



# MICROBIOLOGY

Lecture : 3

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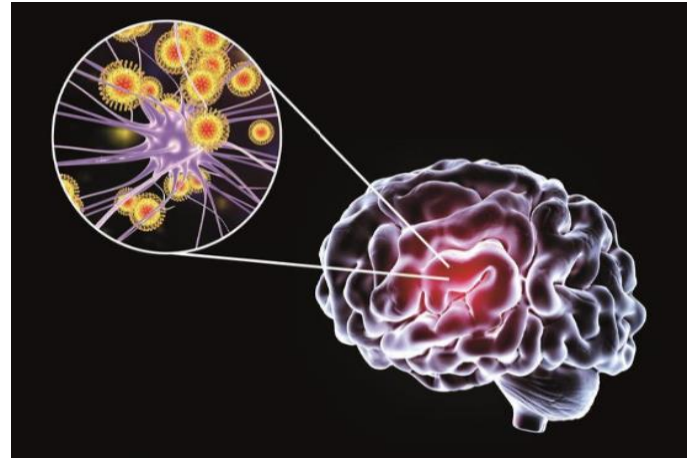
# Encephalitis

السلام عليكم ورحمة الله وبركاته.

السلايدات باللون الأسود، وكلام الدكتور باللون الأزرق

- Encephalitis is an inflammation of the of the brain parenchyma caused by:
  - o A virus, which is the most common type of encephalitis. هاي اللي رح نحكي عنها.
  - o Acute or chronic demyelinating diseases, this includes the postinfectious or allergic encephalomyelitis syndromes, in which the cause and pathogenesis are not always clearly defined.

زي ما هو واضح بالصورة هاي، يكون الفيروس محوِّط ال brain cells ويعمل damage فيهم.



- قبل ما نبدا نحكي عن المرض لازم نعرف بعض المصطلحات وتعريفها:

- **Encephalopathy**: altered consciousness persisting for longer than 24 hours, including lethargy (decrease cognitive), irritability or a change in personality or behavior.
- **Focal neurologic deficit**: a nerve function problem that affects a specific area. For example, hearing loss or double vision.

It means that if the damage affects specific nerve, and this nerve involved in hearing, this will result in hearing loss.

نفس الاشئ لو أثرتنا ع عصب بتعلق بالنظر ممكن ينتج عنا double vision، problem in eye movement، الخ..  
فهاي كلها أمثلة ع لما يكون الضرر بمكان محدد (focal)، أما لما يكون diffuse بأثر على كل ال brain وممكن يؤدي ل loss of movement, loss of hearing, loss of vision.. كلهم بييجو مع بعض

- **Neuropsychiatric features** such as altered mental status, hallucinations, and/or cognitive decline are often seen.

When we said that the patient has Neuropsychiatric features due to a disease this means that he/she has this symptoms, and they are usually associated with brain inflammation.

• **Encephalitis** presents as diffuse and/or focal **neuropsychological dysfunction**. Although it primarily involves the brain, meninges may be frequently involved as well (meningoencephalitis).

يعني كونه ال meninges متصلة بال brain عادة لما يصير في infection بالدماع بعمل irritation لل meninges برضو، فبنمسي المرض meningoencephalitis

#### ➤ Encephalitis:

the official diagnosis of encephalitis is encephalopathy AND evidence of CNS inflammation demonstrated by at least two of the following:

- Fever
- Seizures or focal neurological findings (such as hearing loss, limb paralysis, etc.. as we said before) attributable to the brain parenchyma.
- CSF pleocytosis (increased WBCs)

Radiological findings such as:

- EEG findings suggestive of encephalitis
- Neuroimaging findings (MRI) suggestive of encephalitis

#### ➤ Viral Encephalitis:

• Viral encephalitis is a life-threatening process characterized clinically by **altered consciousness (encephalopathy)** and frequently by **diffuse or focal neurologic signs and behavioral changes**.

زي ما حكينا بالتعريف قبل انه ال encephalitis ما الها تأثير فقط على ال neuron بل أيضا الها تأثير على ال behaviors ← **neuropsychological dysfunction**

• Viruses invade the central nervous system (CNS) by 2 ways:

o Hematogenous route (they enter the CNS by blood)

o In a retrograde manner from nerve endings (the virus enters the tip of the nerve then travels across the axon retrogradely; from the nerve to the brain)

الدكتورة حكيت معلومة زيادة واللي هي: أشهر مثال مشهور على ال retrograde infection هو ال rabies .

