Meningitis and Encephalitis

Silke Dohne
Meningitis:
Infection/Inflammation of the meninges (covering of the brain and spinal cord: duramater, arachnoid and piamater) and the cerebrospinal fluid

Encephalitis:
- Inflammation of the cerebral parenchyma, meninges – meningoencephalitis

Meningoencephalitis – inflammation of brain + meninges
Signs and Symptoms
Babies and toddlers

- Refusing food & vomiting
- Fretful, dislike being handled
- Rapid breathing or grunting
- Fever, cold hands & feet
- Pale, blotchy skin. Spots/rash see Glass Test
- Neck stiffness, dislike bright lights
- Tense, bulging fontanelle
- Unusual cry, moaning
- Drowsy, floppy, unresponsive
- Convulsions/seizures
Symptoms and signs in children and teenagers

- Fever, cold hands & feet
- Vomiting
- Severe muscle pain
- Drowsy, difficult to wake
- Confusion & irritability
- Pale, blotchy skin. Spots/rash see Glass Test
- Stiff neck
- Severe headache
- Dislike bright lights
- Convulsions/seizures

20–30%
Headache and vomiting are important symptoms.

Confusion and irritability can occur.

Neck stiffness and photophobia may occur in older children but their absence is not reassuring.
Signs of meningeal irritation:
Nuchal rigidity:
- It is the inability to flex the head forward due to rigidity of the neck muscles; if flexion of the neck is painful but full range of motion is present, nuchal rigidity is absent.
Kernig's sign:

- It is positive when the leg is bent at the hip and knee at 90 degree angles, and subsequent extension in the knee is painful (leading to resistance).
- **Brudzinski's signs**
  - It is the appearance of involuntary lifting of the legs in meningeal irritation when lifting a patient's head off the examining couch, with the patient lying supine.
Diagnosis/Investigations

Bloods (FBC, CRP, BC, possibly PCR)

Lumbar puncture –

CT scan/MRI –

Chest X-ray (other signs of infection)
Diagnosis/Investigations

- Lumbar puncture
## Normal CSF values for children over 2 months of age

<table>
<thead>
<tr>
<th>Condition</th>
<th>White cells/mm³</th>
<th>Protein g/l</th>
<th>Glucose mmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (age &gt; 3mo)</td>
<td>&lt; 5</td>
<td>&lt; 0.4</td>
<td>&gt; 2.5 or 50% blood level</td>
</tr>
<tr>
<td>Partially treated meningitis</td>
<td>1-10,000 mainly neutrophils</td>
<td>&gt; 0.4</td>
<td>&lt; 2.5</td>
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<tr>
<td>Bacterial meningitis</td>
<td>Usually thousands Mainly neutrophils</td>
<td>Usually &gt; 1.0</td>
<td>&lt; 2.5</td>
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<td>Viral meningitis</td>
<td>Usually &lt;1000 Neutrophils early, then lymphocytes</td>
<td>&gt; 0.4</td>
<td>Normal but may be &lt; 2.5</td>
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<tr>
<td>Tuberculous meningitis</td>
<td>Usually &lt; 1000 50-1000 lymphocytes</td>
<td>&gt; 0.4 (may be normal)</td>
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In a traumatic tap, allow 1 white blood cell for every 500 red blood cells, and 0.01g/L of protein for every 1000 red cells.
Contraindications to lumbar puncture

- Respiratory distress
- ICP (increased risk of herniation)
- Shock
- Extensive or spreading purpura/Coagulation abnormalities
- After convulsions until stabilised
- Platelet count below 100 x 109/litre
- Cellulitis at area of tap
Bacterial meningitis

- 3–8 months old at highest risk
- 66% of cases occur in children < 5 years old
Bacterial meningitis – Organisms

**Neonates**

- Most caused Group B Strep.
  - Common commensal of the bowel and female genital tract, generally transmitted at or after birth

- E.coli, enterococci, Klebsiella, Enterobacter, Salmonella Serratia, Listeria, occasionally H.influenzae
Neisseria meningitis

Commonest cause (UK)

(!!! meningococcal septicaemia)

Since ↑ effective serogroup Men C vacc. 2000 →

- B strains currently cause 85–90% of cases annually (1000/year in England and Wales).

- C,Y and W135 cause small numbers. Other serogroups rare
S. pneumoniae

2nd commonest

Steep reductions in incidence following 7–prevalent P. conjugate vaccine into vacc. schedule 2006.

