seizures → + Light Phobia
أعراض meningitis نفسها يفتقر عن السبب (غيرها، بكتريا، الخ)
ازعاج من الضوء أو ما يشوف الضوء
- Acute disease acquired from carriers or endogenous M.O.
- M.O gain access directly by surgery, trauma or spread to meninges in blood from other infections like pneumonia & Otitis media.

* كل ما استجئنا في العلاج يكون أحسن خاصة في الأطفال

لأنه أعراضها خطيرة ويمكن أن يضر
nerve damage

* اذا كانت Bacterial meningitis تنتقل عن طريق

exogenous [Infectious individuals من Respiratory System □
تأخذها Carriers individuals أو
من يرا

endogenous □ ← مثلاً شخص عينه Respiratory
infection Microorganism

Pneumonia مثل

→ البكتيريا موجودة في الدم ويمكن ترويح الى CNS
و تنتشر وتقل meningitis

* anti-microbial ← كنا نعطيه لما نعرف causative agent و في حالات كنا نعطيه قبل معرفة مسبب المرض (empiric treatment) لما يكون عنا ما بقدر استنى معرفة السبب لا نهحتاج تحليل → Critical Patient في الحس ويد طلب وقت والمريض ممكن يصير عنده مضاعفات

Bacterial meningitis

مثل meningitis

لكن فيه أشياء تساعد الأطباء على تحديد Possible Microorganism مثل Age

حدد Possible Microorganism مثل Age

Table 32.1 Causative microorganisms of acute bacterial meningitis according to age group

Age	Causative microorganism
<1 month	Group B β -haemolytic streptococcus, <i>E. coli</i> , <i>Citrobacter</i> spp., <i>Klebsiella</i> spp., <i>Enterobacter</i> spp., <i>P. aeruginosa</i> , <i>L. monocytogenes</i> , <i>S. aureus</i> , <i>S. epidermidis</i>
1-23 months	Group B β -haemolytic streptococcus, <i>E. coli</i> , <i>H. influenzae</i> , <i>S. pneumoniae</i> , <i>N. meningitidis</i>
2-50 years	<i>S. pneumoniae</i> , <i>N. meningitidis</i>
≥50 years	<i>S. pneumoniae</i> , <i>N. meningitidis</i> , <i>L. monocytogenes</i> , aerobic Gram-negative bacilli (coliforms)

الأكثر حدوث

* يعني لو عن مرضى بسايات عمر < 50 نعطيه antibiotic يستغل bacteria Hu's agents

* الأكثر حشاً في كل الأعمار → *S. pneumoniae*
ماعد الأطقال أقل من سكر

* العلاج يختلف من عمر لآخر تبعاً لاختلاف أنواع البكتريا المحتملة
* أحياناً من Previous notes بقدر نعطى drugs أو من خلال إذا مش متأكدة كونه Combination أو broad spectrum empiric

Combination of broad spectrum antibiotics empiric treatment

LABORATORY DIAGNOSIS

بأخذ عينة من السائل الكهرومخاطي
من L3-L4

- Meningitis is diagnosed by culturing cerebrospinal fluid. The fluid usually is turbid—sometimes so thick with pus that it is difficult to remove with a syringe.

ناخذ Position معينة حتى يتم سحب السائل
Infection

Lumbar Puncture



Lying Position

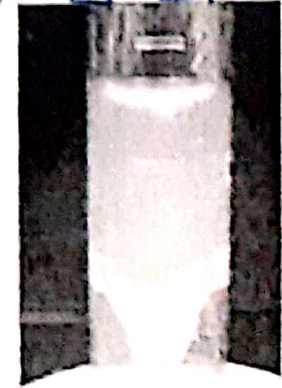


Sitting Position

turbid - دليل على وجود infection
بأن ما يقدّر لعرف سبب infection
التي في الزاوية



Normal CSF



Turbid CSF

CSF : By Lumbar puncture (L3-L4 level) →
See for the turbidity

لا تأخذ ما يصير أي Spinal injury

* نوع مسبب meningitis معروف عن طريق الزراعة ليس ممكن
 CSF Changes تغطي دليل (hint) معيية المرفق
 مثلاً تركيز البروتين والغلوكوز و Lymphocytes