• Viral encephalitis tends to be **more common in younger people** compared to elderly individuals.

## ❖ Etiology:

- The major causes of viral encephalitis:
  - Herpes simplex virus 1 (HSV-1)
  - Arboviruses
  - Measles
  - Varicella-zostervirus
  - Lassa fever encephalitis
  - Human immunodeficiency virus
  - JC virus

رح نحكي عنهم بالاسلايدات الجاي

## ❖ HSV-1:

• Herpes simplex virus-1 is the most important cause of sporadic viral encephalitis in the United States. It is an enveloped DNA herpesvirus.

• Most severely-affected patients are immunologically normal; indeed, an intact immune system may be required for full expression of the disease since immunocompromised patients tend to have a milder course.

Patients who are immune-competent are more affected by HSV-1 (هاد اشي بميز الفيروس)

• HSV-1 encephalitis can be the result of a primary infection, a reactivation of latent HSV (the virus due to loss of immunity), or a re-infection by a second HSV.

في حالة ال reactivation، بكون الفيروس dormant فلما يصير له reactivation بسبب ال loss of immunity بعمل encephalitis.

طيب ممكن نحكي كيف ال loss of immunity بتسبب encephalitis واحنا حكينا انها بتصيب الناس اللي بكونوا immune-competent ؟ هي فعلا بتكون more common عند الناس ال immune-competent، وهاد مش معناه انها ما بتصيب ال immune compromised patients.

• The most characteristic symptoms and signs of encephalitis due to HSV-1 are attributed to the affinity of the virus for the temporal and frontal lobes. The temporal lobe controls memory and speech while the frontal lobe controls emotions and behavior.

الأعراض بتكون متعلقة أكثر بال temporal & frontal lobe

• Encephalitis caused by herpes is dangerous and can lead to severe brain damage and death (if not treated).

## ❖ Diagnosis (HSV-1)

أول اشي، منقدر نميز من الأعراض — temporal lobe & frontal lobe involvement

• Temporal lobe involvement can be demonstrated by imaging procedures (CT or MRI scan) or by electroencephalography (EEG):

بكون في تغيرات معينة بال ECG & MRI خاصة بال encephalitis

- MRI scans are more sensitive and specific than CT scans especially during the early phases of the disease.

○ The EEG shows focal abnormalities in more than 80% of cases.

• Lumbar puncture is usually within normal limits.

If there was a change in CSF analysis there will be slight pleocytosis in lumbar puncture of encephalitis.

• The most important specific test on CSF is the polymerase chain reaction (PCR for HSV-1 DNA). Reported to be up to 98% sensitive and 100% specific, PCR has replaced brain biopsy as the **diagnostic procedure of choice**.

HSV-1 is most properly diagnosed by PCR. It is fast, sensitive, very specific and easily done after the lumbar puncture.

### ❖ Arboviruses

• Arthropod-borne viruses or ‘arboviruses’ are a diverse array of RNA viruses that share the unique characteristic of transmission by hematophagous (blood-sucking) arthropods, including ticks, mosquitoes and sandflies.



Arthropod-borne virus means that this virus is transmitted by blood-sucking arthropods (المفصليات)

الـ ticks هي القرادات، بتلرزق بمكان ما بنشاف زي ورا الأذن، على الرقبة أو الظهر وبتضل تتغذى على الدم وبتكبر هي بالحجم، على عكس الـ mosquitoes بتقرص وبتروح ما بتضل.

• In general, these represent ‘dead-end infections’ in unnatural vertebrate hosts. Infection with arboviruses can result in a wide range of disease syndromes, including systemic febrile illnesses, encephalitis, and hemorrhagic fevers.

• More than 20 arboviruses that can cause encephalitis have been identified. These arboviruses are enveloped RNA viruses from four different families. Arboviruses that infect the CNS usually cause meningoencephalitis.

- This table summarises the major viruses that cause encephalitis and their families, it also shows the major arthropod vectors that transmit each virus to cause encephalitis.