Since 2010 13–valent vaccine

No–vaccine serotypes remain a threat and cont. to cause invasive disease
H. influenzae

Prior to vacc in 1992 Hib was major cause of bacterial meningitis in children under 5.
Now very rare in fully vaccinated children
Other serotypes cause rarely disease
Tuberculosis

Mycobacterium tuberculosis: cause of estimated 200 cases of meningitis annually in the UK

In high TB prevalence areas Peak incidence between 1–4 yrs
Other bacteria (Listeria, can cross placental barrier)

Viral – commonly enterovirus (varicella, influenza, mumps, herpes simplex type 1)

 Usually milder form
 ◦ Summer/fall
 ◦ Treatment – supportive/ no isolation

Fungal (cryptococcus neoformans (found in dirt and bird dropping) – common in AIDS patients
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¹Arbovirus = arthropod-borne virus (e.g. Toscana virus)

* adapted from: www.medunwien.ac.at/hygiene; www.en1vd.de/ENCIDISEASES/fs_encdiseases.htm
Bacterial meningitis– clinical course

- Fever
- Malaise
- Vomiting
- Alteration in mental status
- Shock
- DIC
- Cerebral oedema
Increased intracranial pressure (ICP)

- Papilloedema
- Cushing’s triad
  - Bradycardia
  - Hypertension
  - Irregular respiration
- ICP monitor
- Changes in pupils
Treatment

### Antibiotics for confirmed disease

**Children younger than 3 months**
- **Confirmed disease**
  - Treat Group B streptococcal meningitis with intravenous cefotaxime for at least 14 days
  - Treat bacterial meningitis due to *L. monocytogenes* with intravenous amoxicillin or ampicillin for 21 days in total, plus gentamicin for at least the first 7 days
  - Treat bacterial meningitis due to Gram-negative bacilli with intravenous cefotaxime for at least 21 days
  - Treat meningococcal meningitis with intravenous cefotaxime for 7 days in total

**Children 3 months or older**
- **Confirmed disease**
  - Treat *H. influenzae* type b meningitis with intravenous ceftriaxone for 10 days in total
  - Treat *S. pneumoniae* meningitis with intravenous ceftriaxone for 14 days in total
  - Treat meningococcal meningitis with intravenous ceftriaxone for 7 days in total

### Antibiotics for unconfirmed disease

**Children younger than 3 months**
- **Unconfirmed disease**
  - Treat with cefotaxime plus either ampicillin or amoxicillin for at least 14 days

**Children 3 months or older**
- **Unconfirmed disease**
  - Treat with intravenous ceftriaxone for at least 10 days

### Public health management
- Notify a proper officer of the local authority urgently on suspicion of meningitis or meningococcal septicaemia. This is a legal requirement under Health Protection (Notification) Regulations 2010.
- Be aware of ‘Guidance for Public Health Management of Meningococcal Disease in the UK’.

### Long-term management
- (see box 3 on page 20 and the immune testing pathway on page 18)
Children younger than 3 months

**Confirmed disease**
- Treat *H influenzae* type b meningitis with intravenous ceftriaxone for 10 days in total
- Treat *S pneumoniae* meningitis with intravenous ceftriaxone for 14 days in total
- Treat meningococcal meningitis with intravenous ceftriaxone for 7 days in total

Children 3 months or older

**Confirmed disease**
- Treat *H influenzae* type b meningitis with intravenous ceftriaxone for 10 days in total
- Treat *S pneumoniae* meningitis with intravenous ceftriaxone for 14 days in total
- Treat meningococcal meningitis with intravenous ceftriaxone for 7 days in total

Children younger than 3 months

**Unconfirmed disease**
- Treat with cefotaxime plus either ampicillin or amoxicillin for at least 14 days

Children 3 months or older

**Unconfirmed disease**
- Treat with intravenous ceftriaxone for at least 10 days
Meningitis Fluid management

- Restore intravascular volume + perfusion
- Monitor serum Na (osmolality, urine Na)
  - If Na < 135 mmol, fluid restrict
  - Important for cerebral perfusion for patient not to be underhydrated
  - If severely hyponatraemic, give 3%

SIADH
  - 4–88% in bacterial meningitis
  - 9–64% in viral meningitis
ICP treatment

- 3% NACL, 5 ml/kg over 20 min
- Elevation
- Mild hyperventilation
  - (if PaCO2 too low can cause regional ischaemia)
Complications

