Bacterial meningitis and meningococcal septicaemia in children - management in secondary care
(Adapted from NICE Guidelines June 2010 and Meningitis Research Foundation algorithms)

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Background

Meningococcal disease is the leading cause of death in early childhood.
- 15% presents as meningitis
- 25% presents as septicaemia
- 60% presents as a combination of both

Bacterial meningitis and meningococcal septicaemia are managed in different ways, therefore it is important that healthcare professionals are able to recognise them and manage them accordingly.

Assessment

**RECOGNITION OF SIGNS & SYMPTOMS OF BACTERIAL MENINGITIS AND MENINGOCOCCAL SEPTICAEMIA**

**BACTERIAL Meningitis**
- Diarrhoea, Abdo pain/distension
- Sore Throat, Coryza, ENT Symptoms/Signs
- Stiff Neck
- Back Rigid
- Bulging fontanelles
- Photophobia
- Kernig's Sign
- Brudzinski's Sign
- Paresis
- Focal Neurological deficit including cranial nerve involvement and abnormal Pupils
- Seizures

**Meningococcal Disease**
- Chills/shivering
- Fever
- Vomiting/nausea
- Lethargy
- Irritable/unsettled
- Ill appearance
- Refusing food/drink
- Headache
- Muscle ache/joint pain
- Resp symptoms/signs or difficulty breathing
- Non-blanching rash
- Altered mental state
- Shock
- Unconsciousness
- Cap refill time <25
- Unusual skin colour
- Hypotension
- Leg pain
- Cold hands/feet

*Less common non-specific signs/symptoms
Common non-specific signs/symptoms
More specific signs/symptoms*
MANAGEMENT OF BACTERIAL MENINGITIS IN CHILDREN AND YOUNG PEOPLE

SYMPTOMS AND SIGNS OF BACTERIAL MENINGITIS

CHECK ABC, GAIN VASCULAR ACCESS

SIGN OF RAISED INTRACRANIAL PRESSURE OR SHOCK?

PERFORM DIAGNOSTIC TESTS (1). CORRECT ANY DEHYDRATION

CONTRAINDICATION TO LUMBAR PUNCTURE (2)?

< 3 MONTHS OLD?

Y

- Add vancomycin if recently overseas or prolonged or multiple antibiotic exposure within last 3 months
- Consider TB meningitis if raised CSF/WBC and risk factors for TB
- Consider Herpes simplex meningencephalitis. If HSV in differential give aciclovir.

N

PERFORM LUMBAR PUNCTURE **See LP proforma**

Y

LUMBAR PUNCTURE SUGGESTS MENINGITIS

NEONATES (28 DAYS OLD) ≥20 CELLS/µL OR ≥1 NEUTROPHILS/µL

OLDER CHILDREN > 5 CELLS/µL OR > 1 NEUTROPHILS/µL

PERFORM LUMBAR PUNCTURE

**See LP proforma**

Y

EMPIRICAL ANTIBIOTICS & TREATMENT FOR SUSPECTED BACTERIAL MENINGITIS

IV CEFOTAXIME (can replace cefotaxime with ceftriaxone if no contraindications)

MUST NOT DELAY ANTIBIOTICS

**BOX 1: DIAGNOSTIC TESTS**

- FBC, U+E LFT
- CRP
- COAGULATION SCREEN
- BLOOD CULTURE
- BLOOD GLUCOSE

**BOX 2: CONTRAINDICATIONS TO LP**

- CLINICAL OR RADIOLOGICAL SIGNS OF RAISED ICP
- Shock
- COAGULATION ABNORMAL
- RESP INSUFFICIENCY
- LOCAL SUPERFICIAL INFECTION AT LP SITE

**BOX 3: CONTRAINDICATIONS TO CEFTRIAXONE**

Simultaneous administration of Calcium containing infusions but can be given sequentially as long as infusion line flushed between infusions or different infusion line used.

Children younger than 3 months:
- Prematurity
- Jaundice
- Acidosis

**BOX 4: INDICATIONS FOR CT SCAN IN CHILDREN WITH SUSPECTED BACTERIAL MENINGITIS**

- Cannot reliably assess raised ICP - should be assessed clinically
- Detect other intracranial pathologies, if GCS <8 or focal neurological signs in the absence of an explanation for clinical features
- Do not delay treatment to undertake a CT scan
- Clinically stabilise child before CT scanning
- Consult an anaesthetist, paediatrician or intensivist.