Family	Virus	Arthropod vector	Mortality rate
Togaviruses	Eastern equine virus	<i>Aedes</i> spp.	35%
	Western equine virus	<i>Culex</i> spp.	10%
Flaviviruses	West Nile virus	<i>Culex</i> or <i>Aedes</i> spp.	12% in elderly people
	St Louis encephalitis virus	<i>Culex</i> spp.	2% in young people 20% in elderly people
	Japanese encephalitis virus	<i>Culex</i> spp.	50% in elderly people
Bunyaviruses	La Crosse strain of California encephalitis	<i>Aedes</i> spp.	Low
Reoviruses	Colorado tick fever virus	<i>Dermacentor</i> (tick)	Low

- We should know that these viruses don't the only viruses that cause encephalitis, also these families don't only cause encephalitis (ex: togaviruses have rubella virus as part of their family, reoviruses: in addition to Colorado tick fever virus they also include rotaviruses as part of their family)
- Eastern equine virus is transmitted by aedes mosquito and causes 35% mortality, etc..
- We notice that flaviviruses cause more mortality in the elderly people.

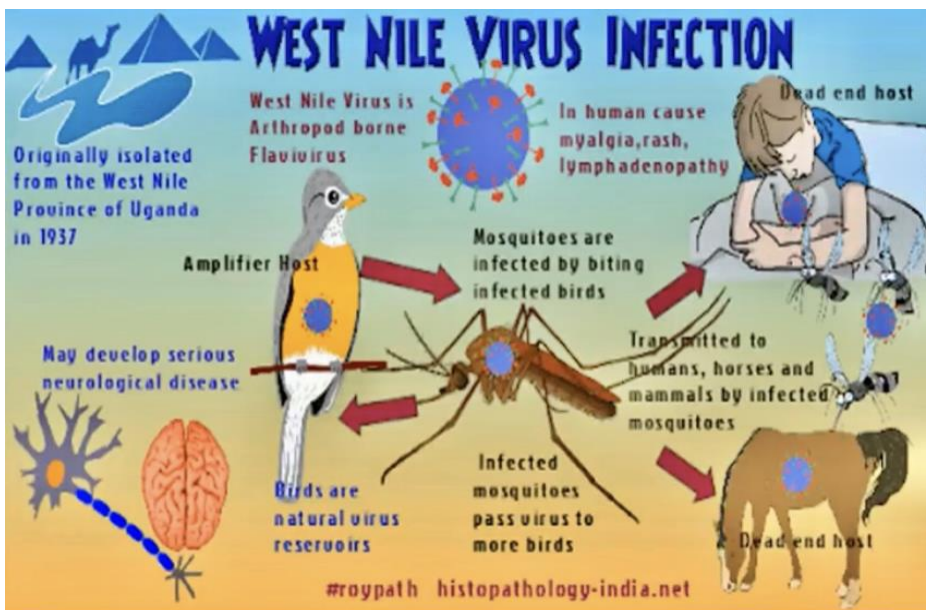
### ➤ West Nile Virus (WNV)

سبب تسميته بترجع للمكان اللي اكتشفوه فيه

- Is an RNA virus that belongs to the Flavivirus family.
- WNV infection manifests as two clinical syndromes: West Nile fever and West Nile encephalitis. WNV encephalitis can be defined as a disease that causes encephalitis, meningitis, or acute flaccid paralysis.
- Advanced age is by far the greatest risk factor for severe neurologic disease and long-term morbidity & mortality.
- Patients may suffer from severe **muscle weakness** or **flaccid paralysis**.

### ➤ The life cycle of the west nile virus

The normal life cycle is between the mosquito and the birds, the infected birds can infect the mosquito, after the mosquito bites them, then the mosquito become the carrier of west nile virus and can infect further more birds when it bites them again. However, sometimes the mosquito bites humans and horses (these are considered as incidental end hosts, because when the mosquito bites the human it is rarely transmitted from the human to other mosquito or another bird)



encephalitis, fever, myalgia & اعراض زي ال lymphadenopathy، طيب هل الطائر بتظهر عليه أعراض لما ينصاب بالفيروس؟ الجواب: اه

### ➤ Diagnosis (WNV)

The best method is to detect IgM in the blood or CSF during the acute phase (gold standard for the diagnosis of west Nile virus encephalitis) because after the infection, the patient can develop viremia for 1 to 2 days then after one week the patient starts developing IgM indicating that there's an acute infection.

