CONTROVERSY

Diagnosis

When to do a lumbar puncture

F A I Riordan, A J Cant

If you suspect meningitis, unless there is a specific contraindication

Lumbar puncture has long been a key investigation. The “classical signs” of meningitis are often absent in infants in the first year of life. Lumbar puncture is thus advocated for any infant who is drowsy or ill, without awaiting the development of meningeal signs. Concerns about the perceived dangers of lumbar puncture and a suggestion that it has little diagnostic value in meningococcal disease have led to fewer lumbar punctures being performed. Some experts have expressed concerns that not enough lumbar punctures are being performed, since the consequences of missing meningitis may be disastrous. A review of the indications for lumbar puncture is thus timely, and papers in this issue by McMaster and colleagues and Carroll and Brookfield contribute to this debate.

CRITICAL QUESTIONS

Critical questions include:

• What are the benefits of lumbar puncture in suspected meningitis?
• What are the contraindications to lumbar puncture?
• How is meningitis diagnosed and treated if an early lumbar puncture is not done?
• Should lumbar puncture be performed after a febrile convolution?

WHAT ARE THE BENEFITS OF LUMBAR PUNCTURE IN SUSPECTED MENINGITIS?

In most cases lumbar puncture confirms or excludes bacterial meningitis. It is rare for microscopy of cerebrospinal fluid obtained at lumbar puncture to be normal, and a pathogen to be grown later. This occurs most often in meningococcal meningitis (up to 8%). These children have clinical signs of meningitis or septicemia (rash) and should receive antibiotics in spite of a “normal” cerebrospinal fluid. Children rarely develop meningitis some hours after a normal lumbar puncture. The suggestion that the lumbar puncture itself performed during bacteraemia may cause meningitis remains controversial and unproven.

Initial Gram staining of cerebrospinal fluid reveals an organism in 68–80% of cases of meningitis, allowing appropriate choice of antibiotics. Subsequent culture gives information on antibiotic resistance, which is especially important in areas where antibiotic resistant pneumococci are prevalent.

Obtaining cerebrospinal fluid also allows identification of uncommon pathogens, such as mycobacteria and fungi. This is particularly important in children with immunodeficiency or on an intensive care unit.

Enteroviral meningitis can be confidently diagnosed by cerebrospinal fluid polymerase chain reaction (PCR), which allows discontinuation of antibiotics and early discharge.

WHAT ARE THE CONTRAINDICATIONS TO LUMBAR PUNCTURE?

Lumbar puncture should be deferred if there are signs of cerebral herniation, focal neurological signs, or cardiorespiratory compromise. Infection in the area of the needle will traverse to get cerebrospinal fluid or signs of a bleeding disorder are also said to be contraindications, but these are based on single case reports.

Table 1 Symptoms and signs of cerebral herniation

<table>
<thead>
<tr>
<th>Symptom/Sign</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow coma score &lt;8</td>
<td>[unilateral or bilateral]</td>
</tr>
<tr>
<td>Abnormal pupil size and reaction</td>
<td></td>
</tr>
<tr>
<td>Absent doll’s eye movements</td>
<td></td>
</tr>
<tr>
<td>Abnormal tone</td>
<td>[decrebrate/decorticate posturing, flaccidity]</td>
</tr>
<tr>
<td>Tonic posturing</td>
<td>[hyperextension, Cheyne-Stokes breathing, apnoea, respiratory arrest]</td>
</tr>
<tr>
<td>Respiratory abnormalities</td>
<td></td>
</tr>
<tr>
<td>Papilloedema</td>
<td>[rare, especially in infants]</td>
</tr>
</tbody>
</table>

Cerebral herniation

Symptoms and signs of cerebral herniation (table 1) occur in 4–6% of children with bacterial meningitis and this complication accounts for 30% of deaths from bacterial meningitis. Cerebral herniation can occur when a lumbar puncture has not been done. However, case series have shown a temporal association between lumbar puncture and herniation. Thus delaying lumbar puncture when there are signs and symptoms of herniation may be lifesaving.

Computed tomography (CT) scanning is unhelpful in children with this clinical presentation; most children with bacterial meningitis and clinically suspected raised intracranial pressure have normal scans. Death from herniation following lumbar puncture can occur despite having a normal CT scan.