ANTIBIOTICS FOR CONFIRMED MENINGITIS

- Meningococcus: IV ceftriaxone x 7 days
- H. influenzae: IV ceftriaxone x 10 days
- S. pneumonia: IV ceftriaxone x 14 days
- Group B Strept: IV cefotaxime x 14 days
- L.Monocytogenes: IV amoxicillin x 21 days + IV gentamicin for at least first 7 days

Unless directed otherwise by antibiotic sensitivities Duration may be dictated by clinical response – d/w infectious disease specialist

Reduced or fluctuating conscious level or focal neurological signs?

FLUIDS

- Full maintenance fluids: enteral feeds if tolerated or isotonic IV fluids e.g. 0.9% sodium chloride or 0.9% sodium chloride with 5% glucose
- Do not restrict fluids unless there is evidence of increased ADH or RICP
- Monitor fluid administration, urine output, electrolytes and blood glucose

- Close monitoring for signs of RICP, shock and repeated review
- See meningococcal disease algorithm if signs found

Specific pathogen identified?

Antibiotics for unconfirmed meningitis

< 3 MONTHS OLD?

Y

IV cefotaxime (or ceftriaxone unless contraindicated) + amoxicillin IV for x 14 days + discuss at weekly micro meeting

N

Ceftriaxone for x 10 days + discuss at weekly micro meeting

**CONTRAINDICATIONS TO CEFTRIAXONE**

SEND SAVE CSF TO HOLD FOR PCR N.MENINGITIDES / S.PNEUMONIAE

**SECONDARY INFECTIONS AT LP SITE**

- LOCAL SUPERFICIAL INFECTION AT LP SITE

**SIGNIFICANT COAGULATION ABNORMAL**

- Cannot reliably assess raised ICP
- Should be assessed clinically

**MENINGOCOCCAL DISEASE ALGORITHM**

- See meningococcal disease algorithm if signs found

**MONITOR FLUID ADMINISTRATION, URINE OUTPUT, ELECTROLYTES AND BLOOD GLUCOSE**

**PERFORM CT SCAN**

**PERFORM LUMBAR PUNCTURE**

**SYMPTOMS AND SIGNS OF BACTERIAL MENINGITIS**

- Fever
- Headache
- Seizures
- Altered mental state
- Focal neurological signs

**PERFORM DIAGNOSTIC TESTS (1). CORRECT ANY DEHYDRATION**

**LUMBAR PUNCTURE SUGGESTS MENINGITIS**

**EMPIRICAL ANTIBIOTICS FOR SUSPECTED MENINGITIS**

IV CEFOTAXIME +/ AMOXICILLIN

**MUST NOT DELAY ANTIBIOTICS**

IV CEFTRIAXONE UNLESS CONTRAINDICATED (3)

- IV CEFTRIAXONE UNLESS CONTRAINDICATED (3)
- STEROIDS: Dexamethasone 0.15mg/kg to max dose of 10mg, QDS x 4 days if ≤12h from first antibiotics
- Frankly purulent CSF
- Raised CSF WBC and protein > 1g/L
- CSF WBC count > 1000 µL
- Bacteria on gram stain

**APPROPRIATE FURTHER MANAGEMENT**

- LUMBAR PUNCTURE IF INDICATED
- PERFORM CT SCAN

**OVERALL MANAGEMENT**

- BLOOD GAS
- BLOOD GLUCOSE
- PROTEIN
- CRP
- FBC, U+E LFT
- MC&S (EDTA) FOR PCR N.MENINGITIDES / S.PNEUMONIAE

**SYMPTOMS OF RAISED INTRACRANIAL PRESSURE OR SHOCK?**

- Reduced or fluctuating conscious level or focal neurological signs?

**SECUORE, U+E LFT**

- Jaundice
- Prematurity
- Acidosis

**CLINICAL OR RADIOLOGICAL SIGNS OF RAISED ICP**

- Reduced LOC / GCS <8 or drop >3, bradycardia and hypertension, focal neuro signs, abnormal posturing, unequal dilated or poorly responsive pupils, papilloedema, abnormal dolls eye movements)

- SHOCK

**RESISTANCE**

- Consider Herpes simplex meningoencephalitis.