- Viremia is detected as early as 1 to 2 days after the primary mosquito bite and persists for up to 1 week until the development of IgM neutralizing antibodies.
- IgM capture enzyme-linked immunosorbent assay (ELISA) in either blood or CSF during the acute phase is **the gold standard** for the diagnosis of WNV encephalitis and is generally always present by the time neurologic symptoms manifest. هاد اشي بميزه

بيجي المريض على الطوارئ عنده neurological symptoms، غالبا لما ينعمله blood test/ CSF test حتى نشوف اذا في IgM بتكون النتيجة positive

- CSF PCR may be helpful very early in the disease but generally has a low sensitivity (57%).

### ➤ Other Arboviruses

- St. Louis encephalitis (Saint Louis encephalitis) virus infection can cause mild febrile illness, aseptic meningitis, or encephalitis. Encephalitis can be accompanied by hyponatremia due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH). Individual susceptibility to the St Louis virus increases with age (& with higher mortality rate).

- Japanese encephalitis virus is a neurologic infection with a broad range of manifestations. It can range from subtle changes in behavior to serious problems, including blindness, ataxia, weakness, and movement disorders. Less than 1% of people infected with Japanese encephalitis virus develop symptomatic disease.

الJapanese encephalitis يكون اغلبه asymptomatic، أقل من 1% من المرضى بيبن عليهم أعراض

- La Crosse virus is the most common cause of arboviral encephalitis in the United States and produces seizures and focal neurologic signs, manifested primarily in children, with a mortality of less than 1% and rare sequelae.

### ➤ Measles

- RNA virus that belongs to the Paramyxoviridae family.

- Measles virus (MeV) infection causes an acute systemic disease (**acute infection/acute measles**); fever, cough, rash, etc.

- Acute measles can be accompanied by early or late CNS complications.

يعني في معه complications، ورح نحكي عن أهم ٢

- 2-4 weeks following acute MeV infection some patients develop **acute post-infectious measles encephalitis** (in 0.1% of measles cases). APME is associated with 20% mortality and severe neurological sequelae, mainly in adults. Symptoms include fever, headaches, seizures, and consciousness alterations (**it can present as encephalitis**).

We should 2 things: acute post-infectious measles encephalitis develop **early** after 2-4 weeks of MeV infection + it can present as encephalitis as we can see in its symptoms

- MeV can also cause **sub-acute sclerosing panencephalitis**. Subacute sclerosing panencephalitis is a very rare, but fatal disease (mortality rate close to 100%) of the central nervous system that results from the persistence of defective measles virus particles in brain cells following an earlier measles infection.

sub-acute sclerosing panencephalitis is more severe and **late** consequence of acute MeV infection, very high mortality rate

Panencephalitis means that it affects all of the brain, and the cause of panencephalitis is that certain defective virus particles remain in the brain after acute MeV infection, then these defective viruses become reactivated and cause disease (sub-acute sclerosing panencephalitis).

### ➤ Diagnosis and Prevention (Measles)

- Diagnosis of measles:

- Serologic testing for measles-specific IgM or IgG titers (**the most important and gold standard**)
- Isolation of the virus in culture
- Polymerase chain reaction (PCR) evaluation. Blood, throat, nasopharyngeal, or urine specimens can be used.

We can do urine test because MeV can be shed in urine.

- Measles has decreased in incidence due to the introduction of the live-attenuated MMR vaccine. CDC recommends that people get MMR vaccine to protect against measles, mumps, and rubella. MMR is part of the Jordanian children vaccination program (**اللي بعمر السنة**).

### ➤ Varicella-zoster virus

- Varicella zoster virus (VZV) is a DNA virus.

-VZV infection gives rise to two distinct syndromes: 1) chickenpox (primary disease) 2) shingles (from reactivation)



- Primary infection causes chickenpox (it is contagious, febrile disease associated with rash, affects children and it is self-limited most of the time)
- If the virus is not fully eradicated from the body, it travels and lies dormant in the dorsal root ganglia or other sensory ganglia. It can remain dormant due to host immunological mechanisms such as the mechanisms that can suppress the replication of the virus. However, with time there maybe failure in the immunity of the host due to immune suppression, stress or other reason, then the dormant virus will be reactivated (this will result in another disease → herpes zoster/ shingles). Secondary VZV skin eruption demonstrates a characteristic unilateral, vesicular, and painful eruption that follows a distinct dermatomal distribution (Shingles).

يعني اذا كان الفيروس قاعد بال cervical ganglia بيحي ال rash في المنطقة اللي بتغذيها هاي ال cervical ganglia

- VZV can also cause many different central nervous system pathologies if the infection invades the spinal cord or cerebral arteries, including cerebellar ataxia, arteritis, myelitis, meningitis, and encephalitis. CNS infection can occur with primary or secondary reactivation of the virus.