Table 32.2 Typical CSF changes in meningitis

	Meningitis			
	Normal	Bacterial	Tuberculous	Viral
Leukocytes (cells/ μ L)	<5	100-10 000	<500	50-500
Polymorphs (%)		>80	20 ^a	5 ^a
Lymphocytes (%)		10	80	95
Protein (g/L)	0.2-0.45	1-10 (>50)	1-10 (>50)	1
Glucose (mmol/L)	4.5-8.5 ^b	11 ^c	11 ^c	Normal

* مثلاً: Glucose تكون تركيزه قليل في حالة bacterial meningitis و Normal اذا كان viral meningitis
 ① و ② Tuberculous meningitis
 يعرف السبب هو فيروس

* Protein content يكون the highest في Tuberculous meningitis
 * Leukocytes يكون اقل في Bacterial meningitis
 اذا سيقدر antibacterial
 من هذا antiviral

* هناك عرفنا causative بناءً على CSF بدون الحاجة وقت طويل لكن تحتاج الى الزراعة مدة 2-3 ايام لتخرج الميكروب من
 Changes agent

البكتريا كونه هناك
 معييات اخرى للسريريا

Bacterial meningitis

- **Meningococcal Meningitis:** caused by *Neisseria meningitidis* (meningococci). : A complication of this meningitis, when the bacteria invade all parts of the body (sepsis), then death occurs within hours from endotoxin shock.
 death Shock ويمكن تؤدي الى death
 bacteria
- Treatment: Penicillin, if resistant use 3rd generation cephalosporins & ampicillin
 Penicillin G → Penicilin Parenterally
 عشانهم جداره
 Routine Vaccines
 اسسه hib Vaccine في الأطفال والرضع dangerous
- **Haemophilus Meningitis** are caused by *Haemophilus influenzae* type B (hib).
- Hib vaccines are available, which all children age 5 and under should receive
 حتى يمنع hib infection

* هو من Bactera وال generations افضل واحد هو 3rd لعلاج meningitis
 antibiotics
 3rd و 4th من Cephalosporins افضل المتي لعلاج meningitis لانهم
 generations قادرين على اختراق BBB

meningitis ← في حالات كثير يكون مدب وصول drug لها
 لكن في meningitis ← اختراق الأدوية لا فتقنم او CNS يكون
 بزياد و هاد قد تكون ← حسنة ← لانه بقدر اختيار اي دواء لالتهاب السحايا
 ويوم Site of action / وقد تكون سيئة ← مريض التهاب السحايا و يأخذ
 ادوية اخرى قد تكون effective CNS و تعالج مشكلة

Table 32.3 Antimicrobial therapy for common causes of bacterial meningitis

Microorganism	Treatment
Aetiology unknown ^a →	Benzylicillin; or cefotaxime/ceftriaxone or chloramphenicol
<i>N. meningitidis</i> →	Benzylicillin (chloramphenicol or cefotaxime/ceftriaxone if penicillin allergic)
<i>H. influenzae</i> type b →	Cefotaxime/ceftriaxone or chloramphenicol
<i>S. pneumoniae</i> →	Benzylicillin (cefotaxime/ceftriaxone or chloramphenicol if penicillin allergic or if isolate is resistant to penicillin)

افضل علاج

Note: that rifampicin is given for 48h or ciprofloxacin (single dose) to patients with meningitis caused by *N. meningitidis* or *H. influenzae* to eliminate nasopharyngeal carriage

^aEmpirical treatment will be directed by the most likely causative microorganism and local antimicrobial sensitivity pattern.

BRAIN ABSCESS

- Bacteria are the most common cause of brain abscesses, but fungi and protozoa are also involved. Viruses do not cause brain abscess.
لـ فلو كان عنـا brain abscess يستبعد Virus
- multispecies infections are common, and anaerobes are as likely to be responsible as are aerobes. لـ التـريـوع يعـمل abscess
- In very early stages, antibiotic treatment can be sufficient, but later surgical drainage or removal of abscesses is usually necessary.

إذا كان السبب بكتريا نعط antibiotic
وإذا فطريات نعط antifungal
[يمكن العلاج بـ قتل و بالتالي جـتـاج Surgical Removal

Viral Diseases of the Brain and Meninges

التهاب سحايا بواسطة الفيروس

1.