- **Systemic**
  - septic shock
  - disseminated intravascular coagulation
  - acute respiratory distress syndrome
  - septic or reactive arthritis,

usually the consequence of the bacteraemia
Acute neurologic complications

- Hydrocephalus
- Subdural effusion or empyema ~30%
- Stroke
- Abscess
- Dural sinus thrombosis
Prognosis, long term sequelae

- hearing loss, which may be partial or total
- problems with memory and concentration
- problems with co-ordination and balance
- learning difficulties (temporary or permanent)
- epilepsy
- cerebral palsy – a general term for a set of conditions that affect movement and co-ordination
- speech problems
- vision loss, (partial or total)
Methods of control

Meningitis: Methods of Control

- Encourage personal hygiene especially the practice of hand washing. Keep hands clean and wash hands properly. Wash hands when they are dirtied by respiratory secretions e.g. after sneezing. Cover nose and mouth while sneezing or coughing and dispose of nasal and mouth discharge properly.
- Do not share eating and drinking utensils and wash them before use by others.
- Avoid going to overcrowded places.
- For Neisseria meningitidis meningitis, household contacts and others who have had close personal contact with infected persons are recommended to receive a preventive antibiotic which kills bacteria living in nose and throat secretions.
- For contacts of Haemophilus influenzae meningitis, antibiotics may also be recommended.
- Effective vaccines against Haemophilus influenzae type b, and some types of Neisseria meningitidis are available.
Meningitis: Nursing Management

- Assess neurologic status.
- Monitor vital signs especially temperature frequently or continuously.
- Pulse oximeter and arterial blood gas (ABG) are used to quickly identify the respiratory support for increasing ICP.
- Institute other cooling measures such as TSB.
- Monitor I & O closely.
- Encourage adequate fluid intake.
- Darken the room if photophobia is present.
- Assist with position to comfort neck stiffness and turn patient slowly and carefully with head and neck in alignment.
- Elevate the head of the bed to decrease intracranial pressure and reduce pain.
- Administer vaccines against H. influenza type B for children; N. meningitides for patients at high risk; and S. pneumonia for patients with chronic illnesses and the elderly.
- Inform patients about the importance of vaccination.
Pathogenesis: Meningococcal Septicaemia

- Meningococcal septicaemia can develop instead of, or co-exist with meningitis.
- Can also cause purulent conjunctivitis
As the bacteria multiply, shed “bleps” from their membranes→ contain endotoxin.

Trigger Systemic Inflammatory Response Syndrome → septic shock

On-going fever, (with advanced septicaemia fever will go down),

Shakes/rigors

Pallor

Muscle aches, myalgia

GI signs common incl. D+V
WCC attempt to engulf bacteria to contain infection, also release pro-inflammatory cytokines.

Endotoxin and SIRS (system.inflamm.response) cause damage to the lining (endothelium) of blood vessels.

leakage of water and proteins from vessels into tissues

Endothel.leak + iv. thrombosis + abn. vascular tone + myocardial dysfunction → decreased perfusion → multiorgan failure
Symptoms:

- as before +
- Increased HR
- Increased RR (2nd acidosis, hypoxia, cap. leak)
- Lower urine output
- Cold hands and feet (blood diverted centrally)
- Rash – variable appearance at onset
  - Maculopapular/Petechia/Purpura/Echymosis
Isolation

- Transmission up to 24 hrs after start of appropriate tx
- Droplet precaution x 24 hrs
- Incubation 1–10 d, usually <4 d

- Prophylaxis (Rifampicin/Ciprofloxacin)
Outcomes

Substantial morbidity 11% of survivors have sequelae
  ◦ Neurological disability
  ◦ Limb loss
  ◦ Earing loss

  ◦ 1% if meningitis alone
**Vaccination**

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<th></th>
<th>DTaP</th>
<th>IPV</th>
<th>Hib</th>
<th>MenC</th>
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- Introduction of rotavirus vaccination at 2 + 3 months
- At 12–13 girls 3 doses of HPV within 6 months
- Men C booster
Encephalitis

- In the UK, the cause in over 50% of cases is unknown, despite extensive testing.
- Most common: herpes simplex
  - Irritation and inflammation (swelling) of the brain
  - Encephalitis with meningitis → meningoencephalitis
Types of encephalitis