### ➤ Diagnosis (VZV)

- Diagnosis:
  - VZV IgM and IgG serum titers.
  - Positive PCR testing in CSF confirms VZV encephalitis.
- VZV serum immunoglobulin M (IgM) appears within 2 to 5 days of symptom onset. Therefore, a positive serum IgM is usually indicative of active infection
 

كونه بظهر بعد يومين ل ٥ أيام، هاد معناه انه ممكن يطلع positive بسهولة، ولما تطلع النتيجة positive هاد بدل انه الشخص عنده active acute infection
- IgG levels decrease with time but generally remain positive for life. Indicating a person's immunity to the disease.
 

اذا طلعت النتيجة انه الشخص positive لل IgG هاد معناه انه الشخص عنده مناعة لهاد المرض
- VZV PCR may be dependent on the time of symptom onset and the time of CSF acquisition with decreasing sensitivity of PCR after 1 week.

PCR is used to detect the DNA of the virus in the CSF

So, the diagnostic method of choice to detect varicella zoster virus infection is IgM and IgG serum antibody titers.

### ➤ Prevention

- VZV encephalitis has become increasingly prevalent in the era of acquired immunodeficiency syndrome (AIDS). VZV encephalitis mortality rate for immunocompetent patients is approximately 15% and almost 100% in an immunosuppressed patient.

- VZV has a vaccine. Two doses of the vaccine are about 90% effective at preventing chickenpox. Some people who are vaccinated against chickenpox may still get the disease. However, it is usually milder with fewer blisters and little or no fever. This vaccine is optional in the Jordanian children vaccination program.

### ➤ Lassa fever encephalitis virus

- RNA Arenaviruses usually infect rodents. Thus, infection most commonly occurs during the winter, when mice are indoors, and humans have contact with their excreta.

ينتشر بالشتاء اكثر لانه يصيب الفئران والفئران بالشتاء بتكون بالبيوت أكثر والناس دايمًا بالبيت فبصير في احتكاك ونقل للمرض، خاصة بالمناطق الفقيرة والتي مستوى النظافة فيها منخفض

- Lassa fever (LF) is a West African disease that starts with gastrointestinal (GI) and respiratory complaints and progresses to hemorrhagic shock (**hemorrhagic fever**).
- In severe cases, LF may present with central nervous system (CNS) features and is usually associated with bleeding and poor prognosis. Unilateral or bilateral deafness may follow the period of encephalitis. Mortality is in the range of 8-52%.

### ➤ Rabies virus

- Bullet-shaped RNA virus of the Rhabdoviridae family.

Bullet-shaped → شكله زي شكل الرصاصة

- Rabies virus is transmitted through saliva of infected animals, usually after a bite.
- Rabies is an important pathogen in developing countries, where endemic canine infection still exists (dogs). Rabies is also present in wild animals (skunks, foxes, raccoons, bats).

It can be controlled in domestic animals with vaccination.