“...a normal CT scan in a child with signs of cerebral herniation does not mean it is safe to do a lumbar puncture”

Disease mimicking meningitis

A few children with clinical signs of meningitis will have another condition (for example, tumour, abscess, or intracranial haemorrhage). Lumbar puncture in these situations would carry a high risk of herniation. The presence of focal signs, depressed consciousness, or failure to respond to treatment are thus an indication for an urgent CT scan to exclude these conditions.

Cardiorespiratory compromise

Excessive flexion of the trunk and neck during lumbar puncture may produce hypoxaemia in neonates, which can be prevented by preoxygenation. Similar adverse effects may occur in children with meningococcal septic shock; for this reason lumbar puncture should be deferred until the next day if a child is shocked.

HOW IS MENINGITIS DIAGNOSED IF AN EARLY LUMBAR PUNCTURE IS NOT DONE?

A delayed lumbar puncture can confirm the diagnosis of meningitis, since the cellular and biochemical changes remain in cerebrospinal fluid up to 44–68 hours after the start of antibiotic treatment. This information can guide subsequent treatment and is crucial when there is a differential diagnosis of cerebral malaria.

Abbreviations: CT, computed tomography; PCR, polymerase chain reaction
since this cannot be differentiated from meningitis clinically.25 Cerebrospinal fluid cultures are negative two hours after parenteral antibiotics are given in meningococcal meningitis, and negative six hours after parenteral antibiotics in pneumococcal meningitis (including antibiotic resistant strains).26

“New molecular techniques for simultaneous detection of Neisseria meningitidis, Streptococcus pneumoniae, and Haemophilus influenzae by cerebrospinal fluid PCR may be helpful23n

If lumbar puncture is not thought safe, empirical antibiotic therapy should be given without delay. In the UK present a third generation cephalosporin alone is likely to be adequate, as cephalosporin resistant pneumococci are rare.27 However, in countries where there is pneumococcal resistance to cephalosporins, vancomycin should be added. Increasing antibiotic resistance makes culturing the causative organism essential.

Blood culture and/or molecular diagnostic techniques may help identify the causative organism and their use should be considered in the following three settings.

Suspected childhood meningitis with non-blanching rash
Meningitis with a non-blanching rash is likely to be meningococcal. Many would suggest a lumbar puncture is unnecessary,12,28 but this clinical picture is not always a result of meningococcal disease. Of 63 children with meningitis and a “meningococcal” rash, 51 had meningococcal disease, 10 had viral illnesses, and two had other types of meningitis. Of 63 children with meningism either have complex seizures (meningism, petechiae, coma) are usually present but may be absent in 30%.13 Children with meningitis but no meningism either have complex seizures (prolonged, partial, or multiple) or symptoms suggestive of meningitis (unwell for three days or more, vomiting or drowsy at home, seen by a doctor in the previous 48 hours). Children with simple febrile convulsions and no symptoms or signs of meningitis are highly unlikely to have bacterial meningitis.7

In conclusion, early lumbar puncture rapidly confirms or excludes bacterial meningitis in most cases and should be performed when meningitis is suspected unless there is a specific contraindication (signs of cerebral herniation, signs suggesting a disease other than meningitis or death). If early lumbar puncture has been performed, blood should be taken for culture and meningococcal PCR, but the causative organism will not be identified in 20–50% of cases of bacterial meningitis. Meningitis rarely presents as a simple febrile convulsion, but complex seizures, a prolonged illness, or toxicity are indications for lumbar puncture.

As antibiotic resistance increases pediatricians managing meningitis will have to decide between using empirical broad spectrum antibiotics (potentially encouraging further antibiotic resistance) or early lumbar puncture as the best method to culture the causative organism.

Arch Dis Child 2002;87:235–237

REFERENCES

25 Nadel S. Lumbar puncture should not be performed in meningococcal disease. Arch Dis Child 2001;84:373.
When to do a lumbar puncture

F A I Riordan and A J Cant

Arch Dis Child 2002 87: 235-237
doi: 10.1136/adc.87.3.235

Updated information and services can be found at:
http://adc.bmj.com/content/87/3/235

These include:

References
This article cites 23 articles, 10 of which you can access for free at:
http://adc.bmj.com/content/87/3/235#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

- Meningitis (197)
- Infection (neurology) (287)
- Drugs: infectious diseases (965)
- Clinical diagnostic tests (1133)
- Radiology (976)
- Radiology (diagnostics) (760)
- Epilepsy and seizures (391)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/