**DO NOT DELAY TREATMENT TO UNDERZAKE A CT SCAN**

**PARTICULARLY IMPORTANT IN CHILDREN WITH SUSPECTED BACTERIAL MENINGITIS**

**CONTRAINDICATIONS TO LUMBAR PUNCTURE**

- Clinical or radiological signs of raised ICP
- COAGULATION ABNORMAL
- RESP INSUFFICIENCY
- SPREADING PURPURA
- Local superficial infection at LP site

**CONTRAINDICATIONS TO CEFTRIAXONE**

- Simultaneous administration of calcium containing infusions but can be given sequentially as long as infusion line flushed between infusions or different infusion line used.

**CHILDREN YOUNGER THAN 3 MONTHS**

- Prematurity
- Jaundice
- Acidosis

**INDICATIONS FOR CT SCAN IN CHILDREN WITH SUSPECTED BACTERIAL MENINGITIS**

- Cannot reliably assess raised ICP - should be assessed clinically
- Detect other intracranial pathologies, if GCS <8 or focal neurological signs in the absence of an explanation for clinical features
- Do not delay treatment to undertake a CT scan
- Clinically stabilise child before CT scanning
- Consult an anaesthetist, paediatrician or intensivist.

**CONTRAINDICATIONS TO LP**

- Clinical or radiological signs of raised ICP
- Shock
- Coagulation abnormal
- Resp insufficiency
- Spreading purpura
- Local superficial infection at LP site

**(Can perform delayed LP in children with suspected bacterial meningitis when contraindications no longer present)
MANAGEMENT OF MENINGOCOCCAL DISEASE IN CHILDREN AND YOUNG PEOPLE

**Call consultant in ED, Paediatrics, Anaesthesia or HDU**

**Assess for shock/raised ICP**

**Do not perform LP**

Give IV ceftriaxone 80mg/kg OD without delay X 7 days (do not use ceftriaxone at the same time as calcium containing solutions, use cefotaxime 50mg/kg qds instead in this event)

**Signs of Shock?**
- Tachycardia
- CRT > 2 s
- Cold hands/feet; pale or blue skin
- Resp distress/ 02 sats < 95% in air
- Altered mental state/ decreased conscious level

**Decrease urine output (<1ml/kg/hr)**

**Hypotension**

**Hypoxia on ABG**

**Base deficit ( worse than ~5mmol/l)**

**Increased lactate (>2mmol/l)**

**Do not perform LP**

**Signs of Shock?**
- Reduced LOC/ GCS <8 or drop >3
- Bradycardia and hypertension
- Focal neuro signs,
- Abnormal posturing

**Do not perform Lumbar puncture; Nil by mouth**

**ABC & High Flow Oxygen (min 10L/min) by face mask**

**Measure Glucose**

**Insert 2 large IV cannulae and take blood (1)**

**Volume Resuscitation**
- Immediate bolus of 20ml/kg of 0.9% sodium chloride over 5-10 minutes and reassess immediately
- If shock persists give second bolus of 20ml/kg of 0.9% sodium chloride or 4.5% human albumin solution over 5-10 minutes, and reassess immediately
- Consider urinary catheter to monitor output.

**After 40mls/kg still signs of shock?**

- Immediately give a third bolus of intravenous or intraosseous 20 ml/kg sodium chloride 0.9% or 4.5% human albumin solution over 5–10 minutes
- Call for anaesthetic assistance for urgent tracheal intubation and mechanical ventilation
- Use local or national protocols for intubation
- Start treatment with vasoactive drugs (use local or national protocols)
- Consult with paediatric intensivist

**Anticipate monitor and correct:**
- Hypoglycaemia
- Hypokalaemia
- Hypomagnesaemia
- Coagulopathy ( FFP 10ml/kg)
- Acidosis
- Hypocalcaemia
- Anaemia

**Transfer to Intensive Care by Paediatric Intensive Care Retrieval Team**

**BOX 1 BLOODS**
- Glucose
- FBC, U+E, Ca++, Mg++, Po4
- CRP
- Clotting
- Lactate
- Blood cultures
- Whole blood (EDTA) for PCR
- Blood gas (bicarb, base deficit)
- X-match

**Clinical features of meningitis?**
- Monitor signs of raised ICP or shock
- Perform LP if no contraindications **See LP proforma**
- DO NOT DELAY ANTIBIOTICS

**Repeat Review**

**Bacterial Meningitis algorithm**
BACTERIAL MENINGITIS AND MENINGOCOCCAL SEPTICAEMIA

LONG-TERM MANAGEMENT CHECKLIST

(Please circle the correct option when carried out)

1) Formal audiological assessment booked as soon as possible FOR BACTERIAL MENINGITIS, preferably before discharge, within 4 weeks of being fit to test. Not indicated for viral meningitis.