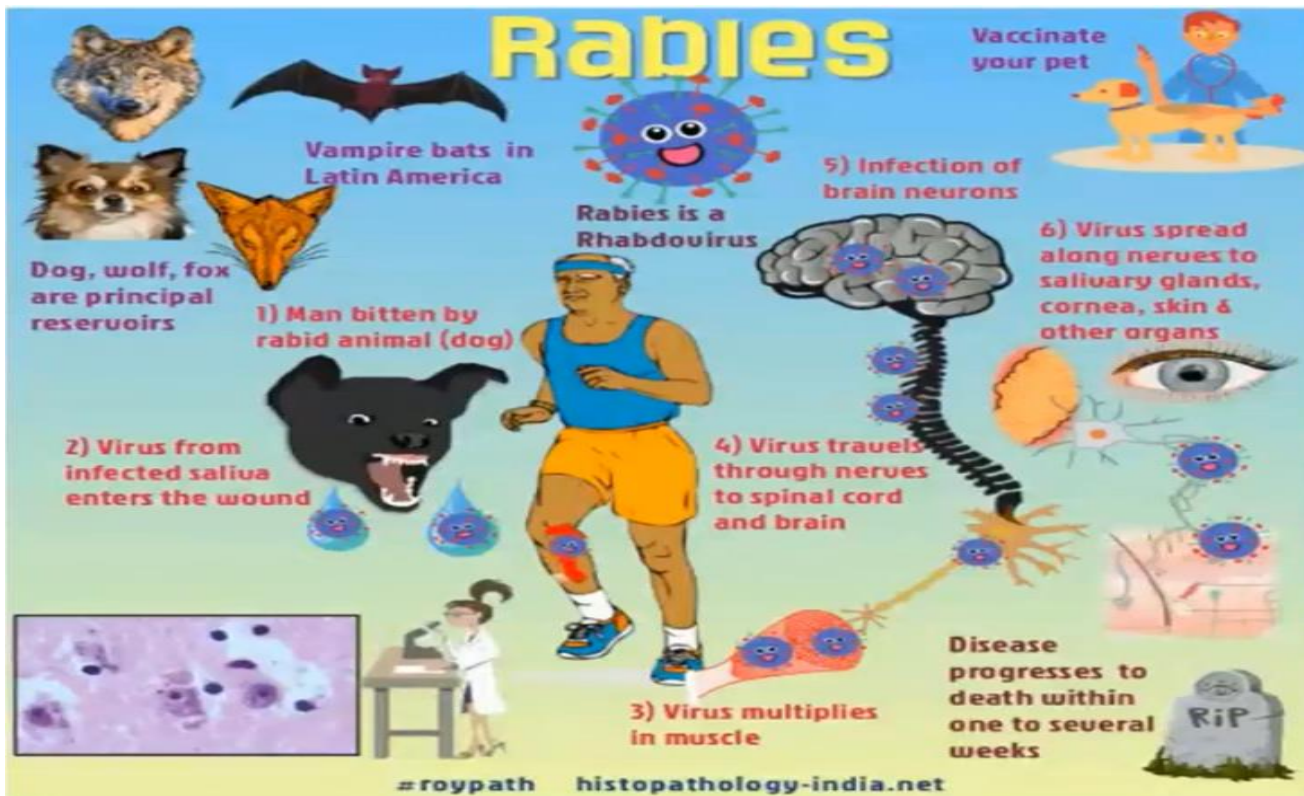
Domestic animals = اللي بتتربى بالبيوت

- After a bite, Rabies virus travels to the CNS by migrating in a retrograde fashion up nerve axons after binding to acetylcholine receptors. It replicates in the neurons of the brain and spinal cord.

After the bite, the virus enters into the human body and rests in the muscles then it enters the neurons through the Ach receptors and travels through the nerve axon in the retrograde fashion and finally reaches the spinal cord and the brain.

- Rabies has a long incubation period (weeks to months) before symptom onset.

## ➤ Life cycle of rabies virus



كل الخطوات بالصورة حكينا عنهم بس زيادة عليهم نقطة ٦

Note: once the neurological symptoms begin, it's very hard to stop the disease and it usually progresses to death within one to several weeks.

## ➤ Diagnosis and Prevention (Rabies)

- Progression of disease:
  - fever, malaise, tingling sensation at the site of the bite
  - agitation, photophobia, hydrophobia, hypersalivation
  - paralysis, coma
  - death
- Rabies is usually diagnosed by **postmortem examination**.  
لما يعملوا histological examination يكون في الدماغ **negri bodies**  
PCR could be done for confirmation.
- **Postexposure prophylaxis** is wound cleaning plus immunization with killed vaccine and rabies immunoglobulin (IgGs). **There is no treatment for rabies after the neurological symptoms start**, only six cases worldwide have survived and most have significant neurological damage.  
Postexposure prophylaxis is very effective and it has prevented cases of rabies.

## ➤ HIV

• While HIV can sometimes cause a type of subacute encephalitis, it is important to mention it here because its associated immunosuppression predisposes the individual to viral encephalitis caused by HSV-1, VZV, or cytomegalovirus (CMV).

• Certain forms of encephalitis are observed almost exclusively in patients with HIV. في فيروسات عادة ما بنشوقها بتعمل encephalitis الا اذا كان المريض عنده HIV، هاي الأمراض بنسميها AIDS defined illnesses

Among those, cytomegalovirus (CMV) encephalitis has emerged as a unique entity in patients with advanced HIV infection.

يعني ال CMV ما بعمل encephalitis، هو بعمل mononucleosis، يكون في fever, muscle aches, large lymph nodes & sore throat ببعض الحالات لما المريض يكون عنده HIV، ال CMV infection بقدر يسبب severe disease (encephalitis)

## ➤ JC virus (John Cunningham virus)

John Cunningham is the name of the patient who developed the JC virus disease.

