Meningitis, Encephalitis, Cerebral Abscess and LPs

Meningitis

Epidemiology
20-100/100,000 neonates; 5/100,000 1/12 – 4yrs
90% mortality untreated
30% survivors have long term sequelae
Paediatrics: 4.5% mortality. Meningococcal sepsis bimodal (0-4yrs, 15-25yrs). <3/12 + febrile = 1% incidence

Pathogenesis
Usually haematogenous spread, sometimes direct; damage from inflammatory response

Strep pneumoniae (60%)
G+ive diplococci
More indolent course; 50% also have pneumonia
25% resistant to penicillin, 9% resistant to cefotaxime; if resistance, use vanc + rifampicin

N meningitidis (16%)
G-ive aerobic diplococci
13 serogroups; C>B in Aussie (usually other way round in developed countries)
Reservoir in NP; aerosol transmission
Sudden onset headache, fever, true rigors, neck stiffness, N+V, photophobia, altered LOC, AP, limb pain, arthritis, rash
(in 40%, may take 6-12hrs to develop; haemorrhagic, petechial, purpuric; may blanch initially)
May be fatal in 12hrs (mortality 1-5% - up to 40% if invasive meningococcal disease)
Assoc with Waterhouse Friedrichsen syndrome (acute adrenal haemorrhage)

Grp B strep (14%), E coli: if <3/12
Hib (7%): if non-vaccinated; use cefotaxime/ceftriaxone
Listeria (2%): if neonate and immunocomp; use benpen or ampicillin
Staph: if CNS shunt, open wound, neurosurg
Viral: mumps, coxsackie, enterovirus, herpes, EBV, echovirus, HIV, CMV
Other bacterial: TB, mycoplasma, borrelia, treponema pallidum, brucella
Fungi and parasites: cryptococcus neoformans, toxoplasma
Drugs: NSAIDS, bactrim
Other: sarcoid, SLE, Wegener’s

Assessment

History
25% bacterial present within 24hrs, viral present day 1-7 (5% within 24hrs)
Classic Sx absent in infants and elderly
Fever in 80% bacterial (30-40% viral); seizures in 30-40% children, 20-30% adults; confusion in 85% bacterial (25-50% viral); photophobia in 80% bacterial (60-70% viral)
Headache + fever + neck stiffness present in 50% (2 present in nearly 100%)

Examination
Isolated CN lesion in 10-20%
Look for shock
Kernig’s (passive knee extension in supine patient causes neck pain and hamstring resistance)
Brudinski’s (passive neck flexion or single hip flexion causes involuntary flexion of both hips)
Paediatrics
15% neonates have physical findings (lethargy, seizures, poor feeding, fever, hypothermia, paradoxical crying, hypotonicity, bulging fontanelle late)
Meningism not present until 18/12; focal signs in 15% all cases, 30% pneumococcal; seizures in 30%; 15-20% decr LOC (more in pneumococcus); subdural effusion / empyema (30% in Hib, 20% in strep); may deteriorate after Abx (bacteriolysis - inflam); beware partially treated meningitis
Suspect encephalitis if seizures/altered LOC/behaviour

Investigation
Bloods
FBC, coag, blood cultures, U+E, BSL; Ag testing if blood/urine not helpful; ?procalcitonin
CT head
If papilloedema, altered LOC, FND, seizure, immunocomp, Ca, concern Re: SOL, history of CNS disease, seizure in week prior, >60yrs
CT may be normal despite incr ICP in 45%
CT features of incr ICP = changes ventricle size, decr basilar cistern size, narrowed sulci, transfalcine herniation, change in rate of grey/white matter
CXR
LP
Cell count, diff, glu, protein, Gram stain, culture, Ag (high sens/spec, esp Hib and neisseria), PCR (HSV/TB); India ink if indicated (cryptococcal)