- **Infectious** – inflammation occurs as a direct result of an infection, which is often viral.
- **post–infectious** – inflammation is caused by the immune system reacting to a previous infection, and can occur days, weeks or sometimes months after the initial infection.
- **autoimmune** – inflammation is caused by the immune system reacting to a non-infectious cause, such as a tumour.
- **chronic** – inflammation develops slowly over many months, and can be the result of a condition such as HIV, though in some cases there is no obvious cause.
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Presentation

Encephalitis usually begins with flu-like symptoms such as:

- high temperature (fever) of 38°C (100.4°F) or above
- headache
- nausea and vomiting
- joint pain
After this initial stage, more serious symptoms can begin to develop within hours or days, which may include:

- changes in mental state, such as confusion, drowsiness or disorientation
- seizures (fits)
- changes in personality and behaviour
- loss of consciousness
Other symptoms can include

- sensitivity to bright lights (photophobia)
- inability to speak
- inability to control physical movements
- stiff neck
- hallucinations (seeing and hearing things that are not actually there)
- loss of sensation in certain parts of the body
- partial or total vision loss
- involuntary eye movements, such as moving the eyes from side to side
Diagnosis

- Screening blood, urine and other body fluids
- CT scans or MRI scans
  - to highlight the extent of brain inflammation
  - help to distinguish encephalitis from other conditions, such as stroke, brain tumours and aneurysms
- Lumbar puncture (PCV herpes)
- Electroencephalogram (EEG)
Treatment

- Infectious encephalitis– aciclovir, initially Cephalosporine/Azithromicin

- Post–infectious encephalitis– iv. high–dose corticosteroids. (several days)

- Autoimmune encephalitis– can be treated with corticosteroids, immunoglobulin therapy and plasmapheresis
Complications

Some people make a full recovery from encephalitis. But for many, encephalitis can lead to permanent brain damage and complications, including:

- **memory problems**, which affect 70% of people with complications
- **personality and behavioural changes**, which occur in just under half of all people
- **aphasia** – speech and language problems that occur in around one in three people
- **epilepsy**, which occurs in one in four affected adults and one in two affected children
- **changes in emotions**, such as anxiety and anger, and mood swings
- **problems with attention, concentrating, planning and problem solving**
- **physical and motor difficulties**
- **low mood and a sense of feeling different**
- **fatigue** (extreme tiredness)
References: NICE Guidelines (Bacterial meningitis and meningococcal septicaemia in children 2010)

RCPCH CPD e-learning course on Bacterial meningitis and meningococcal septicaemia in children

Encephalitis Guidelines
Case discussion
A+E 1 yr old  10kg

- Sitting on mums lap – ‘unwell’
- What do you do?
- Obs at triage
  - T 37.5
  - Sats 96%
  - HR 142
  - RR 35
  - BP 100/50
    - Normal?
History taking
- 3 days of vomiting/no diarrhoea
- Tachypnoea
- High temp to 39
- PU
- Some spots on his face 3 d ago
- Had abx 5 days ago for tonsillitis
- Did not have all vaccination

Obs 1 hr later after triage
- T 39
- Sat 98%
- HR 160
- RR 35
- BP 95/50
- Paracetamol/Brufen
Examination

- Irritable when touched
- Otherwise lethargic
- Chest clear/CVS Heart sounds normal/Abdo NAD
- ENT : ears and throat red
- Neck not very mobile/?tender
- Does not like bright light
- AF closed
- Cap refill 2 sec
- No rashes noted
What do you do now?

Remember ABC
Access and bloods

- Iv line
- FBC, BC, CRP, U+E +/- LFTs, Clotting, ven gas
- Urine (how to obtain?)

While preparing for all this child has brief tonic clonic seizure, self limiting 2 min
In the meantime: Reg phones requests LP
  - Do you do it?
Now:

- Iv fluids – how much?
- Bolus?
- Abx Which/dosage?
Reassess

- T 38.5
- HR 160
- BP 95/50
- Sats 95%
- RR 30

- Cap refill 3–4 sec
- CRP 265, WCC 4
- pH 7.2, Lactate 5
- Bolus 20 ml/kg NSaline
- Maintenance fluids
Reassess

- Very sleepy
- Minimally responsive

- BP 120/70
- HR 80
- RR 15 – 20 but erratic
- L pupil dilated  

And now?
Crash team is on its way but not there yet.............

- What is the problem?
Herniation/Coning

- 2.7% Nsaline  3ml/kg over 20 min
- Possibly fluid restrict

- Mannitol 250mcg/kg
Any questions?