• A naked DNA virus that belongs to Polyomaviridae family.

• JCV causes a disease known as Progressive Multifocal Leukoencephalopathy (PML).

• PML is a rare, subacute, degenerative disease of the brain found primarily in adults with immunosuppressive diseases, especially AIDS and hematologic malignancies, or those receiving immunosuppressive agents.

• The disease is characterized by the development of impaired memory, confusion, and disorientation, followed by a multiplicity of neurologic symptoms and signs that include hemiparesis, visual disturbances, incoordination, seizures, and visual abnormalities.

• PML is progressive, with death usually occurring 3 to 6 months after the onset of symptoms.

## ➤ Diagnosis (JC virus)

التشخيص لهاد الفيروس صعب شوي، وعلاجه أصعب

• CSF findings are often normal, although some patients show a slight increase in lymphocytes, and protein levels may be elevated.

ببس هاد يكون non specific

• Histopathology (brain biopsy): foci of demyelination are found, surrounded by giant, bizarre astrocytes containing intranuclear inclusions.

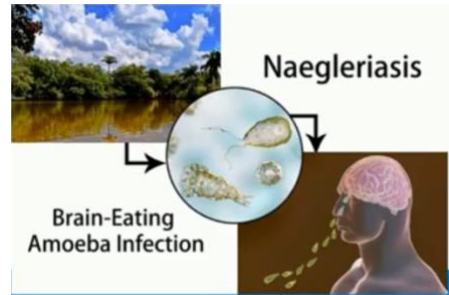
• Electron microscope: Abundant JCV particles can be seen in the brain by electron microscopy and may be concentrated within the nuclei of oligodendrocytes.

- There is no specific treatment for PML, although reducing the immunosuppression, if possible, may have some clinical benefit.

### ➤ Parasitic causes of encephalitis

- 1) They are rarely encountered & 2) they are extremely fatal

- Acanthamoeba species: they can cause granulomatous amebic encephalitis



- Naegleria fowleri: primary amebic meningoencephalitis (PAM); rapidly progressive fatal disease acquired by entry of N. fowleri into the body during swimming in freshwater lakes.

Acanthamoeba & Naegleria fowleri are two parasites that belong to the amoeba family.

### ➤ Differential diagnosis of encephalitis

Other causes of encephalitis (other than viruses).

- Autoimmune:

- Antibodies against neuronal surface antigens, mainly associated with tumors:
  - NMDAR antibody encephalitis (ovarian teratoma)
  - LGI-1 antibody encephalitis (thymoma)

ال tumor بال thymus gland مثلًا بطلع antibody اسمه LGI-1 وهاد ال antibody ممكن يعمل encephalitis لانه يستهدف ال neurons، نفس الاشي بالنسبة لل ovaries

- Infective causes that mimic encephalitis:

- Systemic sepsis with encephalopathy.

اذا الشخص عنده systemic sepsis بسبب البكتيريا بتسببه altered consciousness

- Bacterial meningitis.

نفس الاشي بالنسبة لل meningitis لانها قريبة لل brain parenchyma ← can have some sort of encephalitis-like presentation

- Inflammatory diseases: vasculitis, systemic lupus erythematosus with CNS involvement.

- Metabolic: hypoglycemia, toxins (drugs, alcohol).

- Neoplastic: primary brain tumor (low grade glioma mimicking CNS inflammation and can present as encephalitis).

- Psychiatric disease

### ➤ Diagnosis of encephalitis

- Imaging studies
- Lumbar puncture (CSF analysis)

ونتذكر انه ال CSF بال viral encephalitis يكون clear وممكن يكون normal، ومرات يكون في ارتفاع قليل  
بال WBCs

• CSF PCR for viral DNA/RNA detection usually yields results within 24–48 hours in most laboratories.

- Serum serological tests
- Viral cultures (depends on the virus, because certain viruses cannot grow in cultures. Also, other cultures may need a lot of time and encephalitis is a medical emergency and needs to be treated right away)

### Imaging studies

• Either a computed tomography (CT) scan or, ideally, magnetic resonance imaging (MRI) should be obtained urgently. Following this, if there are no radiological contraindications, LP should be performed as soon as possible.