<table>
<thead>
<tr>
<th>Pressure (cmH20)</th>
<th>Normal</th>
<th>Bacterial</th>
<th>Viral</th>
<th>Fungal/TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (g/L)</td>
<td>0.18-0.45</td>
<td>&gt;1</td>
<td>&lt;1</td>
<td>0.1-0.5</td>
</tr>
<tr>
<td>Glucose (mmol/L)</td>
<td>2.5-3.5</td>
<td>&lt;2.2</td>
<td>Normal</td>
<td>1.6-2.5</td>
</tr>
<tr>
<td>Gram stain</td>
<td>Normal</td>
<td>60-90% Positive</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>Glucose - CSF:Serum Ratio</td>
<td>0.6</td>
<td>&lt;0.4</td>
<td>&gt;0.6</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td>WCC</td>
<td>&lt;3</td>
<td>&gt;300</td>
<td>&lt;1000</td>
<td>100-500</td>
</tr>
<tr>
<td>Other</td>
<td>90% PMN</td>
<td>Monocytes</td>
<td>10% have &gt;90% PMN</td>
<td>30% have &gt;50% PMN</td>
</tr>
</tbody>
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Management
A+B
C: if shocked give IVF; SIADH in 30% children so use 50% maintenance after resus
Supportive: seizure control, analgesia, fever control, BSL
Steroids: IV dex 10mg (0.2mg/kg) Q6h for 4/7 if >1/12; give at least 15-30mins before Abx; give within 30mins; decr host response to bacteria; decr deafness; in children halves incidence of audio / neuro sequelae (but >70% had Hib infections); in adults decr risk of adverse outcome and mortality; benefit best in pneumococcal (adult) and Hib (children)
Antibiotics: give within 30mins (give before LP if there will be >20min delay to LP)
<3/12: amoxicillin 50mg/kg QID + cefotaxime 50mg/kg QID + vancomycin 15mg/kg QID (if suspect pneumococcus, G+ive diplococci seen, Ag +ive)
>3/12: cefotaxime 100mg/kg loading dose - 50mg/kg QID (max 2g)
or ceftriaxone IM 100mg/kg loading dose (max 4g) (if no IV access) + amoxicillin 50mg/kg QID IV (max 2g) (if suspect Listeria) + vancomycin 15mg/kg QID IV (max 500mg) (if suspect pneumococcus, G+ive diplococci seen, Ag +ive)
In adults: MCQ says ceftriaxone 2g + benpen 1.8g
Fungal Meningitis: IV Amphotericin B or fluconazole
Tuberculous (TB) meningitis: steroids and anti-TB medications (RIPE)
Aseptic Meningitis: IV Acyclovir (specifically for Herpes/Varicella Zoster Virus)

**Contact prophylaxis:** meningococcus/Hib – give rifampicin 10mg/kg BD x4
- CI’ed in pregnancy and liver disease; ceftriaxone IM or ciprofloxacin PO if CI’ed
Contact = family and household contacts, those exposed to oral secretions, sexual partners

**Complications**
Seizures (30%), SIADH (30%), cerebral herniation, infarction, oedema, venous/sinus thrombosis, hydrocephalus, shock (10%), DIC, empyema (30% Hib, 20% pneumococcal)

**Encephalitis**
Inflammation of brain parenchyma, commonly from viral infections or spread from bacterial meningitis.
Mortality HSV 60% without treatment, 30% with treatment

**Aetiology**
HSV1 (temporal/frontal - psych, memory, aphasia), HZV, EBV, CMV, enterovirus, adenovirus, rabies, vector-borne; post-viral (eg. Influenza, measles, rubella, varicella, HIV); bacterial (rickettsia, leptospirosis, amoebic)

**Clinical Features**
May begin with flu-like illness or headache, followed by a rapid development of altered consciousness, with confusion, drowsiness, seizures and coma.

**Investigations**
LP: nontraumatic RBCs with HSV1, diagnosis with PCR
CT head: diffuse hypoattenuation in temporal lobe, sparing of lentiform nucleus; mass effect in 80%; maybe vesicular haemorrhage
EEG: slowing of background rhythm or epileptiform; abnormal in 80% HSV

**Management**
Aciclovir 10mg/kg TDS IV for HSV; ganciclovir for CMV
Treat complications: anticonvulsants, sedatives, mannitol for cerebral oedema, consider ventilation

**Cerebral Abscess**
May occur within the cerebral hemispheres (often multiple @ junction of white and grey matter unless temporal lobe) or cerebellum (usually solitary).
Commonly, development is gradual with three phases recognisable:
- Invasion - headache, nausea, slight CSF changes
- Latent - transient attacks of headache, malaise, etc.
- Manifest - localising signs, CSF pressure effects