Viral Meningitis: Unlike bacterial meningitis, it is usually self limiting & non fatal. → ^{من Bacterial meningitis} أقل severity

- Clinical features: Influenza-like illness, followed by meningism (neck stiffness, headache and photophobia).

تشنج الأعصاب وليس عادة تكون درجة الحرارة أقل

- Causative agent: enterovirus, mumps virus & other unidentified viruses

قد تسبب
Viral meningitis

Causative agent هو Virus ينتقل من لحاب الحيوان ويدخل الى دم الانسان عن طريق العض
 والفيروس يحتاج 1-4 ايام حتى يحدث له Replication و target له هذه الفيروسات
 nerve tissue والعراض يمكن ان تحتاج 13 days او 2 years او 20-60 days

Viral Diseases of the Brain and Meninges

2. Rabies... The virus that causes rabies has a worldwide distribution. It infects all mammals exposed to it (dogs, wildlife animals, cats, foxes, bats etc..). so the possibilities for reservoir infections are almost limitless.
 يمكن انتقاله من حيوان لانساة ومن حيوان لحيوان عن طريق العض
- After entering the body through an animal bite or other break in the skin, the rabies virus first replicates in injured tissue for 1 to 4 days and then migrates to nerves, where it replicates slowly until it reaches the spinal cord.
- The time from infection to the appearance of symptoms varies from 13 days to 2 years but is usually between 20 and 60 days which makes post exposure immunization possible. If symptoms appear, too late to vaccinate & death occurs.

مهم اعطي المصاب قبل تطور الاعراض حتى امكن
 اعطى اعطى Death

Viral Diseases of the Brain and Meninges

• Rabies...

- Treatment..The bite of a rabid animal is treated by first thoroughly cleaning it with soap and flushing it with large amounts of water. Hyperimmune rabies serum is introduced into and around the wound in hope of neutralizing viruses before they reach the nervous system.
- A series of injections of vaccine is given to induce the production of neutralizing antibodies.

ProPhylactic ← تطعيم الحيوانات لوقعت الدتسات مايجل العرض

- The best means of preventing rabies is to immunize pets

* العلاج: لازم أغسل مكان العض ونعقمه بصابون وماء غزيرة
ثم بالمستشفى بعمق hyperimmune Rabies Serum ← يشتغل محالاً بربط

بأي فيروسا فوجه حول الجرح حتى يمنع دخوله داخل الجسم

ثم يعطوا مطعوماً ومهم ينعطى ← before symptoms development

inorder to get the best Result

لانه بعد ظهور الأعراض ما في داعي أعطى المطعوماً

Viral Diseases of the Brain and Meninges

3. **Encephalitis** is mainly caused by viruses, but other microorganisms are occasionally responsible. *↳ mainly by herpes Simplex Virus*

- Clinical signs include fever and vomiting, followed by decreased level of consciousness, focal neurological signs and eventually coma.
- Encephalitis is an uncommon complication of HSV infection.

- Treatment is with intravenous aciclovir

او anti herpes drug

حسب Site of infection يعطى اعراض

OTHER DISEASES OF THE NERVOUS SYSTEM

bacterial infection cause by spore forming bacteria

- **Tetanus** is caused by the obligately anaerobic, Gram-positive, spore-forming rod Clostridium tetani. → *anaerobic* *تسبب tetanus*
- Spores are found in all soils but especially in those enriched with manure.
→ *تخافطه DNA تبعها في Spore*
- Spores must be embedded deep in tissue like in deep cuts & puncture wounds (like stepping on nail).

الاعراض:

muscle muscle ← *بسبب* arc backs *
Spasm Stiffness

Fever *

Cardiac muscle و Respiratory muscle (تأخر) *

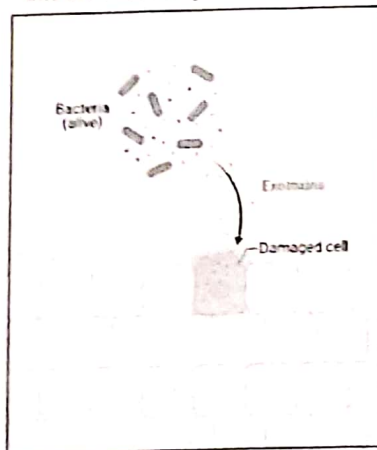
death ← *ممكن يصاب Paralysis وتسبب*

- **Treatment and Prevention. Tetanus toxoid vaccine** given prior to injuries protects against the toxin. Antitoxin and antibiotics are given to non-immunized patients when injuries are treated.