زي ما حكينا بالمحاضرات الماضية، انه لازم قبل ما نعمل LP نتأكد انه ما يكون في increased intracranial pressure عشان لو ما يصير في herniation لل brain & brainstem وينتج عنا further damage .  
- بتأكد عن طريق ال imaging ال CT & MRI + منشوف ال eye اذا في papilledema

• Brain imaging serves three purposes:

- to look for changes of encephalitis.
- to exclude alternative diagnoses.
- to assess patency of the basal cisterns and an absence of mass effect so that LP can proceed without risk of herniation.

Can help us make sure to do LP without any complication.

• Magnetic resonance imaging (MRI) is the gold standard technique for brain imaging in encephalitis and is abnormal in 90% of cases of HSV encephalitis but may be normal or subtly abnormal in autoimmune encephalitis.

وبالتالي ال MRI أهميته بال HSV encephalitis، ويرضو بساعدنا نشوف ال changes بال brain  
بال encephalitis

• Further imaging techniques including ultrasonography, CT of the body and positron emission tomography (PET) imaging may be indicated if a paraneoplastic cause is suspected.

ما بنستخدمهم بتشخيص ال encephalitis، بساعدوا انه نستبعد ال paraneoplastic causes

• Electroencephalography (EEG) is useful in identifying and monitoring seizure activity but is non-specific and can be abnormal in several other causes of encephalopathy.

مممكن يكون normal مرات بس في حالات معينة يكون فيها abnormal زي ال HSV encephalitis لانه يكون فيها changes وهاد بساعد بالتشخيص + بقدر يساعد بال identifying and monitoring seizure activity due to encephalitis

## ➤ Lumbar puncture

حكينا عنها من قبل..

- Lumbar puncture (LP): the key to establishing evidence of central CNS inflammation is the analysis of CSF.
- Ideally, LP should be performed immediately in patients with suspected brain infection, and empirical treatment started immediately thereafter.
- The CSF usually shows:
  - Normal glucose
  - Moderately elevated proteins
  - CSF pleocytosis (>5 white cells x 10<sup>9</sup>/L), comprising predominantly lymphocytes
  - About 10% of patients will have normal CSF studies

So, LP in encephalitis is not very specific

فلما يكون في مريض عنده meningitis or encephalitis منعمله LP بالإضافة لل culture و باقي ال tests

## ➤ Management and treatment

زي ما حكينا قبل عن الفيروسات انها self-limited وبس بنحتاج supportive therapy فما في عنا specific medical therapy

- The treatment of viral encephalitis is primarily supportive as there is no specific medical therapy for most central nervous system viral infections.

- Certain viral encephalitis cases may respond well to antiviral therapies:

اللي هم ال HSV, VZV, CMV

1. When started early, acyclovir has been shown to significantly decrease mortality and morbidity and limit the severity of long-term behavioral and cognitive impairment of HSV encephalitis.

2. Acyclovir with possible adjunctive corticosteroids in immunocompetent patients, is recommended for varicella-zoster virus encephalitis.

3. The recommended treatment for CMV encephalitis is a combination of ganciclovir and foscarnet.

ولو المريض عنده HIV infection عشان أمنع انه ينصاب بفيروس ثاني مسبب لل encephalitis لازم نعطي ال treatment تبع ال HIV اللي هم ال antiretroviral therapy

## ➤ Empirical treatment

زي ما بنعرف انه ال encephalitis حالة طارئة ولازم نبليش العلاج فيها بأسرع وقت، التشخيص تبعها بده وقت خاصة ال LP ممكن يتأخر ل 6 ساعات وهاد اشئ مش منيح، عشان هيك عنا ال empirical treatment اللي هو ال acyclovir لانه ال HSV encephalitis هو ال most common viral encephalitis in patients.

- Empirically, it is recommended that physicians start all patients with suspected encephalitis on acyclovir.

- If LP is delayed for more than 6 hours, empirical acyclovir may be given before the LP. An LP is often excessively delayed, primarily due to performing brain imaging to exclude raised intracranial pressure.

## ➤ Complications

- Encephalitis may be associated with a number of complications, including the following:
  - Seizures.
  - Syndrome of inappropriate secretion of antidiuretic hormone (SIADH).
  - Increased intracranial pressure.
  - Coma.
  - Death.

نهاية التلخيص..

- لا تيأس والله ربك، فرحمته أوسع من كل أمر أهّمك..  
لا تبتئس فالله حسبك..