2) If profound deafness, referral for urgent assessment for cochlear implants made

3) Follow-up outpatient clinic booked with a paediatrician 4–6 weeks after discharge from hospital
   (Need to consider: hearing loss, orthopaedic complications, skin complications, psychological problems, neurological & developmental problems, renal failure)

4) Testing for immunodeficiency booked if:
   - > 1 episode of meningococcal disease
   - > 1 episode of meningococcal disease caused by serogroups other than B
   - Meningococcal disease AND history of other recurrent serious bacterial infections
   - Meningococcal disease AND family history of meningococcal disease/complement deficiency

5) Informed the child's or young person's GP / health visitor / school nurse of their bacterial meningitis or meningococcal septicaemia

6) Notified Health Protection Unit – 01273 403 597 (legal requirement)

7) Considered prophylaxis of household contacts of patients – ciprofloxacin is available in the emergency drug cupboard at BSUH (Site Manager can contact the Pharmacist on call if emergency supplies run out)

8) Meningitis Red Book given
Lumbar puncture proforma sticker

**DATE & TIME:**

Indication: suspected meningitis/encephalitis □ BIH □ Other:

**Verbal Consent** taken from: Relationship to Patient:

Risks explained: Bleeding □ Infection □ Failure of procedure □ Headache □ Back pain □ Other:

**PROCEDURE:**

Cleaning fluid: Aseptic technique throughout □

Sedation/analgesia pre procedure: No of attempts:

Other comments:

**CSF:**

Appearance: Clear & colourless □ Turbid □ Straw-coloured □ Bloody □ Other:

Opening pressure measured: Yes □ No □ If yes: mmHg

Samples sent for: Cell count □ Protein □ Glucose □ MO&S □ Virology □

Save CSF for PCR □ Other:

**BLOOD GLUCOSE LEVEL:**

Time blood glucose taken:

Any complications post procedure? Yes □ No □

If yes, please specify

Signed: Name: Grade: Bleep:

**LAB RESULTS:**

WBC: RBC: Other comments:

Gram stain organisms: Culture after 48 hours:
AUDIOMETRY PATHWAY FOR BACTERIAL MENINGITIS (21/07/10 JB/ VS) Audiology Department, RSCH

Risk factors: Organism - e.g. pneumococcus
Duration of illness before treatment: 
Incidence variable 7-10%

*Within four weeks of being fit to test post diagnosis*
Age appropriate hearing assessment
Ear specific AC/BC include 6kHz and 3kHz if possible.

**Review after further 4 weeks**

Audiological Management — Aids
1. Severe/profound
   **Urgent referral to ENT to facilitate COCHLEAR IMPLANT referral and/or imaging**
2. Mild/moderate. Weekly reviews. If deterioration manage as severe/profound

Audiological Management
Hearing aids: Urgent referral to ENT to facilitate COCHLEAR IMPLANT referral and/or imaging if not already done.
Refer for vestibular assessment
Notify ENT/Paediatrician/HV/SN/GP/SNS

6 month post diagnosis (or 8/12 corrected age for neonates)
Age appropriate hearing assessment
Ear specific AC/BC include 6kHz and 3kHz if possible.
ABRs and OAEs as appropriate

Pathway outcome:
- Normal hearing bilaterally - discharge
- Conductive hearing loss - manage as usual
- Unilateral sensorineural loss - monitor in community
- Bilateral sensorineural loss refer to ENT

* 10% reversible hearing loss but usually within 2 weeks
** Fibrous ossification early 6-8 weeks

NOTE: All children should have ongoing paediatric assessment to look for abnormal neurology and address developmental, general learning concerns, emotional behavioural problems
Useful links

1) NICE Bacterial Meningitis and meningococcal septicaemia in children 16 years- management in secondary care full guidelines:

2) NICE Bacterial Meningitis and meningococcal septicaemia in children 16 years- management in secondary care Quick Reference guidelines:

3) Meningitis Research Foundation Algorithms

   Bacterial Meningitis: http://www.meningitis.org/assets/x/53067
   Meningococcal disease: http://www.meningitis.org/assets/x/50150