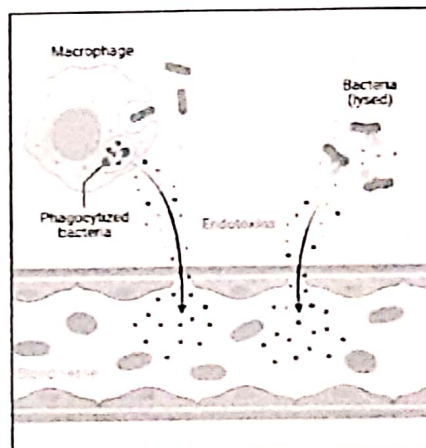
* يومياً المصوم قبل مرور الأعراض

G⁻ ← تفرز endotoxin هي Lipid A تفرز لاغوت G⁻ فقط
G⁺ مثل Clostridium تفرز exotoxin ← هي بروتين وتفرزه وهي مبيدة
أو حية ويقلل brain damage

Exotoxins are proteins produced inside pathogenic bacteria which are secreted into the surrounding medium.



Endotoxins are constitutive elements of the bacteria membrane. They are only liberated when the bacteria die.



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OTHER DISEASES OF THE NERVOUS SYSTEM

عادةً يسبب من الأكل

target → neuron

- **Botulism** is caused by *Clostridium botulinum*, a spore forming obligate anaerobe that releases a potent exotoxin (neuro-toxin).

neuron damage

- Caused by Ingestion of toxin, usually from improperly home-canned non-acid foods.
- Botulism is a neuromuscular disease with sudden onset and rapidly progressing paralysis. It ends in death from respiratory arrest if not treated promptly.

- No Ig produced as toxin amount is not enough to elicit immunity البكتيريا ماتت

- Treatment: antitoxin, maintain respiration ex O₂

antibodies

يمكن استخدام antibiotic عادةً تستخدم antitoxin

acid foods → Protection and Limits Present any M.O

البكتيريا تفرز toxin تعطل Paralysis بى ما يتلف جهاز المناعة حتى يفرز antibodies

الطفل أقل من سنة ينصح
أنه ما يشرب حليب بقري
أفياكل عسل

Infant botulism

لأنه الحليب يزيد فرصة حدوث
type 1 diabetes

والعسل عادة يكون
محتوي على Clostridium
botulinum

- The disease is associated with feeding honey to infants. Studies in California have shown that 10% of the jars of honey sold there contain botulism endospores.

وبالتالي Microflora

الوجود في أن في الطفل هي Probably develop Not وبالتالي ممكن تروح البكتريا الى

الدم
وبالتالي
حدث
اعراض
صل

Floppy
baby

Endospores germinate and grow in the immature digestive tract of infants, probably because they lack appropriate competing microbiota. As toxin is absorbed, the infant becomes lethargic and loses the ability to suck and swallow, so the disease is often called "floppy baby" syndrome. Infant botulism usually occurs in infants under 6 months of age and rarely after 12 months. If parents would not give honey to children under 1 year, most cases could be prevented. Microflora هي defence

Mechanism

حتى تمنع وصول M.O للوصول للدم وحقن infection

OTHER DISEASES OF THE NERVOUS SYSTEM

سبب شلل بسبب
Virus

- **Poliomyelitis** is caused by three strains of polioviruses (picornaviruses) that have an affinity for motor neurons of the spinal cord and brain.
↳ Target for virus
- *non specific* Symptoms: high fever, back pain & muscle spasm. Few cases (less than 1%) accompanied by partial or complete paralysis of muscles. The very old & very young are more prone to paralysis.
- The nature and degree of paralysis depend on which neurons in the spinal cord and brain are infected and how severely they are damaged if they are lysed. Any paralysis remaining after several months is permanent.

مدار الہ مغز