**Aetiology**
Haematogenous spread (30%) – SBE, cyanotic CHD, chronic pulmonary sepsis/bronchiectasis
Multiple, polymicrobial, often anaerobes and strep
Local extension from adjacent foci (30%) – OM, mastoiditis, frontal sinusitis, orbital cellulitis
Direct implantation of organisms - trauma, neurosurgery: Staph.
Impaired immunity - toxoplasmosis common in patients with AIDS; fungal assoc with DM, RF, ↓immunity
Bacterial meningitis - most common cause of cerebral abscess in neonates and infants.
Clinical Features
Onset usually over 2-3 weeks; in the immunosuppressed, more rapid.
Headache, vomiting, drowsiness, fever
Characteristics of the infective source - whether local or distant site
Focal neurological signs:
- Frontal lobe - memory/attention impairment; rarely hemiparesis ± dysphasia & fits
- Temporal lobe - dysphasia, homonymous upper quadrantanopia
- Cerebellar - occipital headache, ataxia, cerebellar signs, neck stiffness

Investigations
Bloods: FBC, UEC, Blood cultures, toxoplasmosis serology
CXR - to identify pulmonary source
MRI or CT + contrast - central necrotic area with surrounding cerebral oedema. ± Mass effect. Smooth ring enhancement with contrast.

Management
Antibiotics: Empirical cefotaxime, metronidazole and flucloxacillin
Abscess drainage
Treatment of primary infection source

Prognosis
Mortality ~5% if ABx before coma.
Long-term neuro morbidity (hemiparesis, dysphasia, visual field defects) in 50%. Seizures >30%.

Lumbar Puncture (LP)

Indications
Suspected CNS infection
?SAH after normal CT scan > 6hrs
Demyelinating conditions: Guillain Barre, MS
Benign intracranial hypertension (therapeutic)
Rarely used to establish diagnosis following meningeal malignancies, CNS vasculitis

Contraindications
Skin infection overlying puncture area
? ICP or mass lesion (LOC, IlIn palsy, focal neuro deficit, papilloedema, etc)
Bleeding tendency, plt <50

Complications
Uncal or tentorial herniation if elevated ICP
Low pressure headache - in 2-15% (risk in younger age, F, lower BMI) lasting 2-8 days.
- typically worse in upright position/coughing, relieved by lying down.
- CSF leak can be reduced by using smaller bore needle, rounded bevel needle tip, aligning bevel with dural fibres, reinserting stylet before withdrawal.
- Rx: bed rest, pain relief, oral/IV fluids; If still persists use extradural blood patch
Spinal epidural haematoma
Rarely: infection, laceration of intervertebral disc, nerve root injury
Technique
SC ends at L1-2 (96%), T12 (2%), L3 (2%); lower in children; go L3-4; use USS if can’t feel IV spaces
22-25G adult (12cm), 22-25G child (6cm), 2cm neonate
20-30deg cephalad; replace stylet before removing; no evidence for immobilisation after
Note: PMN = PolyMorphoNuclear Lymphocytes = GRANULOCYTES = Neutrophils, Basophils, Eosinophils
Cells: If WCC = 500-1000 can be either bacterial or viral

CSF Protein
Traumatic tap? Subtract 1mg/dL for each 1000 RBC to get accurate level.
Elevated in: Meningitis, encephalitis, SAH, CNS vasculitis, syphilis, neoplasm, demyelination
Markedly elevated (>1000mg/dL) in relatively well patient = suggests fungal infection
Stay elevated for weeks/months post infection – not useful as marker of recovery

CSF Glucose
Low in: bacterial, TB, fungal (≤ 1.0 mmol/L strongly predictive of bacterial infection)
Also: Malignancy, SAH, CNS Sarcoid, Viral infection (Mumps, enterovirus, HSV)
Hyperglycaemia: Takes 4hrs for IV glucose to equilibrate with CSF (ie after treatment for hypoglycaemia) so need to
wait to compare CSF to serum glucose in this setting (earlier comparison will give falsely “low” CSF level compared to
serum)

Lactate
Raised in bacterial infection – rarely adds extra information to other parameters

Opening pressure
Normal 5-20cm H2O (in lateral recumbent position)
Increased in sitting position, bacterial, TB, fungal meningitis, Ca, abscess, ICH, benign intracranial HTN
Decreased pressure in CSF leak, dehydration, hyperventilation

Xanthochromia
If traumatic tap & CSF protein > 150mg/dL likely that enough RBC introduced to cause Xanthochromia
If CSF protein < 150mg/dL & Xanthochromia present – likely due to SAH
NB: High CSF protein (> 150mg/dL) or high serum bilirubin on its own may cause Xantho
Bloody Tap: subtract 1 WBC for every 700 (Rosen) to 1000 (Dunn) RBC